

October 5-6, 2017

**Southeastern Institute for Operations
Research and the Management Sciences
2017**

Table of Contents

PAPER PRESENTATION	1
Challenges of Unstructured “BIG” Data	2
<u>Dr. Anil Aggrawal</u> ¹	
<i>1. University of Baltimore</i>	
Thriving in the Realities of Higher Education at a Small Liberal Arts University: A Case Study in Innovation Success	6
<u>Dr. Michael Latta</u> ¹ , <u>Mrs. Eileen Soisson</u> ¹ , <u>Mr. William M. Plate, Jr.</u> ¹	
<i>1. Coastal Carolina University</i>	
HAS THE SUPERIOR COURT OF BRUNSWICK COUNTY, NC ESTABLISHED A SYSTEM OF INJUSTICE THAT DISCRIMINATES AGAINST PRO SE LITIGANTS IN A MANNER THAT VIOLATES THE SUBSTANTIVE DUE PROCESS CLAUSE OF THE FOURTEENTH AMENDMENT TO THE U.S. CONSTITUTION?	11
<u>Dr. Brad Johnson</u> ¹	
<i>1. Francis Marion University</i>	
A Preliminary Analysis and Comparison of International and U.S. Students’ Academic Performance in a U.S. Business College	15
<u>Dr. John Mortimer</u> ¹ , <u>Dr. Gregory Krippel</u> ¹ , <u>Dr. Christopher Becker</u> ¹ , <u>Dr. Phillip Njoroge</u> ¹	
<i>1. Coastal Carolina University</i>	
An Examination of Embedded Supplier Information Utilization in Pre-Decision Phase Procurement and Opportunism in Sales Management	29
<u>Dr. Yvette Holmes</u> ¹ , <u>Dr. Roscoe Hightower</u> ² , <u>Dr. DeShannon McDonald</u> ³ , <u>Ms. Phylicia Taylor</u> ⁴	
<i>1. Alabama State University, 2. Florida A&M University, 3. Alabama A&M University, 4. Jackson State University</i>	
A Ten-Question Sequence to Capture the Concepts of Cost-Volume-Profit Analysis	33
<u>Dr. William Pollard</u> ¹	
<i>1. Appalachian State University</i>	
The business law course: Call for rejuvenation of vital piece in the accounting curriculum	41
<u>Prof. Dustin Grant</u> ¹ , <u>Dr. Lawrence K. Menter</u> ¹ , <u>Prof. Greg Kordecki</u> ¹	
<i>1. Clayton State University College of Business</i>	
The Behavioral Antecedents of Cognitive Supply Chain Agility	48
<u>Dr. Kim Whitehead</u> ¹	
<i>1. Anderson University</i>	
Effect of Solar Energy Price Reduction on Supply Chain Performance and Contract Design	55
<u>Dr. Charles Xiong</u> ¹ , <u>Dr. Xiangrong Liu</u> ²	
<i>1. University of North Carolina at Pembroke, 2. Bridgewater State University</i>	

THE PROBLEM WITH EVALUATING GROUPWORK: BYPASSING STUDENT FEEDBACK ISSUES WITH A MORE TRANSPARENT DELIVERABLE	63
<u>Dr. Matthew Peters</u> ¹ , Mrs. Amanda Peters ²	
<i>1. Lander University, 2. Greenwood District 50</i>	
Motivating Students: Exploring Ways to Encourage Class Attendance	69
<u>Dr. William Pollard</u> ¹	
<i>1. Appalachian State University</i>	
It's what you say that counts.	74
<u>Dr. George Lowry</u> ¹ , <u>Dr. John McManus</u> ¹ , <u>Dr. Ed Showalter</u> ¹	
<i>1. Randolph-Macon College</i>	
A Proposed Study of Job Satisfaction and Organizational Commitment: Public versus Private	75
<u>Dr. Joyce Beggs</u> ¹ , <u>Dr. Edward Jernigan</u> ¹	
<i>1. University of North Carolina at Charlotte</i>	
Conceptualizing Service Structure	83
<u>Dr. Harry Katzan</u> ¹	
<i>1. Webster University</i>	
FLEXIBLE FACILITY LOCATION-ALLOCATION DESIGN PROBLEM UNDER THE RISK OF DISRUPTIONS	90
<u>Dr. Jae-Dong Hong</u> ¹	
<i>1. South Carolina State University</i>	
HOW THE PRACTICE OF OPTIMIZATION EXTENDS BEYOND THE DECISION SCIENCES	100
<u>Dr. Richard Martin</u> ¹ , <u>Dr. Jay Teets</u> ² , <u>Dr. Richard Monroe</u> ³	
<i>1. Coastal Carolina University, 2. Virginia Tech, 3. Longwood University</i>	
EXTENDING THE FRAGILITY APPROACH FOR ASSESSING STATISTICALLY SIGNIFICANT TESTS INVOLVING COUNTS AND PROPORTIONS	104
<u>Dr. Clint Harshaw</u> ¹ , <u>Dr. Clay Harshaw</u> ²	
<i>1. Presbyterian College, 2. Winston-Salem State University</i>	
The Effect of Fast Fashion on the Sustainability Movement	112
<u>Prof. Dick Crandall</u> ¹	
<i>1. Appalachian State University</i>	
SHUT UP!?! FREEDOM OF EXPRESSION VERSUS FREEDOM NOT TO LISTEN	131
<u>Prof. Claire La Roche</u> ¹	
<i>1. Longwood University</i>	
College of Business Organizations: Analysis of Member Satisfaction	142
<u>Mr. Christian Alesius</u> ¹ , <u>Dr. Kurt Schimmel</u> ¹	
<i>1. Slippery Rock University</i>	
Drones in the Supply Chain: A Detriment or Benefit	157
<u>Ms. Megan Krimminger</u> ¹	
<i>1. Anderson University</i>	

MULTI-OBJECTIVE MATHEMATICAL MODELS TO DESIGN BIOMASS TO BIOFUEL SUPPLY CHAIN SYSTEM IN SOUTH CAROLINA	171
<i>Ms. Shadae Taylor¹, Dr. Jae-Dong Hong¹</i>	
<i>1. South Carolina State University</i>	
Building Engaging Online communities	185
<i>Dr. Belinda Shipps¹</i>	
<i>1. North Carolina A&T State University</i>	
Statistics and Analytics Students Success in the Work Place: Role of Analytical/Statistics/Computer Based Academics	186
<i>Dr. Annie Stith-Willis¹, Mrs. Wilma Andrews¹, Dr. Robert Andrews¹</i>	
<i>1. Virginia Commonwealth University</i>	
Getting More From Online Videos: Using EDpuzzle in The Classroom	188
<i>Dr. Leann Mischel¹</i>	
<i>1. Coastal Carolina University</i>	
An Analysis of Risk-Adjusted Returns for Trading Moving Average Crossovers Versus a Straight Buy-and-Hold Strategy	195
<i>Dr. Mike Smith¹</i>	
<i>1. Roanoke College</i>	
Quantitative Easing and Asset Prices	210
<i>Prof. James Winder¹, Mr. Anthony Somma¹</i>	
<i>1. Rutgers Business School</i>	
The Beveridge Curve in the Recovery from the Great Recession: Estimates for Five Geographic Regions	220
<i>Dr. Barry Pfitzner¹, Dr. Steve Lang¹</i>	
<i>1. Randolph-Macon College</i>	
Using a Binomial Logit Model to Estimate and Explain the Home-field Advantage in Major League Baseball	241
<i>Prof. Bill Levernier¹</i>	
<i>1. Georgia Southern University</i>	
2-Game Road Trips: Any Fall-Off in Performance?	255
<i>Dr. Mark Mitchell¹, Dr. Sam Wathen¹, Mr. John Bowles¹</i>	
<i>1. Coastal Carolina University</i>	
Introduction to Privacy Engineering for Business and Management	266
<i>Dr. Harry Katzan¹</i>	
<i>1. Webster University</i>	
Predicting First Year Student Attrition in Higher Education: A Design Theoretic Approach	267
<i>Dr. Caleb Bradberry¹, Dr. Andrew Ray¹, Dr. Jeff Pittges¹</i>	
<i>1. Radford University</i>	

INVESTIGATING THE IMPACT OF AGILE DEVELOPMENT METHODOLOGY ON INFORMATION TECHNOLOGY PROFESSIONALS	275
<u>Dr. Paige Rutner¹, Dr. Feruzan Williams¹</u>	
<i>1. Texas Tech University</i>	
Tourism seasonality and jobs, the case of the Myrtle Beach area and South Carolina	280
<u>Dr. Taylor Damonte¹, Dr. Darla Domke-Damonte¹, Dr. Robert Salvino¹</u>	
<i>1. Coastal Carolina University</i>	
Forecasting the performance of hotel properties in the coastal section of Horry and Georgetown, South Carolina	292
<u>Mr. Pierre Valdema¹, Dr. Taylor Damonte¹</u>	
<i>1. Coastal Carolina University</i>	
Watchlist Concepts for Business and Management - Getting Started	312
<u>Dr. Harry Katzan¹</u>	
<i>1. Webster University</i>	
Information and Communications Technology in Africa: Enabling Big Data, to Enable Development	317
<u>Dr. Donna Schaeffer¹, Dr. Patrick Olson²</u>	
<i>1. Marymount University, 2. National University</i>	
Low Cost Private Cloud	327
<u>Mr. Dennis Baker¹, Dr. Christopher Kadlec¹, Mr. Brandon Kimmons¹</u>	
<i>1. Georgia Southern University</i>	
Actioning Big Data	343
<u>Prof. Bel Raggad¹</u>	
<i>1. Pace University</i>	
Thinking through the write-off: Arguments for the peculiarities of the depreciation charge	347
<u>Prof. Greg Kordecki¹</u>	
<i>1. Clayton State University College of Business</i>	
Divergence in the public company annual report disclosure: What do Holy Land principles and sustainability issues suggest about corporate performance?	354
<u>Prof. Greg Kordecki¹</u>	
<i>1. Associate</i>	
Principles versus Rules and Revenue Recognition Differences Exacerbating U.S. GAAP and IFRS Convergence	363
<u>Dr. Regan Garey¹</u>	
<i>1. Lock Haven University</i>	
The Need for Consistency and Reproducibility in Financial Market Research	376
<u>Dr. Buddy Billbrey¹, Dr. Mike Shurden²</u>	
<i>1. Lander University, 2. Lander</i>	

Data Monetization as a Growing Business Revenue Stream: Issues and Challenges	381
<u>Dr. Uma Gupta</u> ¹	
<i>1. State University of New York at Buffalo State College</i>	
Keynes' Unscientific Theory of Consumption Function and its False Policy Implications for the Multiplier Effect	386
<u>Dr. Nozar Hashemzadeh</u> ¹	
<i>1. Radford University, Radford, VA 24142</i>	
Fast-and-Frugal Trees: A Review	401
<u>Dr. Reza Kheirandish</u> ¹ , Dr. Shabnam Mousavi ²	
<i>1. Cl, 2. Johns Hopkins University</i>	
Investigating Vulnerabilities and Cybersecurity Issues in Connected Cars	403
Mr. Goktug Erkan ¹ , <u>Dr. Michelle Liu</u> ²	
<i>1. NU-PULSE, 2. Marymount University</i>	
Does Using IT As a Strategic Investment Improve Firms Performance?	414
<u>Dr. Rick Weible</u> ¹ , Dr. Marc Sollosy ¹	
<i>1. Marshall University</i>	
Advances in Cybersecurity for Business and Management	418
<u>Dr. Harry Katzan</u> ¹	
<i>1. Webster University</i>	
Branding Your Major: One MIS Program's Approach to Differentiation	425
<u>Dr. Rick Weible</u> ¹	
<i>1. Marshall University</i>	
Using creative writing assignments to facilitate learning and curiosity	426
<u>Dr. Sharynn Tomlin</u> ¹	
<i>1. Angelo State University</i>	
STUDENT ASSESSMENT IN A REAL-WORLD-PROJECTS CAPSTONE COURSE IN COMPUTING	428
<u>Dr. Charles Tappert</u> ¹ , Mr. Jigar Jadav ¹	
<i>1. Pace University</i>	
Unleashing the Hidden Power of the ETS Major Field Test	436
Dr. John Mortimer ¹ , Prof. Barbara Ritter ¹ , Dr. Christopher Becker ¹ , Dr. Phillip Njoroge ¹	
<i>1. Coastal Carolina University</i>	
Precision Learning and Programmed Learning: Systematic improvement or Retrograde Motion?	449
<u>Dr. Donna Schaeffer</u> ¹ , Dr. Patrick Olson ² , Dr. Cynthia Knott ³	
<i>1. Marym, 2. National University, 3. Marymount University</i>	
Student Professional Organizations the Segments Within	451
<u>Dr. Nan Nicholls</u> ¹ , Dr. Bruce Orvis ¹	
<i>1. Slippery Rock University</i>	

What Activities Lead to Student Satisfaction with Professional Clubs	457
<u>Dr. Kurt Schimmel</u> ¹ , <u>Dr. Bruce Orvis</u> ¹	
<i>1. Slippery Rock University</i>	
Is there any Loyalty in the Use of Over-The-Counter Pain Medications	464
<u>Dr. Michael Latta</u> ¹	
<i>1. Coastal Carolina University</i>	
WORKSHOP, PANEL OR TUTORIAL	473
Use of Teams Within a Program: Hodgepodge or Mosaic	474
<u>Dr. Janice Black</u> ¹ , <u>Dr. Jess Doll</u> ¹ , <u>Dr. J. Kay Keels</u> ¹ , <u>Dr. Nicholas Rhew</u> ¹ , <u>Dr. April Spivack</u> ¹	
<i>1. Coastal Carolina University</i>	
Happiness as a Key Ingredient for Innovation in Education	476
<u>Dr. Uma Gupta</u> ¹	
<i>1. State University of New York at Buffalo State College</i>	
Sensemaking in an Era of Big Data Science	477
<u>Dr. Michael Latta</u> ¹ , <u>Dr. Subhajit Chakraborty</u> ¹ , <u>Dr. Monica Fine</u> ¹ , <u>Dr. Bomi Kang</u> ¹ , <u>Dr. Leann Mischel</u> ¹ , <u>Ms. Stephanie Revels</u> ¹	
<i>1. Coastal Carolina University</i>	
ACCOUNTING CURRICULUM CHANGES	482
<u>Dr. Douglas Ziegenfuss</u> ¹ , <u>Prof. Randall Spurrier</u> ²	
<i>1. Old Dominion University, 2. Old</i>	
The Computer Science Capstone Experience: A Transition from Student to Employee	484
<u>Dr. Bob Tucker</u> ¹	
<i>1. Liberty University</i>	
Engaging Generation Z	487
<u>Mrs. Stacy Wassell</u> ¹ , <u>Dr. Chelsea Schrader</u> ¹	
<i>1. Frostburg State University</i>	
Small Business Accounting Versus Corporate Accounting for Non-Accounting/Finance Majors: A Debate	490
<u>Dr. Janice Black</u> ¹ , <u>Dr. Christopher Becker</u> ²	
<i>1. c, 2. Coastal Carolina University</i>	
What We Have Learned From/About Teaching Quantitative, Technology and Communication Classes in a School of Business	492
<u>Dr. Robert Andrews</u> ¹ , <u>Mrs. Wilma Andrews</u> ¹ , <u>Dr. Annie Stith-Willis</u> ¹	
<i>1. Virginia Commonwealth University</i>	
Regulating Artificial Intelligence: Does It Really Pose and Existential Risk? – A Discussion	496
<u>Dr. Harry Katzan</u> ¹	
<i>1. Webster University</i>	

Symposium: Understanding the Impact of Budget Cuts on Higher Education

497

Dr. Wiley Brown¹, Dr. Sherrie Drye¹, Dr. Lisa Snyder¹

1. NC A&T State University

Faculty Transitions: From New Hire to Retirement

500

Dr. Douglas Ziegenfuss¹, Prof. Randall Spurrier², Dr. Gregory Krippel³

1. Old Dominion University, 2. Old, 3. Coastal Carolina University

PAPER PRESENTATION

CHALLENGES OF UNSTRUCTURED “BIG” DATA

Anil Aggrawal, University of Baltimore

ABSTRACT

As social network diffuses so does the data generated through them. This data contains text, videos, graphs, pictures and many other varieties. Data is generated at the speed of light and organizations must take advantage of it. This data is called “big” data typically characterized as 3 V’s velocity, volume and variety. It is the velocity and variety parts that are challenging. Almost 65% of the new data generated conforms to 3Vs.

Organizations are demanding graduates who can understand, manage and make sense of such data. Universities are obligated to provide such skills to their graduates.

This creates challenges for professors who need to either offer a course in big data or at a minimum include it in an existing course. It is important that our students understand this new phenomenon in addition to existing systems. This paper proposes an outline for including big data in an existing database course.

INTRODUCTION

Networked communities are creating an environment where businesses must respond instantaneously to survive. Social media is powerful. Recently, just before the football draft, a potential draftee’s pot smoking images were placed on the social website almost destroying his career. These are not isolated incidences. Such incidences are requiring individuals and businesses to monitor, assess and respond and take advantage of data generated via social sites. Social media is generating big data which is changing how businesses will and are make decisions. Typically, old data is generated by transactions and new data is generated by video, social media sites (Facebook, Twitter, Snapchat, Instagram, etc.) and smart gadgets (watches, fitbits, sensors, smart phones, etc.). Data generated by social media and smart gadgets do not have a typical structure that can be modeled in a relational database. There are differences on how each data type is stored and processed.

This is not to say that old unstructured data is meaningless. Both structured (transaction) and unstructured (Big) data can and must exist side by side. In fact there is attempt to converge these data types. This would simplify processing and mining of data.

THE COURSE EVOLUTION

This paper describes an attempt at a mid-western university to include unstructured data in either an existing course or a course by itself. Before we describe the course, we look at the challenges and constraints by describing both unstructured and structured data.

Data type	Structured	Unstructured
Management	ERD, schema	Columnar, no schema
Implementation	Relational tables	Clusters (e.g. HADOOP), cloud architecture
Processing	SQL	NOSQL, MAPREDUCE, parallel processing
Scalability	Scaling is typically vertical.	Scaling is horizontal, meaning across servers.
ACID Compliancy (Atomicity, Consistency, Isolation, Durability)	ACID compliant.	Typically sacrifice ACID compliancy for performance and scalability
Databases	ORACLE, ACCESS, MYSQL etc	HBase (also a part of the Hadoop ecosystem), Cassandra, mongoDB, etc.

Table 1 uses references from Aggarwal, 2016; Coronel, 2015; Kashley et al, 2014; Krste, et al., 2009; Dean et al, 2008. The challenge is to manage and process unstructured data. On the other hand skill set required for unstructured data management and processing: includes: Computer Science

- Programming
- Structured database
- Virtual platforms
- Operating systems

Matching skill sets to business students is a daunting task. There are several constraints that we have to work with

- Business students typically do not have programming knowledge (R or Python)
- Lack of standard platform
- Complexity of data management
- Skilled technical people for platform installation

Despite such road blocks all is not lost. There are attempts to bring SQL like languages/interface for unstructured data. Cloudera has developed a platform that allows for such processing.

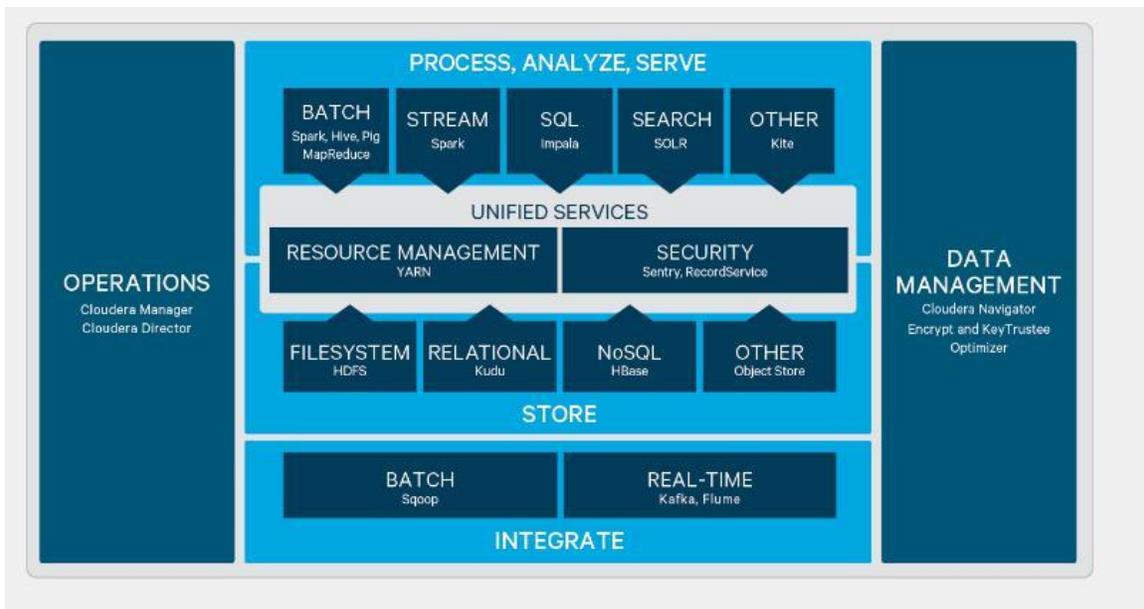


Figure 1 Cloudera Platform (source cloudera.com)

Figure 1 describes current version of Cloudera platform which addresses some of the managing and processing challenges of Big data. HIVE is SQL type language which is built on Apache

HADOOP and can process some form of unstructured data. HIVE can be easily learned since it is similar to structured query language used with relational databases. Since these languages and standard platforms are still emerging an incremental and iterative approach of including big data would be more desirable.

The new database course is still evolving and a final version will contain actual topics and resources. We will discuss our experiences with developing and conducting the course. In addition, we will discuss student learning as measured from their comments.

REFERENCES

Aggarwal, A. K. (2016). A hybrid Approach to Big data Systems development, .chapter in book *Managing Big Data Integration in the Public Sector*, published by IGI group.

Coronel and Morris. (2015). Database Systems: Design, Implementation, & Management, 11th Edition, pub Course Technology.

Dean, J., & Ghemawat, S. (2008). MapReduce: simplified data processing on large clusters. *Communications of the ACM*, 51(1), 107-113.

Kashlev, A and Lu, S. (2014). A System Architecture for Running Big Data Workflows in the Cloud, proceedings, IEEE International Conference on Service Computing, 51-58.

Krste Asanovic, Rastislav Bodik, James Demmel, Tony Keaveny, Kurt Keutzer, John Kubiatowicz, Nelson Morgan, David Patterson, Koushik Sen, John Wawrzynek, David Wessel, Katherine Yelick. (2009). A View of the Parallel Computing Landscape. *Communications of the ACM*, 52(1), 56-67

<http://www.statista.com/statistics/183466/share-of-adult-us-population-on-twitter/>

Thriving in the Realities of Higher Education at a Small Liberal Arts University
A Case Study in Innovation Success

Michael Latta
Coastal Carolina University

Bill Plate
Coastal Carolina University

Eileen Soisson
Coastal Carolina University

53rd Annual Meeting of Southeastern Chapter of INFORMS
Hilton Myrtle Beach Resort
Myrtle Beach, South Carolina
October 5-6, 2017

ABSTRACT

In 2012 a small liberal arts university focused on service excellence as a radical innovation to foster change over time and grow the institution. Combined with a new social media approach to external marketing, a trademarked service excellence training program was put into effect. It was targeted at students, faculty, staff, and administrators. As service excellence spread across the campus, it strengthened brand image and identity as well as improved success metrics in recruitment, retention and brand strength. These positive developments lead to new faculty hires, increased numbers of academic programs, and the first Ph.D. degree program being approved for the university among other measures of success and growth.

BACKGROUND

Why is this university focused on Service Excellence?

Some of the reasons outlined in Raisman (2002) include the following:

- Competition in higher education
- Rising customer expectations
- Strengthen brand image/identity
- Create a pleasant work environment
- Facilitate ongoing learning and improvement
- Turn recruitment success into retention success

Raisman (2010) has linked many factors to survival, but focuses on retention and academic customer service as the keys to success. Customer experience starts at home and includes employees as well as students, parents, alumni, and community stakeholders as pointed out by McKinsey & Company (2017). Businesses are recognizing the benefits of customer-centric strategies: higher revenues, lower costs, and stronger employee and customer loyalty. However, the McKinsey & Company report indicates that many companies fail to get the whole organization, including its support functions, in a customer-centric transformation. In a university, that includes students, faculty and staff most directly and all other stakeholders indirectly.

Inside Higher Education (2017) has provided an analysis showing the competitive landscape and growth in student enrollments. Their results are displayed in Table 1 below:

Table 1: Estimated National Enrollment by Sector (Title IV, Degree-Granting Institutions)

Sector	SPRING 2017		SPRING 2016		SPRING 2015	
	Enrollment	% Change from Prior Year	Enrollment	% Change from Prior Year	Enrollment	% Change from Prior Year
Total Enrollment, All Sectors	18,071,004	-1.5%	18,343,655	-1.3%	18,592,605	-1.9%
Four-Year Public	7,677,659	0.2%	7,660,065	1.0%	7,586,223	0.9%
Four-Year Private Nonprofit	3,703,320	-0.2%	3,710,663	0.7%	3,685,554	-0.2%
Four-Year For-Profit	993,169	-10.1%	1,104,587	-9.3%	1,217,358	-4.9%
Two-Year Public	5,399,145	-2.5%	5,537,822	-3.3%	5,729,111	-4.8%
Unduplicated Student Headcount (All Sectors)	17,740,912	-1.5%	18,003,354	-1.4%	18,267,143	-1.7%

This small public university set out to develop a Service Excellence approach and to improve chances of survival and to grow the university in an environment of declining or flat enrollments...

Mission and Vision

The Service Excellence effort began with a philosophy of customer focus. A Steering Team and Leadership Team including students, faculty and staff were formed to create a mission and vision for the Service Excellence effort.

The Mission was defined as:

“To create and sustain a stronger sense of institutional community and culture among University faculty, staff, students, alumni, and all stakeholders. This mission is accomplished through providing the infrastructure and service training needed to ensure a productive, supportive and educational work environment.”

The Vision statement is:

“To play a vital role in our campus’ retention efforts by cultivating pride, encouraging growth, and providing continuous training and service resources for the university community.”

Faculty might wonder, “Why take this service excellence approach now?” Feldman (2001) has argued that faculty have a responsibility to encourage civility in the classroom. He argues that ignoring incivility in the classroom leads to the spread of incivility to others parts of campus live. As noted by Neal Raisman (2002): “Colleges are starting to see higher education in business-like realities. They are realizing that revenue depends on selling the college (recruitment) to its customers (students and parents). Sales (enrollment) are made based on the college’s brand (image), product (courses, programs degrees), and by creating a connection with the customer (customer service).”

Launch of the Program

The service excellence program was launched in August 2012 by the university's President with the following purpose statement:

- “We must together build a strong university wide culture of exceptional service where everyone can be excellent. By focusing on undergraduate and graduate excellence and good academic customer service, we will see an increase in student willingness to learn and engage not only in their studies, but also in experiential learning and leadership activities. Good customer service will better enable us to offer a quality product – education.”

The training program developed into eight modules covering the following components of service excellence:

1. University Service Basics – this module sets service expectations, defines service excellence, identifies the five delivery steps to main standards and exceed expectation by making service interactions faster, friendlier, and easier.
2. Attitude of Service – this module involves a comprehensive overview of SERVQUAL and showing how attitude affects service delivery.
3. Civility Training – this module ensures everyone can define civility expectations, its importance, and its relevance to service excellence.
4. University History and Traditions – this module covers the major milestones in university history and how certain traditions evolve of time using a History & Traditions Jeopardy Game approach.
5. Assisting with Difficult Situations – this module gives participants tools to handle difficult and conflict situations, to evaluate communication skills to survive and succeed in problematic situations, and to discuss techniques and methods that bring out the best in people thereby decreasing the impact of negative behaviors.
6. Persona Accountability – this module is designed to stimulate accountability thinking without authority by making better choices, asking better questions, and ending the ‘blame game’ and other excuse thinking which hinders QBQ (Question Behind the Question) thinking and goal accomplishment.
7. Service SWOT Workshop – participants in this module engage in business like interactions to identify and discuss strengths, weaknesses, opportunities and threats in service excellence delivery. Improvements in the existing training modules are also explored and communicated to the service excellence leadership team.
8. Celebration – this module allows the university president to personally thank and express his appreciation of the participants who have completed the service excellence modules above.

Since the launch, the President has published a monthly article in the university newsletter with the latest information and updates on progress and new customer service initiatives created based on program principles.

ROLE OF THE UNIVERSITY MARKETING DEPARTMENT

In support of the service excellence effort, the University's integrated marketing communications about service excellence adapted as target audiences moved to new digital communication channels.

The digital marketing channels used to connect with customers (students, faculty, staff, alumni, parents, and local community members) include:

- Mobile
- PPC
- SEM
- SEO
- Display
- SMM
- Increased paid and organic content marketing
- Expanded use of video

All channels are directed at increasing awareness of and traffic on the service excellence program's webpages.

THE ROLE OF ACADEMICS

The University offers 73 areas of study toward the baccalaureate degree. At the graduate level, there are 18 master's degree programs, two educational specialist degrees, a new Ph.D. in the College of Science. There are also specialty programs that are in addition to academic degree programs that appeal to specific student career plans. The service excellence program is targeted at students, faculty, staff, and administrators alike. Since academics are the reason for the university to be in operation, service excellence for both faculty and students is the key to growth. This growth effect is indicated in the success and growth metrics from 2012 through 2016 below.

SUCCESS AND GROWTH METRICS

Positive growth occurred over the five year study period in all 10 metrics below.

1. Total student enrollment + 1,144
2. # Faculty +87
3. # Undergraduate Programs +11
4. # Graduate Programs +8 including 1 new PhD
5. Second Year Retention Rate +5.6%
6. Four Year Graduation Rate +1.1%
7. Five Year Graduation Rate +.5%
8. Annual Sales of University Branded Gear + \$2,036,050
9. New Building Construction + 16
10. Existing Building Renovations +6

TAKE AWAYS

As competition from online plus brick and mortar universities intensifies, effective internal and external service excellence marketing programs are needed to not just survive, but to thrive. As other universities decline, a service excellence university grows using effective service delivery. Sustaining such an approach and extending it to all university stakeholders is not easy. Mrig (2012) has indicated the following key issues in sustaining and extending customer service excellence on campus:

- Avoiding the ‘one off’ effect where once the eight modules are finished, the participants ‘forget about it’ and fail to practice service excellence.
- Training and retraining takes time and most everyone is time starved to begin with.
- Structural barriers in the university create ‘run around’ situations for faculty staff and students which are not easily addressed by service excellence training.
- Culture shifts are slow and require sustained effort – service excellence is a culture shift of utmost importance.

Universities that thrive will make service excellence a pillar of a culture that stands tall.

REFERENCES

- Bardaune, S., Lacroix, S., and Maechler, N. When the customer experience starts at home, McKinsey & Company Marketing and Sales, May 2017. Accessed 5/25/17 7:46 AM, <http://www.mckinsey.com/business-functions/marketing-and-sales/our-insights/when-the-customer-experience-starts-at-home?cid=other-eml-alt-mip-mck-oth-1705&hlkid=4fce120604494b8d824f311e8423df03&hctky=9133427&hdpid=70311958-6448-433b-8c3c-7bdec39abdc0>
- Feldman, L. (2001). Classroom Civility Is Another of Our Instructor Responsibilities, *College Teaching*, 49, 4, 137-140.
- Mrig, A. (2012). Improving Customer Service in Higher Education, *Academic Impressions*, December, 1-9.
- Raisman, N. (2002). Embrace the Oxymoron: Customer Service in Higher Education. Palm Beach FL: LRP Publications.
- Raisman, N. (2010). Customer Service Factors and the Cost of Attrition: Revised and Updated. Columbus Ohio: The Administrator’s Bookshelf

**HAS THE SUPERIOR COURT OF BRUNSWICK COUNTY, NC
ESTABLISHED A SYSTEM OF INJUSTICE THAT
DISCRIMINATES AGAINST *PRO SE* LITIGANTS IN A MANNER THAT
VIOLATES THE SUBSTANTIVE DUE PROCESS CLAUSE OF
THE FOURTEENTH AMENDMENT TO THE U.S. CONSTITUTION?**

Brad R. Johnson, Ph.D., J.D., C.P.A. (Inactive, OR, #4278)
Francis Marion University

ABSTRACT

The primary purpose of this article is to enhance the awareness of *pro se* litigants, i.e., that the Superior Court of Brunswick County, North Carolina may have established a system of injustice that discriminates against *pro se* litigants in a manner that violates the Substantive Due Process Clause of the Fourteenth Amendment to the U.S. Constitution. In this regard, the instant article has significant public interest not only for *pro se* litigants, but also for any person associated with the legal community, including legal scholars.

Specifically, this article argues that the procedural posture of the case study reveals that the Superior Court of Brunswick County, North Carolina (NC) has established a system of injustice that discriminates against *pro se* litigants in a manner that violates the Substantive Due Process Clause of the Fourteenth Amendment to the U.S. Constitution. More specifically, through an analysis of the procedural posture of the case study, this article finds a system of injustice established by the Superior Court of Brunswick County, NC that is applied to a *pro se* plaintiff, as follows.

First, a Brunswick County, NC superior court (trial court) judge, unlawfully dismisses the case of a *pro se* plaintiff against two defendants under N.C.R. Civ. P. 12(b)(6).

Second, when the *pro se* plaintiff attempts to have the order of dismissal reviewed by the N.C. Court of Appeals (by filing a first notice of appeal), before the appeal is docketed in the N.C. Court of Appeals, the same trial court judge (a) unlawfully dismisses this first appeal and (b) contemporaneously issues said plaintiff a Gatekeeper Order, *sua sponte*, without “Notice” and an “Opportunity to be Heard.” The issuance of the Gatekeeper Order in this manner by said trial court judge purposefully (1) deprives

the plaintiff of Substantive Due Process, in violation of the Fourteenth Amendment to the U.S. Constitution, and (2) has the effect of preventing or obstructing the appeal of both (a) the order of dismissal and (b) the *sua sponte* Gatekeeper Order itself.

With respect to the plaintiff's appeal of the unlawful order of dismissal, after said appeal has been dismissed within the system of injustice established by the Superior Court of Brunswick County, NC, the *pro se* plaintiff is foreclosed forever from perfecting his statutory right of appeal.

“There is no inherent or inalienable right of appeal from an inferior court to a superior court or from a superior court to the [appellate division].” *In re Halifax Paper Co.*, 259 N.C. 589, 592, 131 S.E.2d 441, 444 (1963).

“Our own Supreme Court has . . . held that the right to appeal in this state is purely statutory.” *State v. Joseph*, 92 N.C. App. 203, 204, 374 S.E.2d 132, 133 (1988), *cert. denied*, 324 N.C. 115, 377 S.E.2d 241 (1989).

Among the statutes expressly providing for an appeal of right is N.C. Gen. Stat. § 7A-27 (appeals of right from courts of the trial divisions). Appeals lie from the superior court to the appellate court as a matter of right rather than as a matter of grace. *Harrell v. Harrell*, 253 N.C. 758, 117 S.E.2d 728 (1961).

Of course, the *pro se* plaintiff may otherwise file a petition for certiorari with the NC Court of Appeals, but said plaintiff has been completely and irrevocably deprived of his statutory right to appeal the trial court's unlawful order of dismissal, thereby depriving this plaintiff of Substantive Due Process (“Access to Court”), as guaranteed by the Fourteenth Amendment to the U.S. Constitution.

Third, in response to the perceived injustice, the *pro se* plaintiff attempts to have the Gatekeeper Order reviewed by the N.C. Court of Appeals (by filing a second notice of appeal). However, with respect to the *pro se* plaintiff's appeal of said Gatekeeper Order within the system of injustice established by the Superior Court of Brunswick County, NC, the plaintiff's appeal of this Gatekeeper Order is obstructed to the extent that the *pro se* plaintiff is required to file CERTIFIED documents with the trial court (pursuant to the Gatekeeper Order) in perfecting his appeal, unless the plaintiff receives a temporary stay of said Gatekeeper Order.

Notwithstanding the foregoing, the *pro se* plaintiff may be able to appeal the trial court's *sua sponte* Gatekeeper Order. However, before the plaintiff's appeal was docketed in the N.C. Court of

Appeals, within the system of injustice established by the Superior Court of Brunswick County, NC, the same trial court judge unlawfully orders the dismissal of the plaintiff's appeal of the trial court's *sua sponte* Gatekeeper Order, thereby forever depriving the *pro se* plaintiff from perfecting his statutory right to appeal said Gatekeeper Order. In the case study, the trial court judge even refused to allow the *pro se* plaintiff an "Opportunity to be Heard" on the matter, thereby depriving the *pro se* plaintiff of Substantive Due Process, in violation of the Fourteenth Amendment to the U.S. Constitution. Of course, the *pro se* plaintiff may otherwise file a petition for certiorari with the NC Court of Appeals, but within this system of injustice established by the Superior Court of Brunswick County, NC, said plaintiff has been completely and irrevocably deprived of his statutory right of appeal, thereby depriving the *pro se* plaintiff of Substantive Due Process ("Access to Court"), in violation of the Fourteenth Amendment to the U.S. Constitution.

There is one final aspect to this system of injustice established by the Superior Court of Brunswick County, NC that is of public interest. In particular, in the case study, the superior court judge delegated to defendants' counsel the responsibility to prepare the orders (sometimes in advance) to be signed and entered by the superior court judge. In the case study, these orders included findings of fact and conclusions of law that were either (a) never adjudicated by said superior court judge or (b) inconsistent with prior orders. Here again, the *pro se* plaintiff has been deprived of Substantive Due Process, in violation of the Fourteenth Amendment to the U.S. Constitution.

In a case study approach, the three primary objectives of this article are:

- (1) To establish the procedural posture of the case study;
- (2) To establish the law at issue; and
- (3) To apply the law at issue to the procedural posture of the case study for the purpose of identifying U.S. constitutional implications for the *pro se* plaintiff.

This article argues that if these objectives are met, the procedural posture of the case study will have revealed that the Superior Court of Brunswick County, NC has established a system of injustice that discriminates against *pro se* litigants in a manner that violates the Substantive Due Process Clause of the

Fourteenth Amendment to the U.S. Constitution. In this regard, the instant article has significant public interest not only for pro se litigants, but also for any person associated with the legal community, including legal scholars.

In a case study approach, this article accomplishes its primary purpose and objectives in a stepwise fashion as follows.

- In Part I, the procedural posture of the case study is established.
- In Part II, the law at issue is identified.
- In Part III, the law at issue is applied to procedural posture of the case study actual for the purpose of identifying U.S. constitutional implications for the *pro se* plaintiff.

In Part IV, implications of the findings in Part III for pro se litigants, persons associated with the legal community, including legal scholars, are presented.

A Preliminary Analysis and Comparison of International and U.S. Students' Academic Performance in a U.S. Business College

John W. Mortimer, Ph.D., Professor of Accounting Coastal Carolina University

Gregory Krippel, Ph.D., Chair, Department of Accounting, Coastal Carolina University

Christopher J. Becker, Ph.D., Assistant Professor of Accounting, Coastal Carolina University

Phillip K. Njoroge, Ph.D., Assistant Professor of Accounting, Coastal Carolina University

Abstract

The Institute of International Education's 2016 Open Doors Report on International Educational Exchange shows that the influx of foreign students attending U.S. colleges grew 7.1% to 1,043,839 representing 5.2% of the 20,264,000 U.S. college enrollments for that year. The purpose of this study is to examine a sample, $n=165$, of E. Craig Wall, Sr. Wall College of Business (WCOB) alumni, in the college's dual degree program, partitioned on international alumni, $n = 15$, to analyze the effect of international student origin on their GPAs and ETS Major Field Test (MFT) scores. This study finds the 2015 PISA academic mathematics, reading and science assessment scores for the countries represented by WCOB international alumni are higher than their domestic peers. A comparison of international dual degree and domestic student WCOB GPA and Major GPAs in both instances on average show WCOB dual degree international students have higher scores. Although WCOB international dual degree students have a slightly lower Educational Testing Service Major Field Test (ETS MFT) score than their domestic peers, the preponderance of evidence provides modest support of the persistence of learning and the assertion that WCOB international dual degree alumni are at least as academically qualified as their domestic peers when they graduate from the WCOB dual degree program.

Introduction

Coastal Carolina University currently has just under 200 international students on campus from more than 64 countries.¹ In fall 2016, the E. Craig Wall, Sr. College of Business Fact Book demographics section shows that 181 and 166 students are from foreign countries and are non-resident aliens, respectively. Some of these international students are from institutions that participate in the E. Craig Wall Sr., College of Business dual degree partnership program.² To protect their brand, the Association to Advance Collegiate Schools of Business (AACSB) Eligibility Procedures and Accreditation Standards for Business Accreditation, Standard 11, requires that member schools define and broadly disseminate their policies for evaluating, awarding, and accepting transfer credits/courses from other institutions. They must show these policies are consistent with its mission, expected outcomes, strategies, and degree programs. These policies should ensure the academic work accepted from other institutions is comparable to the academic work required for the school's own degree programs.

The determination of the quality/suitability of potential foreign dual degree program partners is particularly costly in terms of time, money and effort for small and medium size post-secondary educational institutions. Educational institutions that attempt to directly solve this challenge incur the

¹ <http://www.coastal.edu/internationalstudents/>

² October 18, 2016 e-mail from Timothy McCormick, Director of Institutional Analysis, Coastal Carolina University.

high costs of travel, translation and evaluation. As an alternative, firms can outsource this task at considerable cost.^{3, 4}

Given the high cost of vetting of potential foreign dual degree program partners, the Wall College of Business requires foreign students to meet the same rigorous entrance standards and degree program requirements as domestic students. Since a pool of Wall College of Business foreign and dual degree program alumni exists, this paper will analyze their performance relative to their U.S. peers. Performance measures include MFT ETS scores and final overall and business college GPAs. Control variables include: citizenship, age and gender. An ex post result that shows foreign students' academic performance, on average, is comparable to their domestic peers would provide additional evidence to the AACSB that the foreign students of the Wall College of business dual degree programs are on par with the college's domestic students and, hence, by induction the quality of Wall College of Business and its dual degree partners is equivalent.

This paper first summarizes literature surrounding the magnitude of foreign students attending U.S. colleges. The literature review highlights research concerning national and international assessments of pre-college domestic and international students' reading, math and science knowledge, skills and abilities. A review of the prior research concerning the quality of student academic performance methodology supports the development of the current paper's sample and methodology. The sample description and statistics are provided. This is followed by the rationale and explanation for the methodology. The paper concludes with findings and results.

Literature Review

Clear evidence of globalization can be seen in the mass migration of large populations around the world. While crises that have led to political and economic strife globally, most notably the Middle East and Africa, have dominated major world news in recent years, for decades immigration has been changing the demographics of the U.S. education system. Clark, Glick and Bures [2009] note that a staggering 24% of U.S. children were foreign-born or native-born children of immigrants. Similarly, the Institute of International Education's 2016 Open Doors Report on International Educational Exchange shows that influx of foreign students attending U.S. colleges grew 7.1% to 1,043,839 representing 5.2% of the 20,264,000 U.S. college enrollments for that year.^{5, 6} The 7.1%, growth rate reflects a modest moderation in the prior year growth rate, 10%. That said, the representation of foreign students enrolled in U.S. colleges grew to a record high of 1,043,839, 5.2%, of all collegiate students.⁷ Figure 2 shows China and India with the greatest representation of students attending U.S. colleges, with 328,547 or (37.4%) 165,918 or (18.9%), respectively.

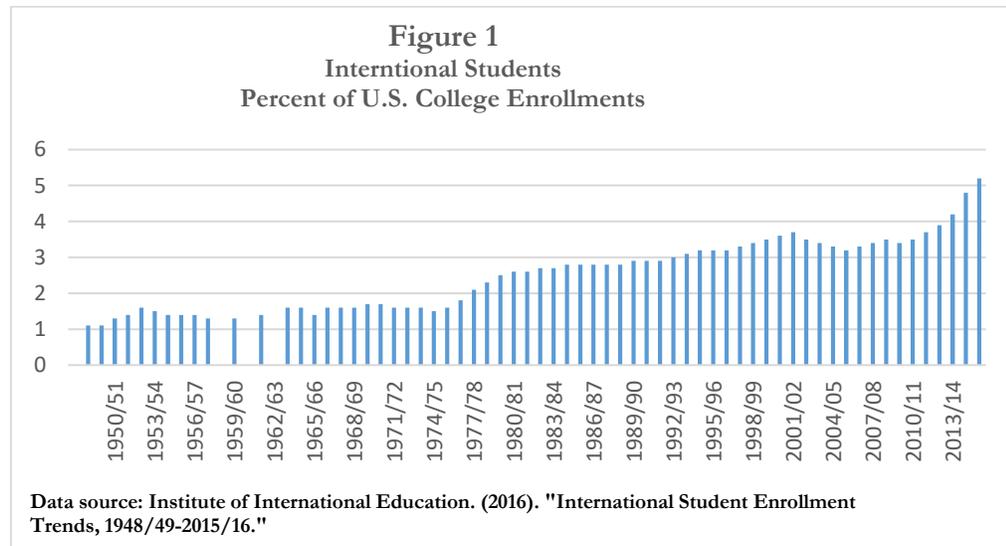
³ The Association of Collegiate Registrars and Admissions Officers (AACRAO) publication, The AACRAO International Guide: A Resource for International Education Professionals, includes sections on comprehensive internationalization, recruiting and promoting the success of international students, working with agents, establishing dual and joint degree programs, fighting fraud, and hosting pre-arrival events in home countries. See <http://www4.aacrao.org/publications/catalog.php?item=0146#.WcxmM7pFzp9>

⁴ International Education Evaluations, Inc. provides translation and evaluation services of foreign diplomas, certificates, transcripts and work experience for a fee. See <http://www.foreigntranscripts.com/>. North American Education Group is a similar organization. See <http://www.naeg.org/>.

⁵ The Institute of International Education's 2016 Open Doors Report is based on data from the National Center for Education Statistics. Founded in 1919, the Institute of International Education (IIE) is a private nonprofit leader in the international exchange of people and ideas. In collaboration with governments, foundations and other sponsors, IIE creates programs of study and training for students, educators and professionals from all sectors. These programs include the flagship Fulbright Program and Gilman Scholarships administered for the U.S. Department of State. IIE also conducts policy research, provides resources on international exchange opportunities and offers support to scholars in danger.

⁶ Since the inception of measurement in 1948/49 through 2015/2106, the average annual growth rate of foreign students enrolled in U.S. colleges is 5.81%. Peak growth in foreign students attending U.S. colleges was 21.2% in 1966/1967.

⁷ Since the inception of measurement in 1948/49 through 2015/2106, the foreign students, on average, have represented 2.5% of annual U.S. college enrollments.



International Student Assessment Instruments

The International Association for the Evaluation of Educational Achievement (IEA) is an international cooperative of national research institutions, government research agencies, scholars and analysts working to evaluate, understand and improve education worldwide. They conduct regular international comparative assessments of student achievement in the following subjects:

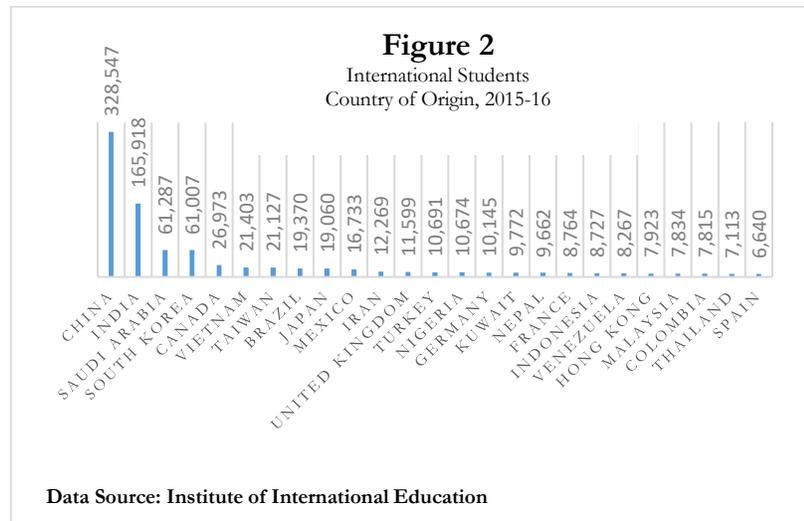
- Mathematics and science: Trends in International Mathematics and Science Study (TIMSS 1995, TIMSS 1999, TIMSS 2003, TIMSS 2007, TIMSS 2011, TIMSS 2015, TIMSS 2019).
- Reading: Progress in International Reading Literacy Study (PIRLS 2001, PIRLS 2006, PIRLS 2011, PIRLS 2016, PIRLS 2021).⁸

The National Center for Education Statistics (NCES) is the primary U.S. federal entity for collecting and analyzing data related to education in the U.S. and other nations. NCES is located within the U.S. Department of Education and the Institute of Education Sciences. NCES fulfills a Congressional mandate to collect, collate, analyze, and report complete statistics on the condition of American education; conduct and publish reports; and review and report on education activities internationally.^{9, 10}

⁸ See <http://www.iea.nl/our-studies>

⁹ See <https://nces.ed.gov/about/>

¹⁰ Through the International Activities Program, NCES supports a variety of activities to provide statistical data for cross-national comparisons of education. On behalf of the United States, NCES participates in the International Indicators of Education Systems (INES), a program of the Organization for Economic Cooperation and Development (OECD), an intergovernmental organization of 34 countries. NCES coordinates the participation of U.S. adults, students, teachers, principals, and schools in various international assessments and surveys, including, currently, the Trends in International Mathematics and Science Study (TIMSS) and the Progress in International Reading Literacy Study (PIRLS), both conducted by the International Association for the Evaluation of Educational Achievement (IEA) and the Program for International Student Assessment (PISA) and the Teaching and Learning International Survey (TALIS), all conducted by the OECD.



Progress in International Reading Literacy Study (PIRLS)

The IEA Research shows student academic performance varies significantly across nation states. Table 1, Panel A shows the summary statistics for survey years 2006 and 2011 for fourth grade reading skills. The 2006 PIRLS survey included 39 participating nations who on average scored 505 points. The 2011 PIRLS survey included an additional 6 participants and the average score increased to 512. In both years the overall PIRLS score for females was higher 16 points higher than males. Although not shown in the tables, it is interesting to note that in 2011 across individual countries, except Colombia (-1 point), females achieved higher reading assessment scores than their male peers. Further, it is very interesting to note that the highest five fourth grade female versus male reading skills divergences occurred largely in male dominated countries: Saudi Arabia (54 points), Oman (40 points), Trinidad (31 points), Qatar (30 points) and Morocco (29 points). Similarly, U.S. fourth grade students scored above the national average score by 35 and 44 points, respectively in 2006 and 2011 which improved the U.S. ranking from 14th to 6th among all national survey participants. Like their international peers, U.S. female fourth graders outperform their U.S. male peers in both years.

Table 2 shows the country rank for the 2011 PIRLS report highlighting one major limitation of using the PIRLS report data for analyzing foreign students' subsequent academic performance in the United States. That is, China and India are not PIRLS participants. As noted earlier, Figure 2 shows China and India account for 56.3% percent of all foreign students attending U.S. colleges in 2016. Another limitation of using PIRLS data is that it only surveys 4th grade students.

Similar to the IEA's PIRLS report that measures 4th grader reading literacy, the IEA's Trends in International Mathematics and Science Study (TIMSS) is used to compare mathematics and science knowledge of fourth and eighth graders over time. Conducted every four years at the fourth and eighth grades, TIMSS has a quasi-longitudinal design, with the fourth-grade student cohort assessed four years later at the eighth grade. Assessing fourth grade students can provide an early warning for necessary curricular reforms, and the effectiveness of these reforms can be further monitored at the eighth grade.

Table 1

Summary Statistics for Progress in International Reading Literacy Study (PIRLS) and Trends in International Mathematics and Science Surveys (TIMSS)

The Progress in International Reading Literacy Study (PIRLS) is an international study of reading achievement in fourth graders. It is conducted by the International Association for the Evaluation of Educational Achievement (IEA).

Conducted every four years at the fourth and eighth grades, TIMSS has a quasi-longitudinal design, with the fourth grade student cohort assessed in Mathematics and Science four years later at the eighth grade.

The IEA and its TIMSS & PIRLS International Study Center at Boston College conduct PIRLS tests on fourth grades and at fourth and eighth grades and provides 20-year trend measures for countries that participated in the first TIMSS assessments in 1995. The IEA is an international cooperative of national research institutions, government research agencies, scholars and analysts working to evaluate, understand and improve education worldwide. The IEA is a nonprofit and independent organization. More than 60 countries are actively involved in the IEA network, and over 100 education systems participate in our studies.

Panel A: PIRLS Summary Reading Information for 2006, 4th Grade Students and 2011 8th Grade Students

Grade, Topic, Year, Participating Nations	4th Grade, Reading, 2006, n = 39			4th Grade, Reading, 2011, n = 45		
Observations (Gender)	Females	Males	All	Females	Males	All
Average National Score	513	497	505	520	504	512
Maximum National Average Score	572	559	565	579	563	571
Minimum Average National Score	319	283	302	326	296	310
U.S. Average Score	545	535	540	562	551	556
U.S. Ranking (Absolute)	16	13	14	7	5	6
U.S. Ranking (Percentage)	59.0%	66.7%	64.1%	84.4%	88.9%	86.7%

Panel B: TIMSS Summary Math Information for 2007, 4th Grade Students and 2011 8th Grade Students

Grade, Topic, Year, Participating Nations	4th Grade, Math, 2007, n = 37			8th Grade, Math, 2011, n = 42		
Observations (Gender)	Females	Males	All	Females	Males	All
Average National Score	472	472	472	469	465	467
Maximum National Average Score	605	609	607	615	616	613
Minimum Average National Score	236	214	224	318	334	331
U.S. Average Score	526	532	529	508	511	509
U.S. Ranking (Absolute)	11	10	11	10	9	9
U.S. Ranking (Percentage)	70.3%	73.0%	70.3%	76.2%	78.6%	78.6%

Panel C: TIMSS Summary Science Information for 2007, 4th Grade Students and 2011 8th Grade Students

Grade, Topic, Year, Participating Nations	4th Grade, Science, 2007, n = 37			8th Grade, Math, 2011, n = 42		
Observations (Gender)	Females	Males	All	Females	Males	All
Average National Score	476	473	474	480	474	477
Maximum National Average Score	587	587	587	589	591	590
Minimum Average National Score	209	188	197	290	320	306
U.S. Average Score	536	541	539	519	530	525
U.S. Ranking (Absolute)	8	7	8	11	11	10
U.S. Ranking (Percentage)	78.4%	81.1%	78.4%	73.8%	73.8%	76.2%

Data Source: National Center for Education Statistics: <https://nces.ed.gov/timss/ide/timss/dataset.aspx>

Rank	2011 4th Grade Females		2011 4th Grade Males		2011 4th Grade All Genders	
	Jurisdiction	Average	Jurisdiction	Average	Jurisdiction	Average
1	Hong Kong, SAR	579	Hong Kong, SAR	563	Hong Kong, SAR	571
2	Finland	578	Russian Federation	559	Russian Federation	568
3	Russian Federation	578	Singapore	559	Finland	568
4	Singapore	576	Finland	558	Singapore	567
5	Northern Ireland	567	United States	551	Northern Ireland	558
6	England	563	Northern Ireland	550	United States	556
7	United States	562	Denmark	548	Denmark	554
8	Chinese Taipei	561	Croatia	546	Croatia	553
9	Croatia	560	Chinese Taipei	546	Chinese Taipei	553
10	Denmark	560	Ireland	544	Ireland	552
11	Ireland	559	Netherlands	543	England	552
12	Canada	555	Canada	542	Canada	548
13	Netherlands	549	Czech Republic	542	Netherlands	546
14	Sweden	549	England	540	Czech Republic	545
15	Czech Republic	549	Italy	540	Sweden	542
16	Portugal	548	Israel	538	Italy	541
17	Hungary	547	Germany	537	Germany	541
18	Germany	545	Sweden	535	Israel	541
19	Israel	544	Portugal	534	Portugal	541
20	Italy	543	Hungary	532	Hungary	539
21	New Zealand	541	Slovak Republic	530	Slovak Republic	535
22	Slovak Republic	540	Austria	525	Bulgaria	532
23	Bulgaria	539	Bulgaria	524	New Zealand	531
24	Slovenia	539	Slovenia	523	Slovenia	530
25	Lithuania	537	New Zealand	521	Austria	529
26	Australia	536	Lithuania	520	Lithuania	528
27	Austria	533	Australia	519	Australia	527
28	Poland	533	Poland	519	Poland	526
29	France	522	France	518	France	520
30	Spain	516	Spain	511	Spain	513
31	Norway	514	Belgium (French)	504	Norway	507
32	Romania	510	Norway	500	Belgium (French)	506
33	Belgium (French)	509	Romania	495	Romania	502
34	Georgia	499	Georgia	477	Georgia	488
35	Trinidad and Tobago	487	Malta	468	Malta	477
36	Malta	486	Azerbaijan	456	Trinidad and Tobago	471
37	Azerbaijan	470	Trinidad and Tobago	456	Azerbaijan	462
38	Iran, Islamic Rep. of	467	Colombia	448	Iran, Islamic Rep. of	457
39	Saudi Arabia	456	Iran, Islamic Rep. of	448	Colombia	448
40	United Arab Emirates	452	United Arab Emirates	425	United Arab Emirates	439
41	Colombia	447	Indonesia	419	Saudi Arabia	430
42	Qatar	441	Qatar	411	Indonesia	428
43	Indonesia	437	Saudi Arabia	402	Qatar	425
44	Oman	411	Oman	371	Oman	391
45	Morocco	326	Morocco	296	Morocco	310
	Average	520		504		512
	Maximum	579		563		571
	Minimum	326		296		310

Data Source: National Center for Education Statistics: <https://nces.ed.gov/timss/dictims/dataset.aspx>

Trends in International Math and Science Surveys (TIMSS)

Figure 1, Panel B shows the TIMSS math survey data summary data for 2007 fourth grade and 2011 survey eighth grade female and male student and the overall average.¹¹ The 2007 TIMSS math survey results show that fourth grade female, male and average national scores were 472 points. In 2011, female eighth grade students outpace their male counterparts by four points and the average national score falls to 467 points. In 2007 and 2011, U.S. fourth grades score 57 and 42 points higher, respectively, than the average international score. U.S. male fourth grade students have a 6 point advantage over their U.S. female counterparts. In the 2011 PILRS survey results, that lead falls to slightly to 3 points.

The TIMSS science survey data for 2007 fourth grade and 2011 eighth grade female, male and overall student averages are displayed in Figure 1, Panel C. The TIMSS science survey average national scores for 2007 fourth grade and 2011 eighth grade students were 474 and 477, respectively. At the national level, females outpaced their male peers by 3 points in 2007 which doubled to 6 points in 2011. In 2007, U.S. students scored 65 points higher than the average international score. This lead in science diminishes to 48 points for eighth grade students in 2011. U.S. fourth grade male students score 5 points higher than females in 2007. Four years later, the U.S. male students extend that lead to 11 points.

Programme for International Assessment (PISA)

Table 3 shows the OECD 2015 Programme for International Student Assessment (PISA) 2015 triennial international survey that assesses worldwide education by testing the mathematics, science and reading skills of 15-year-old students for 72 participating countries. An advantage of PISA 2015 PISA assessment results is that it includes four of mainland China's major provinces. Panels A, B, and C provide the summary statistics in aggregate and partitioned on gender for the PISA reading, mathematics and science assessments, respectively. U.S average score and ranking (absolute and percentage) are presented for comparison with international PISA norms. As shown in Panel A, the reading average national score was 460. On average, the female score, 475 points, was 30 points higher than their male peers. At 496 points, the U.S. ranked 25th among countries in the sample. Similar to their international peers, the average U.S. female reading score was 26 points higher than U.S. males.

Table 3, Panel B summarizes the 2015 PISA mathematics assessment information. The average national score was 461 points. The average national males' score, 463 points, was 5 points higher than the average national female score. The U.S. national average score was 9 points higher than the average aggregate score placing U.S. 15-year-old students ranking at 40th among the 72 participating countries. U.S. males' average reading score, 463, was 5 points higher than their female peers.

Table 3, Panel C provides the 2015 PISA science assessment aggregate information. The average national science score was 465 points. The female average national score, 466, was one point higher than their male peers. On average, U.S. students scored 496 points ranking 25th among PISA science assessment participants. The average U.S. male PISA science assessment score was 7 points higher than their female peers.

¹¹ The 2007 and 2011 TIMSS survey both included 37 and 42 nation states.

Table 3

Summary Statistics for the 2015 Programme for International Student Assessment (PISA) survey.

The PISA assessment is a triennial international survey which aims to evaluate education systems worldwide by testing the mathematics, science and readings skills and knowledge of 15-year-old students. In 2015 over half a million students, representing 28 million 15-year-olds in 72 countries and economies, took the internationally agreed two-hour test. Students were assessed in science, mathematics, reading, collaborative problem solving and financial literacy.

Panel A: PISA Summary Reading Assessment Information for 2015 15 Year Old Students

Topic and Participating Nations	Reading, n = 72		
	Females	Males	All
Observations (Gender)			
Average National Score	475	445	460
Maximum National Average Score	551	525	535
Minimum Average National Score	353	329	347
U.S. Average Score	507	481	496
U.S. Ranking (Absolute)	24	26	25
U.S. Ranking (Percentage)	66.7%	63.9%	65.3%

Panel B: PISA Summary Mathematics Assessment Information for 2015 15 Year Old Students

Grade, Topic, Year, Participating Nations	Mathematics, n = 72		
	Females	Males	All
Observations (Gender)			
Average National Score	458	463	461
Maximum National Score	564	564	564
Minimum Score	330	326	328
U.S. Average Score	465	474	470
U.S. Ranking (Absolute)	40	40	40
U.S. Ranking (Percentage)	44.4%	44.4%	44.4%

Panel C: PISA Summary Science Assessment Information for 2015 15 Year Old Students

Grade, Topic, Year, Participating Nations	Science, n = 72		
	Females	Males	All
Observations (Gender)			
Average National Score	466	465	465
Maximum National Score	552	559	556
Minimum Score	331	332	332
U.S. Average Score	493	500	496
U.S. Ranking (Absolute)	28	26	25
U.S. Ranking (Percentage)	61.1%	63.9%	65.3%

Data Source: The Organization for Economic Cooperation and Development, [HTTP:// WWW.OECD.ORG/PISA](http://www.oecd.org/pisa)

Sample

Coastal Carolina University has a diverse and growing student body. Table 4, Panel A shows student enrollments have increased over 5% from 9,976 in 2014 to 10,479 in 2016. International student enrollments have also grown 24% from 163 to 202 during the same period. Table 4, Panels A and B show the diversity of these students has increased as the number of countries represented on campus has increased 11% from 58 to 65. The 2014 through 2016 Coastal Carolina University student body will serve as the sample for the final comprehensive study.

Table 4								
Summary Statistics for International Student Enrollments.								
Panel A is a summary description of students home of record. It is note worthy that the number international students and their diversity, as shown by the number of countries represented in Coastal Carolina University undergraduate enrollments steadily risen from Fall 2014 through Fall 2016, Panel B lists Coastal Carolina University international students by country of origin. Panel C displays the country of origin for international students admitted to the Wall College of Business from 2012 through 2016.								
<i>Panel A: Coastal Carolina University Student Enrollments</i>								
Date	Total	In-State	%	Out-of State	%	International	%	Countries
Fall 2016	10,479	5,363	51.2%	4,914	46.9%	202	1.9%	65
Fall 2015	10,263	5,189	50.6%	4,896	47.7%	178	1.7%	60
Fall 2014	9,976	5,158	51.7%	4,655	46.7%	163	1.6%	58
<i>Panel B: Fall 2015 International Student Enrollments by Country of Citizenship</i>								
Albania	3	Czech Republic	2	Italy	2	Russia	10	
Aruba	1	Denmark	1	Jamaica	3	Saudi Arabia	4	
Australia	7	Ecuador	1	Japan	3	Senegal	1	
Bahamas	1	Egypt	1	Latvia	1	Serbia	3	
Bangladesh	1	France	6	Luxembourg	1	Slovakia	1	
Belarus	1	Germany	24	Mexico	6	South Africa	5	
Brazil	4	Ghana	1	Montenegro	1	South Korea	1	
Bulgaria	3	Greece	1	Nepal	1	Spain	3	
Cameroon	1	Guatemala	2	Netherlands	2	Sweden	3	
Canada	6	Honduras	1	New Zealand	1	Taiwan	1	
China	10	Hungary	2	Nigeria	4	Trinidad and Tobago	1	
Colombia	4	Iceland	8	Norway	1	United Arab Emirates	1	
Cote D'Ivoire	1	India	2	Pakistan	1	United Kingdom	10	
Croatia	1	Ireland	1	Poland	1	Uzbekistan	2	
Cyprus	1	Israel	2	Qatar	1	Vietnam	3	
<i>Panel C: Wall College of Business Fall International Student Enrollments, by Country of Citizenship</i>								
		2012	2013	2014	2015	2016		
Australia		0	0	1	1	2		
Brazil		1	2	2	3	2		
Canada		2	4	2	2	2		
China		6	5	3	5	10		
France		0	4	5	2	4		
Germany		1	1	1	3	3		
Mexico		1	2	1	2	5		
Netherlands		0	0	0	2	5		
Sweden		2	2	1	2	4		
United Kingdom		3	1	3	1	2		
Other Countries		34	37	40	40	42		
International Students		50	58	59	63	81		
Total WCOB Students		1,853	1,858	2,010	2,128	2,188		
Percent International Students		2.70%	3.12%	2.94%	2.96%	3.70%		

* Data Source for Panels A and B is the Coastal Carolina University 2014 - 2016 Fact Books

** Data Source for Panel C is the E.Craig Wall College of Business 2016 Fact Book

Similarly, the Wall College of Business is growing in terms of student enrollments and diversity. The college's student enrollments experienced increased growth from 1,853 in 2012 to 2,188 in 2016, an average annual increase of 3.6% over the five-year period. The number of Wall College of Business students grew even faster, averaging 7.4% during the same five-year period. This study examines a 2012 through 2016 sample of 165 Wall College of Business undergraduate alumni partitioned on residency status to determine whether students' pre-collegiate reading, mathematics and science skills persist through their undergraduate degree. Table 5, Panel A shows the sample statistics for 165 Wall College of Business graduates partitioned on residency status.

Table 5								
Sample Descriptive Statistics								
Panel A of this table provides the sample descriptive statistics for the sample of E. Craig Wall Sr., College of Business partitioned on U.S. residency status. Panel B shows the t-test results for the college of business (COB) GPA, business major GPA, ETS Score and Age variables means testing.								
Panel A: Sample Descriptive Statistics								
	<i>COB GPA</i>		<i>Major GPA</i>		<i>ETS</i>		<i>Age</i>	
	International	U.S.	International	U.S.	International	U.S.	International	U.S.
Mean	3.48	3.13	3.43	3.21	Not Shown	Not Shown	22.60	25.09
Standard Error	0.11	0.04	0.13	0.04	2.76	0.96	0.16	0.34
Median	3.55	3.11	3.67	3.26	148.00	149.00	23.00	24.00
Sample Variance	0.19	0.22	0.27	0.28	0.40	17.19	0.40	17.19
Range	1.75	1.96	1.8	2	2	29	38	66
Minimum	2.25	2.04	2.2	2	22	21	125	120
Maximum	4	4	4	4	24	50	163	186
Count	15	150	15	150	15	150	15	150
Panel B: Significance Testing Results								
Mean Difference		0.35		0.22		#VALUE!		-2.49
F Test (P - Value)		0.39		0.50		0.37		0.00*
t-(Observed)		2.74		-1.56		1.03		6.63
p-value (Two-tailed)		0.01		0.12		0.31		0.00
t (Critical)		1.97		1.97		1.97		1.98
alpha		0.05		0.05		0.05		0.05

*t-test (unequal variances)

Methodology and Results

Sample National Average Aggregate and Gender 2015 PISA Benchmarks

The Wall College of Business Dual Degree sample partition includes: (8) Chinese, (5) French and (2) German students. This study's methodology first explores the national academic achievement in the functional areas of the countries representative of these dual degree students to serve as an aggregate benchmark for their country-level national competencies in mathematics, reading and science and in

aggregate. Table 6, Panel A columns (a), (b), and (c) provide the national average scores in math, reading, and science for China, France, Germany and the U.S. Column D is the country average 2015 PISA score and Column E is the weighted average country score.¹² The information in Table 6 is used to assess the strength of academic mathematics, reading and science programs in the international countries represented in the Wall College of Business dual degree programs.

Sample Nation Aggregate and Gender 2015 PISA Assessment Comparisons

Table 6, Panel A lists the aggregate country national average. Panel A, Column (b) shows China (B,S,J,G) leads mathematics in aggregate and by gender with a national average aggregate, female, and male scores of 531, 528 and 534, respectively.¹³ The sample aggregate international average mathematics score was 510 points. The U.S. aggregate mathematics score was 40 points lower than the sample national average reading score. Panels B and C show that in the area of mathematics, international males, at 515 points, perform only slightly better than females, at 505 points. Similarly, U.S. males' average mathematics scores are 9 points higher than their female peers.

Table 6, Panel A, B, and C, Column (c) show Germany leads the mathematics assessment scoring in aggregate and by gender with national average aggregate, female and male scores of 509, 520 and 499 points, respectively. The U.S. aggregate national reading score, 497 points, is 3 points below the international benchmark. Columns (c) of Panels B and C, show U.S. females' average reading score, 507 points, is 20 points higher than their male peers.

Table 6, Panel A, Column (d) shows that China leads the science assessment scoring in aggregate and by gender. The Chinese national aggregate, female and male scores were 518, 515 and 514, respectively. The U.S. aggregate science score was 11 points below the 507-point international average. The U.S. males' 500-point score was 7 points higher than their female peers.

The foregoing analyses of the 2015 PISA mathematics, reading and science assessments demonstrate the lead 15-year-old French, German and Chinese children have over U.S. students have in the basic academic knowledge, skills and abilities. Table 6, Panels A, B and C, Column (e) is the country average of the mathematics, reading and science assessment scores. Chinese 15-year-old children's dominance in mathematics and science underpins their lead in 2015 PISA aggregate average score for all academic areas. The U.S. aggregate average score, 488 points, is 18 points below their international peers in this sample. Table 6, Panels A, B and C, Column (f) is the aggregate average country score for mathematics, reading and science weighted by the number of students represented in each of the non-U.S. countries in the study. Although Chinese 15-year-old children represent the 53.3% of sample is Chinese and they dominate the unweighted aggregate average country score, the second most dominate nationality, the French, has the lowest average aggregate score resulting in little difference between the unweighted and weighted aggregate average country score. These findings add support for the Wall College of Business assertion that on average the students in the countries represented in its dual degree programs have strong academic mathematics, reading and science programs.

¹² Weights are based on the number of dual degree international students in each country represented in the sample.

¹³ NOTE: B-S-J-G (China) refers to the four PISA participating China provinces: Beijing, Shanghai, Jiangsu, and Guangdong.

Panel A: National Average (All)						
	n	Math	Reading	Science	Average Score	Weighted Average Score
Citizenship	(a)	(b)	(c)	(d)	(e)	(f) = (a) * (e) / 15
*China B, S, J, G	8	531.0	494.0	518.0	514.3	274.3
France	5	493.0	499.0	495.0	495.7	165.2
Germany	2	506.0	509.0	509.0	508.0	67.7
Average		510.0	500.7	507.3	506.0	507.3
U.S.		470.0	497.0	496.0	487.7	487.7
Difference		40.0	3.7	11.3	18.3	19.6
Panel B: National Average (Female)						
	n	Math	Reading	Science	Average Score	Weighted Average Score
Citizenship	(a)	(b)	(c)	(d)	(e)	(f) = (a) * (e) / 15
*China B, S, J, G	8	528	503	513	514.7	274.5
France	5	490	514	494	499.3	166.4
Germany	2	498.0	520.0	513.0	510.3	68.0
Average		505.3	512.3	506.7	508.1	509.0
U.S.		465.0	507.0	493.0	488.3	488.3
Difference		40.3	5.3	13.7	19.8	20.6
Panel C: PISA National Average (Male)						
	n	Math	Reading	Science	Average Score	Weighted Average Score
Citizenship	(a)	(b)	(c)	(d)	(e)	(f) = (a) * (e) / 15
*China B, S, J, G	8	534	486	522	514.0	274.1
France	5	496	485	496	492.3	164.1
Germany	2	514.0	499.0	522.0	511.7	68.2
Average		514.7	490.0	513.3	506.0	506.5
U.S.		474.0	487.0	500.0	487.0	487.0
Difference		40.7	3.0	13.3	19.0	19.5

* NOTE: B-S-J-G (China) refers to the four PISA participating China provinces: Beijing, Shanghai, Jiangsu, and Guangdong.

** Data Source: OECD PISA Reports <http://pisadataexplorer.oecd.org/ide/idepisa/report.aspx>

International Student Performance in the Wall College of Business Dual Degree Programs

Table 5 presents the descriptive statistics for the Wall College of Business sample of alumni partitioned on dual degree programs, Table 5, Panel B provides the statistical analysis of the differences in sample means for the variables; college of business (COB) GPA, Major GPA, ETS and Age. On average international dual degree students' GPA, 3.48, is .35 greater than their U.S. Wall College of Business peer. A t-test (equal variances) showed that the difference between the international and domestic students COB GPA is statistically significant, $p = 0.01$. International students' Major GPA is .22 greater than their domestic peers. However, a t-test shows that the difference in international and domestic

students' Major GPAs is not statistically significant. During their senior year, all Wall College of Business students are required to take the ETS MFT in their CBAD 478 capstone course. Contrary to all of the evidence presented thus far, international students mean and median scores of the ETS MFT assessment instrument were just slightly lower than their domestic peers, 3.24 and 1 point, respectively.

Summary and Conclusion

In recent years, the influx of foreign students attending U.S. colleges has grown significantly and represents a greater proportion of enrollments each year. Some of these international students are from institutions that participate in dual degree partnership programs. In an effort to protect their brands, academic accreditation programs often prescribe quality standards for participating non-accredited members of dual degree programs. The determination of the quality/suitability of potential dual degree program partners is particularly costly in terms of time, money and effort for small and medium size post-secondary educational institutions. As an alternative, the Wall College of Business requires foreign students to meet the same rigorous entrance standards and degree program requirements as domestic students.

This study approaches the evaluation of the quality of international students in Coastal Carolina University dual degree programs in two ways. First, this study examines the average quality the academic mathematics, reading and science programs of the students' country of residency. The evidence from the analysis of 2015 PISA assessments of 15-year-old children in the three international countries represented in the Wall College of Business Dual Degree sample partition show that U.S. academic mathematics, reading and science lag these countries as measured by the PISA assessment scores. Second, this study compared the College GPA, Major GPA and EFT MFT Business assessment means of the partitioned sample. The dual degree international students' College of Business GPA is greater than their domestic peers and that difference is significant. While the Major GPA is also greater for international students in the Wall College of Business Dual Degree Program, that difference is not statistically significant. Results of the EFT MFT Business assessment show international students underperform their domestic peers on this measure, however, that underperformance is not statistically significant.

In conclusion, this study's sample included Wall College of Business dual degree program international alumni from countries where the PISA academic mathematics, reading and science assessment scores are higher than U.S. PISA scores. Similarly, the international alumni' average COB and Major GPA at the Wall College of Business are higher than their domestic peers. However, the international alumni's ETS MFT Business assessment score is marginally lower than their domestic peers and not statistically significant. The preponderance of the evidence supports the notion that international dual degree students' academic success in Wall College of Business, as measured by GPA, make them at least as academically prepared as their U.S. peers to enter business employment.

Bibliography

Clark RL, Glick JE, Bures RM. Immigrant families over the life course. *Journal of Family Issues*. 2009;30(6):852–872

Coastal Carolina University Fact Books 2014-2016

Coastal Carolina University, E. Craig Wall Sr., College of Business, Fact Book 2016

Institute of International Education. (2016). "International Student Enrollment Trends, 1948/49-2015/16." *Open Doors Report on International Educational Exchange*. Retrieved from <http://www.iie.org/opendoors>

"International Students." Retrieved 10-02-2017, from <http://www.coastal.edu/internationalstudents>.

McCormick, Timothy, Director of Institutional Analysis, Coastal Carolina University. E-mail, October 18, 2016.

National Center for Educational Statistics, <https://nces.ed.gov/about/>

Organization for Economic Cooperation and Development, <http://www.oecd.org/pisa>

NPR, <http://www.npr.org/sections/ed/2015/11/18/456353089/u-s-colleges-see-a-big-bump-in-international-students>

Pong S, Landale NS. Academic Achievement of Legal Immigrants' Children: The Roles of Parents' Pre- and Post-migration Characteristics in Origin-Group Differences. *Child development*. 2012;83(5):1543-1559. doi:10.1111/j.1467-8624.2012.01790.x.

U.S. News, American Students Fall in International Academic Tests, Chinese Lead the Pack, <https://www.usnews.com/news/articles/2013/12/03/american-students-fall-in-international-academic-tests-chinese-lead-the-pack>

**AN EXAMINATION OF EMBEDDED SUPPLIER INFORMATION UTILIZATION IN
PRE-DECISION PHASE PROCUREMENT AND OPPORTUNISM IN SALES
MANAGEMENT**

Yvette Holmes, Alabama State University; Roscoe Hightower, Florida A&M University,
DeShannon McDonald, Alabama A&M University

Abstract

In this paper, we will address the question of why and how information from embedded suppliers is used during the solution development phase of organizational purchasing. We also will introduce a potential moderator of problem conceptualization between embedded suppliers and members of the buying center. Drawing on the strength of ties (and strength of weak ties) literature in the social network domain and the problem solving literature, we will develop a model of information utilization in the pre-decision stage of organizational buying. We will close with a profound discussion on ethical theory and social responsibility related to opportunism and ethical behavior in sales management.

Keywords: Supplier Embeddedness, Information Utilization, Organizational Buying, Problem Solving, Social Network Theory, Strength of Ties Theory, Ethics, Social Responsibility

An Examination of Embedded Supplier Information Utilization in Pre-Decision Phase Procurement and Opportunism in Sales Management

1.0 Supplier Embeddedness

The concept of relational embeddedness is derived from research in economics. For many years, economists assumed away the idea that individuals are influenced by social relationships in economic decision making. One school of economists began to point out that experience gained in transacting with certain parties explained a great deal more about future transaction behavior than the explanations provided by classic market mechanisms, such as price (Granovetter 1985). As parties begin to build a transaction history with each other, they are more likely to rely on each other for future transactions due to “trust and the abstention from opportunism” (Granovetter 1985, p.490). Parties who build these experience-based relationships are said to become embedded with one another.

2.0 Information Utilization

Defining information utilization seems like an intuitive task at first glance. However, as Menon and Varadarajan (1992) point out, information utilization is a multifaceted construct. Two key dimensions of information utilization seem inherently related to organizational buying; the extent of information utilization and types of information utilization. The *extent* of information utilization is fairly straightforward and has been conceptualized as the level or amount of information utilized by information recipients. The *types* of information utilization are slightly more complicated and have been conceptualized as instrumental and conceptual utilization (Caplan, Morrison, and Stambaugh 1975; Rich 1977). A more thorough review of these two types of information utilization is found below.

2.1 Instrumental Use

Research on information use in public policy making provides a detailed definition of instrumental use of information. Instrumental utilization of information refers to the use of information for specific tasks (Deshpande and Zaltman 1982; Menon and Varadarajan 1992; Moorman 1995; Rich 1977). An example of this type of use would be a buying center using information to create exact specifications for new assembly line equipment or using information to figure out how, exactly, a particular idea could be implemented in the firm. This perspective of information utilization is the most common in the marketing literature.

2.2 Conceptual Use

Conceptual use is typically defined as information used for general enlightenment (Beyer and Trice 1982; Deshpande and Zaltman 1982; Menon and Varadarajan 1992; Moorman 1995; Rich 1977). The buying center’s use of information in the pre-decision stage to gain an understanding of trends in the industry or to increase its general

understanding of the latest technologies related to assembly line equipment would be an example of conceptual utilization. This definition of information use is widely overlooked in studies focusing on information use in marketing.

3.0 Supplier Embeddedness and Information Utilization

Relational embeddedness is synonymous with the idea of strong ties found in the social network literature. As researchers have sought to delineate strong and weak ties, they have often characterized strong ties as linkages between two or more nodes in a cluster that have strong levels of trust, reciprocity and indebtedness (Rindfleisch and Moorman 2001). Antecedents of these strong ties include frequency of interaction, stability of the relationship and cluster centrality (Brass 1995; Marsden and Campbell 1984). Based on these two streams of research, we define an embedded supplier as a supplier that frequently interacts with the buying center, has interacted with the buying center for an extended period of time, and that has many connections with different members of the buying center.

More specifically, the strength of ties theory has been used to explain information sharing among individuals found within a particular network (Rindfleisch and Moorman 2001). Essentially, information utilization is a function of perceived information quality and usefulness which is in turn derived from trust in the sender (Maltz and Kohli 1996; Moorman, Zaltman, and Deshpande 1992). Likewise, the closeness of the embedded supplier allows for much greater information flow which logically leads to higher levels of information utilization on the part of the buying center. Intuitively, individuals with strong ties are more likely to share information due to their frequent interactions and close interpersonal relationships (Frenzen and Nakamoto 1993; Hansen 1999; Uzzi 1996). As shown in **Figure 1**, members of the buying center are more likely to utilize information received from embedded suppliers due to higher levels of trust created by frequent interactions and relationship stability. Thus, a supplier's embeddedness has a positive impact on the extent to which the buying center utilizes information received from that supplier in the pre-decision stage of organizational buying.

The Problem with Ethics

Ethical decision making plays a critical role for every individual in today's business environment. The constant barrage of U.S. corruption in business, politics, and general society has led Americans to question the status of ethics and morality in the U.S. In fact, a 2011 Gallup poll revealed the dismal state of the public's view of business people; the poll exposed that this group has been coined as one of the least trustworthy professions (Hartman, DesJardins, & MacDonald, 2018). Consequently, in the present post-trust era of business, leaders and employees alike face societal pressure for increased levels of transparency, harsher legal penalties, and higher codes of ethical expectations. Due to the plethora of corporate debacles, such as the 2013 JPMorgan Chase's \$13 billion settlement for suspicious mortgage transactions, that have plagued and impacted companies, employees, communities, and countless other stakeholders, it is incumbent upon business leaders to foster ethical, socially responsible work environments

(McAdams, Dosanjh Zucker, Neslund, & Neslund, 2015). The challenge of navigating ethical behavior is important; yet, for those individuals working in intensely competitive professions, like the business arena, this challenge may be even more daunting.

Opportunism and Unethical Behavior in Sales Management

Business ethics emphasizes an objective set of ethical decision making standards for those working and operating within professional environments (Hartman, et al., 2018). Ethical behavior in businesses with a focus on sales management is imperative because the seller makes countless decisions, principally within problem frame and problem urgency contexts, that impact stakeholders in embedded supplier relationships. It is well-known that a strong connection within the buyer-seller relationship is paramount for and predictive of further growth and development of said relationships. Therein, the growth and development of the buyer-seller relationship may continue or halt based on opportunism and unethical behavior as well as calculative commitment and affective commitment.

For the purposes of this paper, opportunism is defined as “transgressions of the norms of a specific business relationship” while unethical behavior is determined as “transgressions of relational or societal norms of fairness and honesty” (Ganesan, Brown, Mariadoss, & Ho, 2010). Calculative commitment is founded on the desire of buyers and sellers to maintain their existing relationship. Indeed, it “... is grounded on an ‘instrumental realization of the benefits of staying and the costs of leaving’” (Ganesan, et al., 2010). In comparison, affective commitment is founded on emotions, or based on an emotive state and perceptions of “identification, loyalty, and affiliation” (Ganesan, et al., 2010). Highlighting the desired affective and calculative commitment, the following example depicts an optimal buyer-seller relationship between two parties at difference companies.

A TEN-QUESTION SEQUENCE TO CAPTURE THE CONCEPTS OF COST-VOLUME-PROFIT ANALYSIS

William B. Pollard, Appalachian State University, Boone, NC 28608, pollardwb@appstate.edu

ABSTRACT

Cost-volume-profit analysis is an important planning tool used in business to capture the behavior of costs so that the behavior patterns can then be used to determine the impact of various production and sales levels on the net income (or net loss) of the business. This paper first presents a discussion of cost behavior possibilities, followed by a ten-question sequence that captures the key determinants found in cost-volume-profit analysis that is a part of economics, finance, accounting and other business courses. These ten questions include determining units and sales dollars needed to break-even, units needed to earn a target net income of both a total amount and an amount per unit both without and then with a tax rate, finding unknowns when changes are made to the data (such as increasing variable costs, decreasing fixed costs, etc.) and a final problem that takes a broader look at cost behavior patterns and the corresponding positive or negative impact of the behavior patterns on the business.

INTRODUCTION

Cost-volume-profit analysis is an important planning tool used in business to capture the behavior of costs so that the behavior patterns can then be used to determine the impact of various production and sales levels on the net income (or net loss) of the business. This paper first presents a discussion of cost behavior possibilities, followed by a ten-question sequence that captures the key determinants found in cost-volume-profit analysis that is a part of economics, finance, accounting and other business courses. These ten questions include determining units and sales dollars needed to break-even, units needed to earn a target net income of both a total amount and an amount per unit both without and then with a tax rate, finding unknowns when changes are made to the data (such as increasing variable costs, decreasing fixed costs, etc.) and a final problem that takes a broader look at cost behavior patterns and the corresponding positive or negative impact of the behavior patterns on the business. Cost-volume-profit calculations can be worked by using either an equation format or a “short-cut” fraction setup. The equation format is actually the variable (or direct) costing income statement expressed in the equation format of $\text{Sales} - \text{Variable Costs} - \text{Fixed Costs} = \text{Net Income}$. In this arrangement, net income is, of course, zero at break-even, but then changes for various levels of net income in total or per unit, with or without taxes. The “short-cut” fraction setup determines the answer by the fraction of Fixed Costs divided by $\text{Sales} - \text{Variable Costs}$, which equals break-even in units. To determine units needed to earn a target net income, the desired net income is added to the appropriate cost. If a total amount of net income is desired, the total targeted (after-tax) net income is added to fixed costs in the numerator of the fraction. On the other hand, if a per-unit amount of net income is desired, the targeted (after-tax) net income is added to the variable costs in the denominator – with care taken to use parentheses to ensure the proper order of operations [e.g., the denominator should not be $\text{Sales} - \text{Variable Costs} + \text{Net Income}$; rather, it should be $\text{Sales} - (\text{Variable Costs} + \text{Net Income})$]. Which procedure is better, the equation or “short-cut” approach? Occasionally there will be a problem set up such that one method might deliver a quicker answer than the other. However, both methods give the correct answer and, in the classroom, some students usually seem to prefer one method, while some prefer the other. Accordingly, while students are most often allowed to use both methods, students should be warned that the name “short-cut” can be misleading. In fact, students should be reminded of the saying, “Sometimes the longest distance between two points can be a short-cut.” In other words, while the name “short-cut” can be enticing, the equation method versus the fraction method might be more appropriate names.

COST BEHAVIOR POSSIBILITIES

In their purest forms, costs behave in only one of two ways – they are either variable or fixed. A variable cost increases in total as production or sales increase, but stays the same per unit. A fixed cost stays the same in total over the relevant range of production, but decreases per unit as production or sales increase. Many costs, however, are neither totally variable nor totally fixed – they are a combination of these two behaviors, which produces a cost that is semi-variable or mixed. Such costs have to be analyzed and subdivided into their variable and fixed components before cost-volume-profit analysis procedures can be utilized. Additionally, cost-volume-profit analysis assumes that only one product (or, if more than one, a constant sales mix of products) is under investigation, that inventories remain constant and that cost relationships are linear with no impact from changing efficiencies from learning curves or technological improvements.

TEN-QUESTION SEQUENCE

The ten-question sequence is based on data from Z Company, which has the following information available for one of its products:

Estimated annual sales: 10,000 units		
Estimated costs:	<u>Amount</u>	<u>Unit Cost</u>
Raw materials	\$ 70,000	\$ 7.00
Direct labor	30,000	3.00
Factory overhead	40,000	4.00
Selling and Administrative expenses . . .	<u>80,000</u>	<u>8.00</u>
	\$220,000	\$22.00

The selling price is \$40 per unit. All factory overhead and all selling and administrative expenses are 100% fixed.

- Question
1. What is the break-even point in units?
 2. What is break-even in sales dollars?
 3. If all factory overhead and all selling and administrative expenses are 50% fixed, what is the break-even point in units?
 4. If all factory overhead and all selling and administrative expenses are 50% fixed, how many units must be produced and sold to earn a target net income of \$24,000?
 5. If all factory overhead and all selling and administrative expenses are 50% fixed, how many units must be produced and sold to earn a target net income of \$24,000 with a 20% tax rate?
 6. If all factory overhead and all selling and administrative expenses are 50% fixed, how many units must be produced and sold to earn a target net income of \$14.40 per unit?
 7. If all factory overhead and all selling and administrative expenses are 50% fixed, how many units must be produced and sold to earn a target net income of \$14.40 per unit with a 20% tax rate?
 8. Refer to the original data. What is the necessary sales price per unit needed if the desired break-even point is 1,500 units and total fixed costs and variable costs per unit will not change?
 9. Refer to the original data. If variable costs increase by 20% and fixed costs decrease by 30%, what is the new break-even point in units?
 10. Refer to the original data. If variable costs increase by 300% and fixed costs decrease to zero, what is the new break-even point in units? Is this consequence good or bad?

ANSWERS TO THE QUESTIONS

Question 1. What is the break-even point in units?

1. Equation Method:

$$\begin{aligned} S - VC - FC &= NI \\ \$40U - (\$7 + \$3)U - (\$40,000 + \$80,000) &= -0- \\ \$40U - \$10U - \$120,000 &= -0- \\ \$30U &= \$120,000 \\ U &= \underline{4,000 \text{ Units}} \end{aligned}$$

1. “Short-Cut” Method:

$$\frac{FC}{S - VC} = \frac{\$40,000 + \$80,000}{\$40 - (\$7 + \$3)} = \frac{\$120,000}{\$40 - \$10} = \frac{\$120,000}{\$30} = \underline{4,000 \text{ Units}}$$

Question 2. What is break-even in sales dollars?

Since break-even in units was calculated in Question 1, the fastest procedure here would be to multiply the answer in Question 1 by the sales price per unit. Accordingly, $\$40 \times 4,000 \text{ units} = \underline{\$160,000}$.

2. Equation Method:

$$\begin{aligned} S - VC - FC &= NI \\ S - [(\$7 + \$3)U/\$40U]S - (\$40,000 + \$80,000) &= -0- \\ S - (\$10U/\$40U)S - \$120,000 &= -0- \\ S - .25S - \$120,000 &= -0- \\ .75S &= \$120,000 \\ S &= \underline{\$160,000} \end{aligned}$$

2. “Short-Cut” Method:

$$\frac{FC}{(S - VC) \div S} = \frac{\$40,000 + \$80,000}{[\$40 - (\$7 + \$3)] \div \$40} = \frac{\$120,000}{[\$40 - \$10] \div \$40} = \frac{\$120,000}{\$30 \div \$40} = \frac{\$120,000}{.75} = \underline{\$160,000}$$

Question 3. If all factory overhead and all selling and administrative expenses are 50% fixed, what is the break-even point in units?

The key to unlocking this question turns on a student’s ability to cut the fixed costs of \$40,000 and \$80,000 in half – AND – to recognize that if factory overhead and selling and administrative expenses are now only 50% fixed, the other 50% must be variable. Accordingly, variable factory overhead is now \$2 (which is 50% of \$4) and variable selling and administrative expenses are now \$4 (which is 50% of \$8).

3. Equation Method:

$$\begin{aligned} S - VC - FC &= NI \\ \$40U - (\$7 + \$3 + \$2 + \$4)U - (\$20,000 + \$40,000) &= -0- \\ \$40U - \$16U - \$60,000 &= -0- \\ \$24U &= \$60,000 \\ U &= \underline{2,500 \text{ Units}} \end{aligned}$$

3. “Short-Cut” Method:

$$\frac{FC}{S - VC} = \frac{\$20,000 + \$40,000}{\$40 - (\$7 + \$3 + \$2 + \$4)} = \frac{\$60,000}{\$40 - \$16} = \frac{\$60,000}{\$24} = \underline{2,500 \text{ Units}}$$

Question 4. If all factory overhead and all selling and administrative expenses are 50% fixed, how many units must be produced and sold to earn a target net income of \$24,000?

With the equation method, net income is easily handled by increasing it from zero at break-even to the desired new level. The “short-cut” method is more difficult. Since the desired level of net income is a total amount, it is added to fixed costs since its behavior, too, stays the same in total over the relevant range. Occasionally students might need a reminder that target net income, of course, is not now a cost. Target net income is added to fixed costs as a consequence of both fixed costs and target net income having similar behavior patterns and because both items are now to be covered by contribution margin.

4. Equation Method:

$$\begin{aligned} S - VC - FC &= NI \\ \$40U - (\$7 + \$3 + \$2 + \$4)U - (\$20,000 + \$40,000) &= \$24,000 \\ \$40U - \$16U - \$60,000 &= \$24,000 \\ \$24U - \$60,000 &= \$24,000 \\ \$24U &= \$60,000 + \$24,000 \\ \$24U &= \$84,000 \\ U &= \underline{3,500 \text{ Units}} \end{aligned}$$

4. “Short-Cut” Method:

$$\frac{FC + NI}{S - VC} = \frac{\$20,000 + \$40,000 + \$24,000}{\$40 - (\$7 + \$3 + \$2 + \$4)} = \frac{\$84,000}{\$40 - \$16} = \frac{\$84,000}{\$24} = \underline{3,500 \text{ Units}}$$

Question 5. If all factory overhead and all selling and administrative expenses are 50% fixed, how many units must be produced and sold to earn a target net income of \$24,000 with a 20% tax rate?

This question is identical to the previous question, except there is now a 20% tax rate. Accordingly, the before-tax net income must be determined by dividing the after-tax net income by one minus the tax rate. Sometimes a student can calculate the previous question with no difficulty, but has trouble with the inclusion of a tax rate. The dilemma of dealing with taxes in equations or fractions can be mitigated to some degree if students will break the problem into two steps. First, in step one, as a calculation independent of the rest of the problem, students should convert the after-tax net income into before-tax net income. In this question, $\$24,000 / (1 - .2) = \$30,000$. Second, in step two, students can now complete the problem identically to the solution procedure in the previous question. Once students realize that with just one additional step they can convert a question with a tax rate into the more familiar non-tax question, they will hopefully realize that if they can answer Question 4 correctly, Question 5 should, for the most part, follow suit.

5. Equation Method:

$$\begin{aligned}
 S - VC - FC &= NI \\
 \$40U - (\$7 + \$3 + \$2 + \$4)U - (\$20,000 + \$40,000) &= \$24,000/(1-.2) \\
 \$40U - \$16U - \$60,000 &= \$24,000/.8 \\
 \$24U - \$60,000 &= \$30,000 \\
 \$24U &= \$60,000 + \$30,000 \\
 \$24U &= \$90,000 \\
 U &= \underline{3,750 \text{ Units}}
 \end{aligned}$$

5. “Short-Cut” Method:

$$\frac{FC + (1-t) \frac{NI}{1-t} - \frac{\$24,000}{1-t}}{S - VC} = \frac{\$20,000 + \$40,000 + \frac{\$24,000}{(1-.2)}}{\$40 - (\$7 + \$3 + \$2 + \$4)} = \frac{\$20,000 + \$40,000 + \$30,000}{\$40 - \$16} = \frac{\$90,000}{\$24} = \underline{3,750 \text{ Units}}$$

Question 6. If all factory overhead and all selling and administrative expenses are 50% fixed, how many units must be produced and sold to earn a target net income of \$14.40 per unit?

Here, the desired net income is not a total amount, but an amount per unit. Per-unit target net income is often not included in textbooks with cost-volume-profit analysis. However, it is a common consideration in the business world, especially since cost-volume-profit analysis has the limiting assumption that only one product is under investigation (or, if more than one product, there is a constant sales mix of products). Accordingly, in this question there is a desire to earn net income of \$14.40 per unit. Since the desired level of net income is a per-unit amount, it is added to variable costs since variable costs, too, stay the same per unit. Students sometimes find the equation method more accommodating when working with per-unit net income amounts. One reason, as mentioned earlier, is that in the “short-cut” method, care must be taken to use parentheses to ensure the proper order of operations [e.g., the denominator should not be Sales – Variable Costs + Net Income; rather, it should be Sales – (Variable Costs + Net Income)]. With the equation method, the per-unit net income figure is simply inserted into the normal location for net income in the equation.

6. Equation Method:

$$\begin{aligned}
 S - VC - FC &= NI \\
 \$40U - (\$7 + \$3 + \$2 + \$4)U - (\$20,000 + \$40,000) &= \$14.40U \\
 \$40U - \$16U - \$60,000 &= \$14.40U \\
 \$24U - \$60,000 &= \$14.40U \\
 \$24U &= \$60,000 + \$14.40U \\
 \$24U - \$14.40U &= \$60,000 \\
 \$9.60U &= \$60,000 \\
 U &= \underline{6,250 \text{ Units}}
 \end{aligned}$$

6. “Short-Cut” Method:

$$\frac{FC}{S - (VC + NI)} = \frac{\$20,000 + \$40,000}{\$40 - (\$7 + \$3 + \$2 + \$4 + \$14.40)} = \frac{\$60,000}{\$40 - \$30.40} = \frac{\$60,000}{\$9.60} = \underline{6,250 \text{ Units}}$$

Question 7. If all factory overhead and all selling and administrative expenses are 50% fixed, how many units must be produced and sold to earn a target net income of \$14.40 per unit with a 20% tax rate?

Once again taxes are encountered. As with Question 5, some students may find it beneficial to convert the after-tax net income into before-tax net income as a separate step before tackling the rest of the problem.

7. Equation Method:

$$S - VC - FC = NI$$

$$\$40U - (\$7 + \$3 + \$2 + \$4)U - (\$20,000 + \$40,000) = \$14.40U/(1-.2)$$

$$\$40U - \$16U - \$60,000 = \$14.40U/.8$$

$$\$24U - \$60,000 = \$18U$$

$$\$24U = \$60,000 + \$18U$$

$$\$24U - \$18U = \$60,000$$

$$\$6U = \$60,000$$

$$U = \underline{10,000 \text{ Units}}$$

7. “Short-Cut” Method:

$$S - \frac{VC + NI}{1-t} = \frac{FC}{1-t} = \frac{\$20,000 + \$40,000}{1-.2} = \frac{\$60,000}{1-.2} =$$

$$\frac{\$60,000}{\$40 - \$34} = \frac{\$60,000}{\$6} = \underline{10,000 \text{ Units}}$$

Question 8. Refer to the original data. What is the necessary sales price per unit needed if the desired break-even point is 1,500 units and total fixed costs and variable costs per unit will not change?

An important concept in cost-volume-profit analysis is that any variable (or even a subpart of a variable) in the equation or “short-cut” method can be a candidate for discovery (i.e., the item to be found). For example, in Question 8, the variable under investigation is the sales price per unit. Equally possible would be a set of numbers with the focus on determining variable costs per unit – or perhaps fixed costs in total – or perhaps just an additional new amount that could be spent on fixed costs (a subpart of total fixed costs) under certain conditions. In other words, the unknowns are sales price, variable costs per unit, fixed costs in total, and net income. As long as values for all but one of these are given, the remaining item can be found (or even a subpart of that item).

8. Equation Method:

$$S - VC - FC = NI$$

$$S(1,500) - (\$7 + \$3)1,500 - (\$40,000 + \$80,000) = -0-$$

$$1,500 S - \$10(1,500) - \$120,000 = -0-$$

$$1,500 S - \$15,000 - \$120,000 = -0-$$

$$1,500 S - \$135,000 = -0-$$

$$1,500 S = \$135,000$$

$$S = \underline{\$90}$$

8. “Short-Cut” Method:

$$\frac{FC}{S - VC} = 1,500 \text{ Units}$$

$$\frac{\$40,000 + \$80,000}{S - (\$7 + \$3)} = 1,500 \text{ Units}$$

$$\frac{\$120,000}{S - \$10} = 1,500 \text{ Units}$$

$$\begin{aligned} 1,500 S - \$15,000 &= \$120,000 \\ 1,500 S &= \$120,000 + \$15,000 \\ 1,500 S &= \$135,000 \\ S &= \underline{\$90} \end{aligned}$$

Question 9. Refer to the original data. If variable costs increase by 20% and fixed costs decrease by 30%, what is the new break-even point in units?

Another important concept in cost-volume-profit analysis is that there is an unlimited number of “what if” scenarios that can be postulated. In fact, one of the primary benefits of cost-volume-profit analysis is this flexibility for planning. In Question 9, variable costs are increasing and fixed costs are decreasing. This is similar to what can happen when a company decides to outsource part of the business. Question 9 is the lone representative in this ten-question listing of this type of event, but an array of these “what if” scenarios would prove beneficial to students.

9. Equation Method:

$$\begin{aligned} S - VC - FC &= NI \\ 40U - 120\%[(\$7 + \$3)U] - 70\%[(\$40,000 + \$80,000)] &= -0- \\ 40U - 120\%(\$10U) - 70\%(\$120,000) &= -0- \\ 40U - 12U - \$84,000 &= -0- \\ 28U - \$84,000 &= -0- \\ 28U &= \$84,000 \\ U &= \underline{3,000 \text{ Units}} \end{aligned}$$

9. “Short-Cut” Method:

$$S - VC = \frac{FC}{\$40 - 120\%(\$7 + \$3)} = \frac{70\%(\$40,000 + \$80,000)}{\$40 - 120\%(\$10)} = \frac{\$84,000}{\$40 - \$12} = \frac{\$84,000}{\$28} = \underline{3,000 \text{ Units}}$$

Question 10. Refer to the original data. If variable costs increase by 300% and fixed costs decrease to zero, what is the new break-even point in units? Is this consequence good or bad?

10. Equation Method:

$$\begin{aligned} S - VC - FC &= NI \\ 40U - 300\%[(\$7 + \$3)U] - -0- FC &= -0- \\ 40U - 300\%(\$10U) - -0- FC &= -0- \\ 40U - \$30U - -0- FC &= -0- \\ 10U - -0- FC &= -0- \\ 10U &= -0- FC \\ U &= \underline{-0- \text{ Units}} \end{aligned}$$

10. “Short-Cut” Method:

$$\frac{FC}{S - VC} = \frac{\$-0-}{\$40 - 300\%(\$7 + \$3)} = \frac{\$-0-}{\$40 - 300\%(\$10)} = \frac{\$-0-}{\$40 - \$30} = \frac{\$-0-}{\$10} = \underline{\underline{-0- \text{ Units}}}$$

Question 10 deals with the important issue of analyzing the results of the answers. In this question, break-even is zero units. This seems “good.” However, break-even is only a point on a continuum. After working with cost-volume-profit analysis, it may be tempting for students to begin to view variable costs as “good” since they lead to a quicker break-even point. However, variable costs are not “good” and fixed costs are not “bad” since the objective of the business is not to break-even, but to maximize the return to the owners (in a socially responsible way). So, given a choice as to whether a business would choose to incur a variable cost or a fixed cost, the answer to the question is the two-word answer appropriate for most business questions of, “it depends.” For example, if students are asked to imagine that they are financing a music concert in an arena that can hold 9,000 people and a firm has offered to provide security for a price of either a total of \$5,000 or for \$1 per person attending, which would the students choose? The right answer is, of course, “it depends.” If further told that 7,000 tickets have already been sold, students will quickly choose the fixed cost of \$5,000. This highlights that fixed costs can be “good” for a business. Consequently, just because variable costs lead to a quicker break-even for a business is no reason to give variable costs any priority – fixed costs may be a better choice. For example, in Question 10, suppose Z Company only sells 20 units. This would result in a \$200 net income under the new data of zero fixed costs (\$10 contribution margin per unit x 20 units) versus a net loss of \$119,800 under the original data (\$10 contribution margin per unit x 20 units – \$120,000). On the other hand, suppose 10,000 units (as estimated) were sold. This would generate a \$100,000 net income [(\$40-\$30) = \$10 contribution margin x 10,000 units] under the changed, zero-fixed-costs method, but there would be \$180,000 net income [(40-\$10) = \$30 contribution margin x 10,000 units - \$120,000 fixed costs] under the original data. There are also qualitative factors, such as analyzing exactly which fixed costs would be eliminated – machinery? Salaries of key personnel? Whatever it is that would be eliminated, would it truly have no impact whatsoever on the continuing business? Accordingly, the answer to the question of whether the change is “good” or “bad” is, of course, “it depends.”

SUMMARY AND CONCLUSIONS

This paper presented a discussion of cost behavior possibilities, followed by a ten-question sequence designed to capture the key determinants of cost-volume-profit analysis. Questions focused on determining units and sales dollars needed to break-even, units needed to earn a target net income of both a total amount and an amount per unit both with and without a tax rate, finding unknowns when changes are made to the data, and examining cost behavior patterns with a focus on the corresponding impact to a business. These ten questions represent an overview of cost-volume-profit analysis possibilities. Students should find that this brief exposure to the several facets of cost-volume-profit analysis is beneficial in alerting them to the various possibilities they might encounter in cost-volume-profit analysis questions both in the classroom and in the workplace.

THE BUSINESS LAW COURSE: CALL FOR REJUVENATION OF VITAL PIECE IN THE ACCOUNTING CURRICULUM

Dustin M. Grant, Clayton State University, dustingrant@clayton.edu
Lawrence K. Menter, Clayton State University, lawrencementor@clayton.edu
Gregory S. Kordecki, Clayton State University, gregkordecki@clayton.edu

INTRODUCTION

The importance of business law in the undergraduate business curriculum has been a hot topic for many years. Robert E. Stone stated back in the 1930's that the study of law in business is the most practical and beneficial education for the business student (Stone, 1930-1934). The disruption in the securities markets in the early 20th century served as a catalyst for regulatory reform and hence the need to study the business law component in institutions of higher learning. Yet, formalized study via a course or series of business law courses in the accounting curriculum varies across institutions.

Dow Votaw covered the importance of business law courses in the undergraduate business curriculum in an article from 1960. He stated in the article "to remove law from the education of the businessman for the purpose of broadening that education is much like dumping a blimp's helium in order to lighten the load. Law provides one of the best means by which collegiate business training can be given increased scope and meaning beyond the professional business range" (Votaw, 1960). Subotnik writing two decades later stated ". . .accounting education, considered both as a self-contained discipline and as a means of preparing practitioners, could benefit from a dose of the methodology that underlies legal education" (Subotnik, 1987). More recently, Menter and his colleagues offered arguments supporting both more and less business law in the accounting curriculum (Menter, Grant, & Kordecki, 2013).

PROFESSIONAL REQUISITES

"Today, it is arguable that accountants, more than ever before and more than any others in business, need to be legally aware" (Prentice, 2001). Receiving a background in business law courses would help drive home the concepts early and often in a student's journey throughout their business curriculum. Accordingly, students can apply what they learned to their professional lives and careers. Prentice acknowledged that "only law students enter the business world with a greater chance of coming face to face with the legal system than accounting students" (Prentice, 2001).

"Knowledge of the law is important to those who conduct business and especially to those professionals who conduct business in the form of a public accounting practice" (Kocakulah, Austill, & Long, 2008 & 2009). Public accountants must be careful when representing clients and should know the rules and laws associated with different business transactions. Public accountants have a civic duty to act under ethical standards and uphold the law to protect the public trust. "The nature of an accountant's work necessarily brings him in touch with areas of law that he must comprehend in order to produce accurate computations and conclusions" (Schwab, 2000).

Lawrence and Wright commented that "knowledge of the law has long been considered important to all business people but especially for accounting professionals as they must be able to identify significant legal issues and take steps to reduce their exposure and that of their employers and clients to legal liability" (Lawrence & Wright, 2015). Accountants must abide by laws from many different agencies, including, but not limited to, the Internal Revenue Service (IRS), Internal Revenue Code (IRC), and the Securities and Exchange Commission (SEC).

Not only do accountants have to know and interpret those laws, but they must conduct business by adhering to a strict Code of Ethics and follow the rules and guidelines adopted by Generally Accepted Accounting Principles (GAAP), the American Institute of Certified Public Accountants (AICPA), the Public Company Accounting Oversight Board (PCAOB), state licensing boards, and professional societies, just to name a few. “It is clear that accountants have a duty to clients. If any accountants fail in that duty, whether fraudulently (generally, intentionally) or negligently (generally, mistakenly), and clients are hurt as a result, the clients have a right to bring suit” (Mednick, 1987). Educating student accountants early and often throughout their academic careers can save them from the legal headaches that could haunt them later in their professional careers.

CONFOUNDING FACTORS

In an article posted on the AACSB Blog, Bird and Hiller state that “Accreditation requirements as a driver for legal knowledge might come to mind first, as AACSB 2013 Standards identify common content to include the legal, regulatory, technological, and social context of business. The standards also identify ethics, sustainability, and social responsibility, which are found in many legal studies courses. But we find that managers themselves provide the strongest rationale for legal knowledge” (Bird & Hiller, 2016).

Business law seems to receive less fair treatment than other courses within the business school curriculum, especially within the accounting curriculum, where business law courses are necessary to help prepare students for the CPA and other professional certification exams. Kocakulah and others addressed this as they asserted “when accounting students are required only to take a single course in legal environment, only a small number of topics included on the CPA examination can be satisfactorily covered” (Kocakulah, Austill, & Long, 2008 & 2009). Many business school undergraduate accounting curriculums only require one business law course, and the extent of the business law topics covered vary by program and university. The overall course offerings for business law courses are substantially fewer than most other business courses, and business law professors are traditionally paid less than many other business school professors.

The absence of formal course work in legal responsibility can lead to deleterious effects, such as slippery slope dealings with stakeholders and lack of understanding of the true strength in professional pronouncements (Mastracchio, 2005; Stahl & Dunning, 2015). Course classification is also a concern as some institutions do not specifically identify legal environment material separate from business law, or even categorize business law as a general education course (Stahl & Dunning, 2013). In fact, some pundits recommend two strong courses in business law in the undergraduate curriculum to prepare accounting students not only for professional examinations but also for career life situations (Boyd & Rubenfield, 2000; Fuller & Hargadon, 2010).

EVIDENCE FROM GEORGIA

In a review of all the public universities within the University System of Georgia, Exhibit 1 shows the university name, university classification, AACSB accreditation (both as a business school and separate accounting accreditation), accounting major offered, required business law course, and in what area of the undergraduate accounting curriculum the business law course is housed. All universities and colleges that have an accounting major do require a business law course, with most of them satisfying that requirement in Area F, the major section, of the curriculum.

Of the twenty undergraduate accounting programs within the University System of Georgia, fourteen universities and colleges (70%) have the business law courses listed under MGMT or BUSA. Only six others (30%) have a separate course listing which are LEGL, LSTD, BLAW, and LENB. Does it make a significant difference whether the courses are listed under MGMT or BLAW, BUSA or LEGL? The best

answer for that question would be the textbook chosen and used for the course. One would believe that the textbook would make a statistical difference in the outcomes of the course and the content that is delivered to the students.

PROFESSIONAL CONUNDRUM

Professional accounting certification is widely recognized both inside and outside of the academy as a highly desirable credential beyond the degree. However, business law as a course seems to get pushed to the back burner in the undergraduate accounting curriculum. The professional exams for accounting certification—the Certificate in Management Accounting (CMA) and the Certified Public Accountant (CPA) carry content specification outlines that demonstrate the academy lags significantly behind the profession. The CPA examination major topic area specification calls for 17-21% business law with another 15-17% emphasis on legal responsibility.

The CMA examination is more pervasive with its specification for business law, ethics, and legal responsibility embedded in components of financial planning, performance, control, and decision making (Hargadon & Fuller, 2010). Business law questions currently make up 10 – 20% of the questions in the Regulation section of the uniform CPA exam (Roger CPA Review, 2017). Legal duties and responsibilities and ethics questions fall under a different category within the Regulation section of the exam still forcing upward emphasis of an additional 5 to 10%.

Should a topic that could be worth as much as 25 – 30% of the Regulation section of the CPA exam be taught through one course in the undergraduate accounting curriculum and then swept under the rug? In fact, law questions have been asked on every CPA exam since its inception in 1896. “In 1896, the accounting profession was not regulated, had no code of ethics, and was virtually never a target for litigation. How can law suddenly be less important to a profession that today is heavily regulated by government, operates under a detailed code of ethics, and faces the omnipresent threat of litigation?” (Prentice, 2001).

In reviewing the CPA exam pass rates for the Regulation section of the CPA exam (Exhibit 2), only once has the pass rate been over 50% in the past ten years. That happened to be 50.66% in 2010. Interestingly, the following year in 2011 had the lowest pass rate in the past ten years at 44.22%. Also in 2011, the 44.22% represented the lowest pass rate for any of the four sections of the CPA exam. The average pass rate for the Regulation section for the past ten years is 48.44%. Would an increase in business law topics in the undergraduate accounting curriculum help improve those scores?

REFERENCES

Bird, R. & Hiller, J. “Rediscovering the Power of Law in Business Education.” *AACSB Blog*. 23 February 2016, retrievable online at website <http://www.aacsb.edu/blog/2016/february/rediscovering-the-power-of-law-in-business-education>.

Boyd, R., & Rubenfield, A. J. (2000). Learning the law: What you need to know. *New Accountant*, 16(2), 6-10. Retrieved from http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/202670779?account_id=10139

Fuller, L. R., & Hargadon, J. M. (2010). Go for gold! take the new CMA and CPA exams while earning your MBA. *Management Accounting Quarterly*, 11(3), 30-40. Retrieved from http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/749330153?account_id=10139

Hargadon, Joseph, & Fuller, L. R. (2010). Take less-and earn more. *Strategic Finance*, 91(9), 47-53.

Retrieved from

<http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/229826668?accountid=10139>

Kocakulah, M. C., Austill, A. D., & Long, B. J. (2008). "The Business Law Education of Accounting Students in the USA: The Accounting Chairperson's Perspective." *Accounting Education*, 17, 17-36.

Kocakulah, M. C., Austill, A. D., & Long, B. (2009). "The Present State of the Business Law Education of Accounting Students: The Business Law Professor's Perspective." *Journal of Legal Studies Education*, 26(1), 137-183.

Lawrence, R., & Wright, M. (2015). "The Current Role of Business Law in the Accounting Curriculum." *Journal of Higher Education Theory & Practice*, 15(7), 86-96.

Mastracchio, Nicholas J., Jr. (2005). Teaching CPAs about serving the public interest. *The CPA Journal*, 75(1), 6-8. Retrieved from

<http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/212328184?accountid=10139>

Mednick, R. (1987). "Accountants' Liability: Coping with the Stamped to the Courtroom." *Journal of Accountancy*, 164(3), 118-122.

Menter, L. K., Grant, D. M., & Kordecki, G. S. (2013). "Accounting and Business Law: Arguments for Greater Legal Scope and Depth in the Accounting Curriculum." *Proceedings of the 2013 Annual Meeting of the Southeast Decision Sciences Institute*. Charleston, S. C.

Prentice, R. A. (2001). "The Case for Educating Legally-Aware Accountants." *American Business Law Journal*, 38(3), 597-631.

Roger CPA Review. (2017). "REG CPA Exam Content and Structure," <https://www.rogercpareview.com/cpa-exam/content-and-structure/reg> (visited May 30, 2017).

Schwab, S. B. (2000). "Bringing Down the Bar: Accountants Challenge Meaning of Unauthorized Practice." *Cardozo Law Review*, (4), 1425.

Stahl, Charles E., I, II, & Dunning, G. R. (2013). Instructional case-hypo corporation, the financial accounting educative process, A void! *Journal of Accounting and Finance*, 13(6), 209-221. Retrieved from

<http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/1502619567?accountid=10139>

Stahl, Charles E., I, II, & Dunning, G. R. (2015). Instructional case-hypo corporation A quasi-experimental study of students' perceptions. *Journal of Accounting and Finance*, 15(3), 124-140.

Retrieved from

<http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/1726801460?accountid=10139>

Stone, R. E. "The Importance of Law in the Education of the Business Student." 7 Am. L. Sch. Rev. 233 (1930-1934).

Subotnik, D. (1987). "What Accounting Can Learn from Legal Education." *Issues in Accounting Education*, 2(2), 313.

Votaw, Dow (1960). "Some Views on Law in the Curriculum of the Collegiate Schools of Business." *American Business Law Association Bulletin*, 4, 42-57.

EXHIBIT 1. UNIVERSITY SYSTEM OF GEORGIA BUSINESS LAW OFFERINGS

University Name	Classification	Business School AACSB Accredited	Separate Accounting AACSB Accredited	ACCT Major Offered	Business Law Courses Required	Required Business Law Course Housed
Augusta State Univ	Research	✓	✗	✓	MGMT 2106	Area F
Georgia State Univ	Research	✓	✓	✓	BUSA 2106	Area F
Georgia Tech	Research	✓	✗	✓	MGT 2106	Area F
Univ of Georgia	Research	✓	✓	✓	LEGL 2700	Area VI
Georgia Southern Univ	Comprehensive	✓	✓	✓	LSTD 2106	Area F
Kennesaw State Univ	Comprehensive	✓	✓	✓	BLAW 2200	Area F
Univ of West Georgia	Comprehensive	✓	✓	✓	BUSA 2106	Area F
Valdosta State Univ	Comprehensive	✓	✗	✓	BUSA 2106	Area F
Albany State Univ	State University	✗	✗	✓	MGMT 3105	Area G
Armstrong State Univ (Merging w/GA Southern)	State University	✗	✗	✗	✗	✗
Clayton State Univ	State University	✓	✗	✓	BLAW 2106	Area F
Columbus State Univ	State University	✗	✗	✓	BUSA 2106	Area F
Fort Valley State Univ	State University	✗	✗	✓	BUSA 3313	Area G
Georgia College & State Univ	State University	✓	✗	✓	LENB 3135	Major Requirement
Georgia Southwestern State Univ	State University	✓	✗	✓	BUSA 2106	Area F
Middle Georgia State Univ	State University	✗	✗	✓	LENB 3135	Business Core
Savannah State Univ	State University	✓	✗	✓	BUSA 2106? (Called the Environment of Business)	Area F
Univ of North Georgia	State University	✓	✗	✓	BUSA 2810	Area F
Abraham Baldwin Agricultural College	State College	✗	✗	✗	✗	✗
Atlanta Metro College	State College	✗	✗	✗	✗	✗
Bainbridge State College	State College	✗	✗	✗	✗	✗
College of Coastal Georgia	State College	✗	✗	✓	MGMT 3500	Required Core
Dalton State College	State College	✓	✗	✓	BUSA 3060	Business Core
East Georgia State College	State College	✗	✗	✗	✗	✗
Georgia Gwinnett College	State College	✗	✗	✓	BUSA 2106	Area F
Georgia Highlands College	State College	✗	✗	✗	✗	✗
Gordon State College	State College	✗	✗	✗	✗	✗
South Georgia State College	State College	✗	✗	✗	✗	✗

EXHIBIT 2. SUCCESS RATE ON PROFESSIONAL EXAMINATIONS

Professional Exam	Section	Contain Business Law Questions	% of Business Law in Exam Section	CPA Exam Pass Rates 2016*	CPA Exam Pass Rates 2015*	CPA Exam Pass Rates 2014*	CPA Exam Pass Rates 2013*	CPA Exam Pass Rates 2012*	CPA Exam Pass Rates - Past 10 Years Average*
CPA Exam	REG	✓	10-20% of Regulation Section pertains to business law questions (per Roger CPA Review). Legal Duties, Responsibilities, & Ethics make up an additional 5 – 10%.	48.45%	49.43%	49.41%	48.48%	48.15%	48.44%
	BEC	X**		55.41%	56.48%	55.46%	55.83%	52.83%	51.28%
	AUD	X**		45.86%	47.28%	46.35%	45.87%	46.89%	47.21%
	FAR	X**		45.55%	46.75%	47.60%	48.32%	47.97%	47.54%
* per AICPA									
** While the individual exam descriptions do not specifically list business law as a topic covered, some questions may refer to an aspect of business law within each exam.									
REG Section Stats									
Only once has the pass rate been over 50%, which was in 2010 at 50.66%	44.22% pass rate in 2011 (lowest of all four sections that year)								

THE BEHAVIORAL ANTECEDENTS COGNITIVE SUPPLY CHAIN AGILITY

Kim Whitehead, Anderson University

Abstract: Despite the importance of organizational learning to supply chain agility, it is not well understood. This research expands the understanding of organizational learning and agility by exploring the effect of knowledge management capabilities on the cognitive dimensions of supply chain agility. It is proposed that these dimensions (alertness, accessibility and decisiveness) are positively affected by the absorptive capacity and distributive capabilities of the firm. The better an organization becomes at processing incoming and managing outgoing information the more agile they become. This leads to better firm performance.

Keywords: agility, firm supply chain agility, absorptive capacity, distributive capabilities

Introduction

Organizations are tasked with the daily challenge of scanning and understanding their environment. Firms must be alert and prepared to respond to their environment due to increasing complexity, customer expectations, and stakeholder requirements. In order to address these uncertainties, firms work closely together and compete via collaborative supply chains (Grant & Baden-Fuller, 2004; Teece et al., 1997). Firms interact daily with their environments by and through their supply chains. This direct interaction provides organizations a conduit for immediate and constant knowledge acquisition regarding environmental changes. “Knowledge is the most sought after remedy for uncertainty” (Davenport and Prusak, 1998).

Firms utilize supply chain agility to identify, understand and assimilate environmental knowledge and to respond in a way that allows the organization to be flexible and adaptive while supporting its operations (Li et al., 2009; Gligor et al., 2013). Gligor et al. (2013) describe supply chain agility as a multidimensional concept composed of five dimensions. These dimensions include alertness, accessibility, decisiveness, swiftness and flexibility (Gligor et al., 2013). Based on the literature, the authors further classify these dimensions into two categories

cognitive (alertness, accessibility and decisiveness) and physical (swiftness and flexibility) (Gligor et al., 2013). Cognitive dimensions facilitate information-processing and organizational learning while physical dimensions support action-taking (Gligor et al., 2013).

The literature regarding agility has evolved from presenting a single-dimensional ambiguous construct focused on manufacturing to presenting a multidimensional construct that applies to all types of supply chains (Gligor et al., 2013; Li et al., 2009; Swafford et al., 2006; Zhang, 2011). This research leverages the multidimensional understanding of agility by expanding the research of Gligor et al. (2013). The purpose of this paper is to advance our understanding of supply chain agility by focusing on its cognitive component and its behavioral knowledge-based antecedents.

Despite the importance of knowledge management and organizational learning to supply chain agility, it is not well understood (Tu et al., 2006). This paper addresses this literature gap by focusing on the information-processing and organizational learning dimensions of supply chain agility. It is proposed that these dimensions (alertness, accessibility and decisiveness) are positively affected by the absorptive capacity and distributive capabilities of the firm. The better an organization becomes at processing incoming (absorptive capacity) and managing outgoing information (distributive capabilities) the more agile they become. This, in turn, leads to better firm performance.

Research Questions

RQ1: Do knowledge transfer abilities affect cognitive supply chain agility?

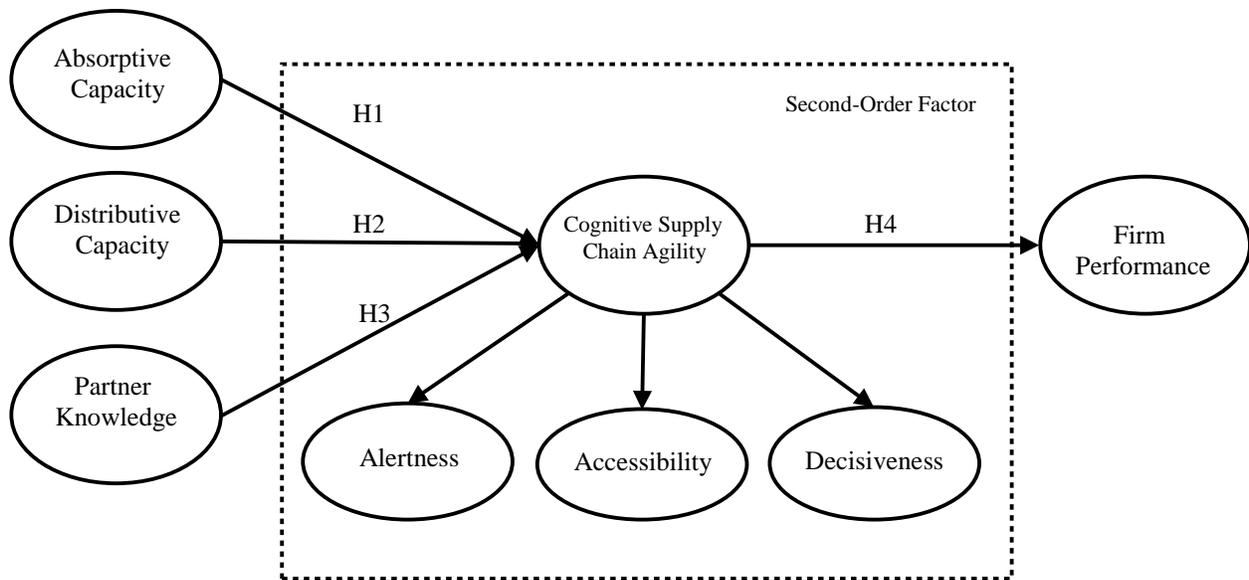
RQ2: Can the cognitive dimensions of supply chain agility be measured and modeled separately from the physical dimensions of supply chain agility?

RQ3: Does cognitive supply chain agility affect firm performance?

Model

The model is developed based on the cognitive category of supply chain agility posited by Gligor et al. (2013). See Figure 1. Because the cognitive dimensions of supply chain agility are based on their relationship to information-processing and organizational learning it is theorized that they are affected by the behavioral elements of knowledge management (absorptive capacity and distributive capabilities) (Najafi et al., 2013; Whitehead et al., 2016). The knowledge based view of the firm suggests that organizations can combine and transform individual knowledge into collective knowledge (Nonaka, 1994; Spender, 1996) and thereby provide a basis for knowledge-based predictions regarding information-processing and organizational learning (Grant, 1996).

Figure 1: Hypothesized model of the behavioral antecedents of supply chain agility



Firms use their absorptive capacity (ability to recognize, assimilate and apply external information) (Cohen & Levinthal, 1990) to understand their environments. Further,

organizations exercise absorptive capacity when they use intellectual capital (Zhang et al., 2015) alongside external acquired knowledge to improve operational and relational outcomes (Patel et al., 2012). Absorptive capacity is directly related to the three dimensions of cognitive supply chain agility as it supports firm alertness through recognition, accessibility via assimilation and decisiveness by application of external information. Najafi et al. (2013) found a direct and significant positive relationship between firm performance and agility. Accordingly, it is hypothesized that

H1: Absorptive capacity is positively related to cognitive supply chain agility.

Whitehead et al. (2016) describes the distributive capabilities of the firm as distributive capacity and partner knowledge. Distributive capacity is the intellectual capital of a firm and its ability to transmit that knowledge to an external partner (Craighead et al., 2009). The distributive capacity of an organization allows it to utilize its internal resources and knowledge to improve alertness and accessibility through the application of its own intellectual capital to determine the relevance of external information in order to induce an agile response (Whitehead et al., 2016; Tseng & Lin, 2011). Distributive capacity contributes to the organization's ability to make quick decisions and be decisive because it leverages the firm's intellectual capital to provide knowledge, know-how and confidence to make quick and informed decisions (Oppat, 2008). To examine this relationship, it is hypothesized that

H2: Distributive capacity is positively related to cognitive supply chain agility.

The distributive capabilities of a firm also involve the ability of a firm to know and understand their partners (Whitehead et al., 2016). Partner knowledge is a separate and distinct knowledge-based construct that represents the level of information a firm has about their partners with whom they are sharing information (Whitehead et al., 2016). The more knowledge that a

firm has about its supply chain partners the more agile it becomes. Partner knowledge allows the firm to increase alertness and the ability to scan their environment for information, improves the accessibility of information through insight and relationships and increases the decisiveness of the organization by reducing uncertainty. This leads to the next hypothesis

H3: Partner knowledge is positively related to cognitive supply chain agility.

Cognitive supply chain agility is modeled as a second-order latent variable with three dimensions: alertness, accessibility and decisiveness (Gligor et al., 2013). Based on literature that finds a significant positive effect of supply chain agility on firm performance, this paper posits that cognitive supply chain agility will also positively influence firm performance.

H4: Cognitive supply chain agility is positively related to firm performance. **Research**

Methods

The proposed research methods to address the research questions in this paper are:

- Step 1: Interviews with supply chain professionals to clarify research questions and model constructs and their scale items.
- Step 2: Case study to collect dyadic responses to continue to improve the model and operationalization of the constructs.
- Step 3: Wide scale survey using OLS regression to test hypothesized.

Contribution

This paper expands on the research contained in Gligor et al. (2013). This important research concluded with a call to advance their study by:

- 1) Providing analysis of the cognitive dimensions of supply chain agility in order to validate whether these are truly distinct dimensions as their research showed lack of evidence of discriminant validity;
- 2) Improving the measurement scales for the cognitive dimensions of supply chain agility and testing the scales in different populations;

- 3) Testing the cognitive dimensions of supply chain agility in a nomological model with antecedents and performance related outcomes; and,
- 4) Evaluating the dimensions of supply chain agility from a dyadic perspective in order to further validate the constructs and their measurement scales.

Conclusion

This research proposes to advance the prior research of Gligor et al. (2013) in order to provide new insights for academics and managers into the components of supply chain agility. By providing a study of the knowledge-based antecedents of cognitive supply chain agility this paper will give academics new insights into the subject constructs and how they can be measured. Additionally, this research will provide managers with information regarding how to explore, measure and utilize their absorptive capacity and distributive capabilities to maximum advantage. When managers are equipped with tools that allow them to operationalize these topics they will be able to leverage them to improve the operating and relational outcomes that improve firm performance.

References

- Cohen, W.M. and Levinthal, D. (1990), "Absorptive capacity: A new perspective on learning and innovation", *Administrative Science Quarterly*, Vol. 35 No. 1, pp. 128-152.
- Craighead, C.W., Hult, G.T.M. and Ketchen Jr, D.J. (2009), "The effects of innovation–cost strategy, knowledge, and action in the supply chain on firm performance", *Journal of Operations Management*, Vol. 27 No.5, pp. 405-421.
- Davenport, T.H. and Prusak, L. (1998), *Working knowledge: Managing what your organisation knows*, Harvard Business School Press, Boston, MA.
- Gligor, D.M., Holcomb, M.C. and Stank, T.P. (2013), "A multidisciplinary approach to supply chain agility: Conceptualization and scale development", *Journal of Business Logistics*, Vol. 34 No. 2, pp. 94–108.
- Grant, R.M. (1996), "Toward a knowledge-based theory of the firm", *Strategic Management Journal*, Vol. 17 Winter Special Issue, pp. 109-122.

- Grant, R.M. and Baden-Fuller, C. (2004), "A knowledge accessing theory of strategic alliances", *Journal of Management Studies*, Vol. 41 No. 1, pp. 61-84.
- Li, X., Goldsby, T.J., and Holsapple, C.W. (2009), "Supply chain agility: scale development", *The International Journal of Logistics Management*, Vol. 20 Issue: 3, pp.408-424.
- Najafi, S., Hossein, F., Hossam, S. and Ismail, S. (2013), "A study of contingency relationship between supplier involvement, absorptive capacity and agile product innovation", *International Journal of Operations and Production Management*, Vol. 34 Issue: 1, pp. 64-92.
- Nonaka, I. (1994), "A dynamic theory of organisational knowledge creation", *Organisation Science*, Vol. 5 No.1, pp. 14-37.
- Opat, K. (2008), "Disseminative capabilities", Dissertation of the University of St. Gallan, Switzerland.
- Patel, P.C., Terjesen, S. and Li, D. (2012), "Enhancing effects of manufacturing flexibility through operational absorptive capacity and operational ambidexterity", *Journal of Operations Management*, Vol. 30 No. 3, pp. 201-220.
- Spender, J.C. (1996), "Making knowledge the basis of a dynamic theory of the firm", *Strategic Management Journal*, Vol. 17 Winter Special Issue, pp. 45-62.
- Swafford, P.M., Ghosh, S., and Murthy, N. (2006), "The antecedents of supply chain agility of a firm: Scale development and model testing", *Journal of Operations Management*, Vol. 24 No. 2, pp. 170–188.
- Teece, D.J., Pisano, G. and Shuen, A. (1997), "Dynamic capabilities and strategic management", *Strategic Management Journal*, Vol. 18 No. 7, pp. 509-533.
- Tseng, Y., and Lin, C. (2011), "Enhancing Enterprise Agility by Deploying Agile Drivers, Capabilities and Providers", *Information Sciences*, Vol. 81 No. 17, pp. 3693–3708.
- Tu, Q., Vonderembse, M., Ragu-Nathan, T.S., and Sharkey, T.W. (2006), "Absorptive capacity: enhancing the assimilation of time-based manufacturing practices", *Journal of Operations Management*, Vol. 24 No. 5, pp. 692–710.
- Whitehead, K.K., Zacharia, Z.G. and Prater, E.L. (2016), "Absorptive capacity vs. distributive capability: The asymmetry of knowledge transfer", *International Journal of Operation and Production Management*, Vol. 36 No. 10, pp. 1308-1332.
- Zhang, D.Z. (2011), "Towards Theory Building in Agile Manufacturing Strategies—Case Studies of an Agile Taxonomy", *International Journal of Production Economics* Vol. 13 No. 1, pp. 303–312.

Effect of Solar Energy Price Reduction on Supply Chain Performance and Contract Design

Dr. Charles Xiong, University of North Carolina at Pembroke; Dr. Xiangrong Liu, Bridgewater State University

Abstract:

Over the past ten years, global electricity generation has been dominated by fossil fuel sources, particularly coal. With concerns of large pollution emissions from coal-fired power plants increasing, and a general increased commitment to green energy, solar power has begun to surge worldwide. However, while the production of solar PV panels has risen greatly globally, there has been a sharp reduction in the price of solar PV panels, which has created a challenging issue for PV manufacturers and installers due to the quick change in the market. To have a deeper understanding of the PV supply chain, this research models the strategies for one manufacturer, one installer and one customer in one supply chain setting. Using the inventory model with stochastic demand, this research aims to (1) characterize the manufacturer's and PV assembler's optimal ordering and production decisions in decentralized and centralized situations; (2) conduct sensitivity analysis by simulating the supply chain performance with different parameter settings; and, (3) provide guidance on supply chain contract design.

Keywords: Solar Energy; Supply Chain; Inventory Management; Contract; Price Decreasing.

1 Introduction

Renewable energy has become a hot topic worldwide over the last two decades. Energy, particularly electricity, has seen an increase in demand along with rapid economic development. Traditionally, fossil fuels such as

coal and natural gas have been considered the major sources that generate electricity; since these resources are not renewable and emit large amounts of pollutants, however, interest in solar and wind power as new sources for power generation has increased in recent years. Especially after the new landmark COP21 climate change agreement reached in Paris last December, to keep global warming below the 2-degree Celsius threshold requires the how international community to reduce the use of fossil fuel (Rongjing, 2016) According to the estimation by U.S. department of energy, renewable energy in the United States accounted for 16 percent of the domestic all y produced electricity in 2016. In particular, solar energy has gained increased attention because of its least negative impact on the environment and a long history of usage.

Investment of PV panel production all over the world was stimulated in 2004 by high-level feed-in tariffs and PV subsidy policies initiated by several countries, including Germany. As Chen and Su (2014) point out, in the past 15 years, the development and utilization of solar photovoltaic energy are progressing very fast. From 2006 to 2011, annual installations of photovoltaic (PV) systems had grown 60% per year globally and 53% per year in the United States. In fact, in 2011, the United States installed roughly 2 GW of the 21 GW of PV installed globally, which was a 109% increase over 2010 (Feldman, Barbose, Margolis, Wiser, Darghouth & Goodrich, 2012). As of 2015, around 208,859 people work in the solar industry and 43 states deploy net metering, where energy utilities buy back excess power generated by solar arrays. (SEIA, 2014). Similarly, in Europe, photovoltaic solar power has been widely promoted and used. From the report of European Photovoltaic Industry Associate, until 2012, Europe still lead the way with more than 70 GW (i.e. about 69% of the world's total solar photovoltaic cumulative capacity). The summit by European Union in Brussels on October 2014 aimed for agreement on carbon emission cuts that could make Europe the global leader in climate policy and continue to act as the leader to promote renewable energy.

China has installed Photovoltaic (PV) capacity growth in just a few years has been truly astounding. Since 2008, China has seized the solar power generation opportunity and leapfrogged to being the largest producer of PV systems in the world. According to the China Photovoltaic Industry Alliance (CPIA) report released in January 2016, China reached 43 GW in the cumulative installed capacity by the end of 2015 and with more than 20

The PV system production process could be demonstrated as the following. Raw materials such as crystalline, or multicrystalline, both of which are a high purity level of silicon are casted into ingots and then cut into pieces, or wafers, which can be used to produce solar cells: Multiple solar cells then string together to become a solar module. A solar panel includes a solar module and a balance of system including wiring, invertors for transforming AC to DC, batteries and other electronic parts. Finally, the installer can purchase the solar panel and install it onsite. The major players among the solar PV supply chain are module suppliers and installers.

With the increasing production level of solar PV panels, the market in 2008 was short of the supply of high purity silicon and wafers; this is significant, for the competition of the PV supply chain is the competition of seizing the silicon. Thus, vertical integration (merging the upper stream suppliers) or long term contracts with silicon/wafer suppliers became common strategies of supply chain management. Unexpectedly, with the technology advancement and the over-production in this industry, the glut of silicon, wafers and PV panels caused a sharp drop in prices at all the stages of production/something after 2008. Consequently, the price of solar modules decreased from 36 RMB/Wp (\$6/Wp) in 2007 to an average of 4.5 RMB/Wp (\$0.75/Wp) in 2012 (National Survey Report of PV power Applications in China, 2012). With the pressure of declining rates and the anti-dumping investigations started by the U.S. and countries in the European Union in 2012, many Chinese PV panel producers and their suppliers went out of business because they did not anticipate and accommodate this dramatic change in the market. For example, SunTech, as the number 1 producer of PV panels, was founded in 2001 and reached its peak in 2008. In July 2006, Suntech signed a 10-year period contract with pre-determined pricing with Monsanto Electronic Materials Company (MEMC) to ensure the supply of solar wafers. With the drop of wafer price around 2011 and the overproduction of solar panels, it had to terminate its contract with MEMC and pay USD120 million. This wrong purchasing decision led directly to its bankruptcy in 2012. The sharp change in price caused the bullwhip effect (Lee, Padmanabhan & Whang, 1997), which influenced all decisions regarding order quantity, price setting and inventory control for all the players along the whole supply chain. This feature of sharp price reduction of solar PV panels has generated a series of challenging and complicated multiple-period problems along the solar PV supply chain for multiple periods.

To simplify the whole business scenario, this research only considers a PV panel supply chain with an end customer, a PV installer (as a retailer), and a PV manufacturer without considering the other players such as the upper stream silicon suppliers and wafer suppliers. The findings in this simplified situation could be easily extended to multiple players at different stages. Therefore, the purpose of this research is to (1) characterize the manufacturer's and PV assembler's optimal ordering and production decisions in decentralized and centralized situations; (2) conduct sensitivity analysis by simulating the supply chain performance with different parameter settings; and, (3) provide guidance on supply chain contract design.

2 Literature Review

Our paper is related to the literature that studies production and inventory decisions in serial supply chains. Anupindi and Akella (1993) were the first to explore multistage supply chains with stochastic demands. Since then, there has been a plethora of research on these systems, most of which have been compiled in books by Tayur, Magazine and Ganeshan (1999) and de Kok and Graves (2003). Gavirneni and Morton (1999) studied a retailer's inventory speculation behavior in the case of price increase. Zhao, Xiong, Gavirneni and Fein (2012) extended the application to the inventory policy of pharmaceutical industry under price increase. In terms of price reduction, Wang's (2001) is the only work that modeled the stocking decisions and derived conditions under which myopic stocking policies are optimal. Our research extends his results by investigating a more complicated decision making process in the solar PV supply chain.

As to our knowledge, there is very limited research which targets the analysis of the supply chain performance in the solar PV industry. Davis and Joglekar (2010) studied the influences of decisions regarding usage of standards, customization, and product and production modularity on the stock market valuation of all the firms within the supply chain through an empirical study on 42 supply chains drawn from the solar photovoltaic energy sector. The final results showed the varying role of modularity, customization and standards on the value of the firm and the supply chain. For PV supply chain coordination, Chen and Su (2014) explained how the involvement of a strategic consumer - one who waits for purchasing an item at a discount - influences the inventory decisions of the suppliers and the installers under a revenue sharing coordination mechanism. Although our

research also investigates the performance of the supplier and the installers, different from their papers, our research aims to study the performance of the supply chain in a dynamic setting with multiple periods, and in particular, under the condition of the decreasing price environment.

In terms of the studies to date involving price decreases, our research bridges the gap between solar PV industry and supply chain inventory modeling. In studying the PV supply chain, we show the high likelihood of how price decrease will change the behavior of the players at various levels in the supply chain. Our hope is that this research helps practitioners in the solar PV industry with optimal decision making, and with ensuring the effectiveness of inventory management while also stimulating more theoretical research in this field.

3 Photovoltaic Supply Chain Model and Notations

The solar modules are the most important component of a solar PV system. Consider a three-level Photovoltaic (PV) module supply chain, where the PV module manufacturer (she) supplies the PV module installer (him) who sells and installs PV modules to the customers over an N -period finite horizon. The installer faces stochastic demand that is independent and identically distributed (i.i.d.) for each period k with a cumulative distribution function (cdf) Φ and probability density function (pdf) ϕ , which we assume to be known to the manufacturer and the installer. All unsatisfied demands are backordered. Since the decreasing price pattern is common in the solar energy industry, we consider the finite horizon N with one time price decrease. For example, if a module drops the price every year, then the finite horizon is set to be one year. We also assume there is a price decrease at period n where $1 < n < N$ which means the price decrease of PV module happens in the middle of the finite horizon. Furthermore, t periods before price decrease, installer knows or speculates the exact time and extent of future price decrease. This means in period $n - t$ installer knows the price decrease will happen in period n where $0 < t < n$. In practice, there may be more than one price decrease during the life cycle of a specific PV product. However, as we will show, after one price decrease, each individual party as well as the supply chain settle down to a new steady state as long as the two price decreases are far enough apart so that their impacts do not interact.

We first summarize notations and parameter used in our supply chain model: h^a : PV installer's unit holding cost; s^a : PV installer's

unit penalty cost for backorders before price decrease, $s_a > h_a$; r :

PV installer's unit selling price before price decrease; D_k :

stochastic demand seen by the installer in period k ,

Q_k : order quantity from the installer to the manufacturer in each period k , $1 \leq k \leq N$; c^a : PV installer's buying price from the manufacturer before price decrease;

x_k^a : PV installer's on-hand inventory level at the beginning of period k ;

y_k^a : PV installer's total amount of inventory available to satisfy demand in

period k ; x_k : PV manufacturer's on-hand inventory level at the beginning

of period k ; y_k : PV manufacturer's total amount of inventory available to

satisfy demand in period k ; h : PV manufacturer's unit holding cost; s : PV

manufacturer's unit shortage penalty cost before price decrease, $s > h$; c :

PV manufacturer's unit production cost;

η : the amount of unit price decrease of the PV product in period n ;

Next we will demonstrate PV installer and PV manufacturer's optimal inventory and production policy. We will prove that the installer has the base-stock policy in all the periods after price decrease and he will have a lower optimal inventory level than any period before price decrease.

We will also show how the price decrease affects the production and inventory decision of manufacturer. Furthermore, contract design will be discussed to improve the total revenue the whole supply chain and strengthen the coordination of players in PV supply chain system.

References

- Anupindi R, Akella R (1993) Diversification under supply uncertainty. *Management Sci.* 39(8):944-963.
- Chen F (2003) Information sharing and supply chain coordination. de Kok AG, Graves SC, eds. *Supply Chain Management: Design, Coordination and Operation*, Handbooks in Operations Research and Management Science, Vol. 11 (Elsevier, Amsterdam), 341-421.
- Chen Z, Su SI. (2014) Photovoltaic supply chain coordination with strategic consumers in China. *Renewable Energy*, 68, 236-244.
- de Kok AG, Graves SC (2003) *Supply Chain Management: Design, Coordination and Operations*, Handbooks in Operations Research and Management Science, Vol. 11 (Elsevier, Amsterdam).
- Editorial Board (2014) The Koch Attack on Solar Energy, New York Times, Retrieved from <http://www.nytimes.com/2014/04/27/opinion/sunday/the-koch-attack-on-solarenergy.html>
- European Photovoltaic Industry Associate (2012) °Global Market Outlook for photovoltaics until 2016±.
- Faiers A, Neame C (2006) Consumer Attitudes towards Domestic Solar Power Systems, *Energy Policy*, 34, 1797-1806.
- Feldman D (2014) Photovoltaic (PV) pricing trends: historical, recent, and near-term projections.
- Gavirneni S, Kapuscinski R, Tayur S (1999) Value of information in capacitated supply chains. *Management Sci.* 45(1):16-24.
- Gavirneni S, Moron TE (1999) Inventory control under speculation: Myopic heuristics and exact procedures. *Eur. J. Oper. Res.* 117(2):211-221.
- Glasserman P, Tayur S (1995) Sensitivity analysis for base-stock levels in multiechelon production-inventory systems. *Management Sci.* 41(2):263-281.

Graves SC (2002) Manufacturing planning and control. Resende M, Parados P, eds. Handbook of Applied Optimization (Oxford University Press, New York), 728-746.

Kaplan, AW (1999) From passive to active about solar electricity: innovation decision process and photovoltaic interest generation. Technovation, 19(8), 467-481.

Kee KC (2014) Assessing the effects of Customer Innovativeness, Environmental Value and Ecological Lifestyles on Residential Solar Power Systems Install Intention, Energy Policy, 67, 951-961.

Lee H, Padmanabhan P, Whang S (1997) Information distortion in a supply chain: The bullwhip effect. Management Sci. 43(4):546-558.

Pillai GG, Putrus GA, Georgitsioti T, Pearsall NM (2014) Near-term economic benefits from grid-connected residential PV (photovoltaic) systems. Energy, 68, 832-843.

Schelly C (2010) Testing residential solar thermal adoption. Environment and Behavior, 42(2), 151-170.

Sun H, Zhi Q., Wang Y, Yao Q, Su J (2014) China's solar photovoltaic industry development: The status quo, problems and approaches. Applied Energy, 118, 221-230.

Tayur S, Magazine M, Ganeshan R (1999) Quantitative Models for Supply Chain Management (Kluwer Academic, Norwell, MA).

Zhao, H., Xiong, C., Gavirneni, S., Fein, A (2012) Fee-for-service contracts in Pharmaceutical distribution supply chains: design, analysis, and management. Manufacturing & Service Operations Management, 14(4), 685-699.

**THE PROBLEM WITH EVALUATING GROUPWORK: BYPASSING STUDENT FEEDBACK ISSUES WITH A
MORE TRANSPARENT DELIVERABLE**

Matthew R Peters, Ph.D

Lander University

Amanda K Peters, M.Ed

Greenwood District 50

SEINFORMS 2017

ABSTRACT

In business education, instructors often find themselves in a position in which the evaluation of student work and the expectations therein are more ambiguous than the ideal. Subjectivity, while sometimes necessary, is oftentimes perceived by students as biased, displaying of favoritism, and otherwise "unfair" as opposed to a more objective evaluation system. Oftentimes, this subjectivity arises when the students are responsible for group/team work. Traditionally, research in business education has focused on the feedback mechanisms for grading, including most recently computer adaptive modeling to assist instructors in guaranteeing a more anonymous peer-review system and more robust method of points allocation. In most methodology in said research, the deliverable of group/team work is one of two things: A collaborative paper, or a collaborative presentation. The peer-review feedback system is under study, and these two deliverables are typically controlled as the appropriate evaluate-able vehicle. The difficulty is in evaluating which members of the group/team contributed what portion of the deliverable (quantity and quality both). This paper begins to suggest another, lesser used deliverable: a discussion board.

INTRODUCTION

This researcher has informally documented the following: Students typically groan when presented with the assignment of a group project. Often, literally. When pressed, students respond "Group work is unfair"; when pressed further, students respond "no one ever does their fair share" and "I always seem to be doing all the work". Interestingly, it seems all students claim this even though statistically speaking, at least some portion of the complainers must in fact be part of the problem. A recent informal questionnaire among junior level management majors at a small public university yielded ~95% of the students were dissatisfied at even the thought of a group work assignment (61/64).

The problem seemed to be the evaluation process itself. Typically, a 360 degree feedback model is conducted including a self evaluation, a peer-evaluation, and instructor evaluation. Students claim to be interested in learning the material, but in actuality are primarily concerned with their grade. Students inevitably evaluate their contributions disproportionately highly, and can anecdotally be seen inflating their favored peers contributions with a similar bias. When faced with the option of a collaborative paper versus a collaborative presentation, as recommended by Topping (1998) neither choice yielded a clear preference from the students. This led to the questioning of the perceived validity and reliability of the feedback process, and dissatisfied student perceptions of the process.

LITERATURE REVIEW

Teamwork and group projects are ubiquitous in management education because they enhance the development of skills and knowledge particularly relevant to the real world, provide an excellent forum for experiential learning, promote collaborative learning, and help to more efficiently instruct large student numbers (Fellenz, 2006). They proposed a Groupwork Peer-Evaluation Protocol (GPEP), an approach for using peer evaluation as part of the assessment procedure for student group work. It is described as including a self evaluation, a peer-evaluation, and instructor evaluation.

Elliot & Higgins (2005) found in their study of group work by nursing students that problems can arise "if members of the group do not contribute equally to the process and required outcome. Self and peer assessment has been advocated as one means of overcoming the problem of 'free riders'". This point was further found to be true by Zhang, Johnston & Kilic (2008) where they stated "peer and self-ratings have been strongly recommended as the means to adjust individual contributions to group work. To evaluate the quality of student ratings, previous research has primarily explored the validity of these ratings, as indicated by the degree of agreement between student and teacher ratings".

More recently, Cheng, Li, Sun & Zhu (2014) began development of a computer-assisted method for students to utilize to help measure their feedback vehicles. Specifically, they introduced a Computer Supported Collaborative Learning (CSCL) and Process Support Systems (PSS) model that allowed them to collect data from students regarding, among other points, these: Satisfaction with Process (SP) and Satisfaction with Outcome (SO). This let students anonymously and remotely evaluate not only their groups and themselves, but the feedback mechanisms themselves.

Looking further into this possibility of computer assisted feedback, Freeman & McKenzie (2002) claimed students often enjoy learning in teams and developing teamwork skills, but criticize team assessment as unfair if there is equal reward for unequal contributions and showed a design, implementation and evaluation in four subjects of the Self and Peer Assessment Resource Kit (SPARK), a web-based template which aims to improve learning from team assessment tasks and make the assessment fairer for students. Students benefit because the web-based template improves confidentiality and the potential for accurate assessment of relative contributions.

METHODOLOGY

To try to give the students a more fair, transparent and overall superior feedback method for evaluation seemed impossible given the efforts presented in the literature. Instead of focusing in on the feedback vehicle, we began to approach the problem with an updated deliverable that is more transparent: An online discussion board, driven through the university's online classroom management software, in which all groups could easily see who has contributed what as a part of the overall effort. Instructor prerogative was still present in regarding how to evaluate the board (simply, as in work count, more abstractly, as in innovative or more noteworthy contribution, and energetically, as in who might have followed up most often with solid additional thought). Groups were allowed to form organically, as talent recognition is often an important aspect of team building, with minimal instructor assistance.

An assignment given in previous iterations of the course was given again, with the deliverable being the only notable difference.

RESULTS

The student responses were varied and interesting, as was expected. Upon evaluation of the students work, it was found that the deliverables were very similar to written papers from previous classes in terms of quality. However, the student feedback rubrics were perceived to be much more acceptable than the traditional. Student overall impression with the discussion board as the deliverable instead of the paper or presentation was stated as "much better", "much more fair", and "easier to understand".

DISCUSSION

Business education is ever-evolving, and the literature stream regarding group work evaluation has been developed into a robust and interesting set of readings. It is interesting to note that the changing of the deliverable from group work was so well received in this instance. It is the intention of this research to set a new longitudinal study to determine how much the delivery method affects student outcomes and student perceptions of evaluation empirically.

REFERECES

Cheng, X., Li, Y., Sun, J., & Zhu, X. (2014, January). Easy collaboration process support system design for student collaborative group work: a case study. In *System Sciences (HICSS), 2014 47th Hawaii International Conference on* (pp. 453-462). IEEE.

Elliott, N., & Higgins, A. (2005). Self and peer assessment—does it make a difference to student group work?. *Nurse Education in Practice*, 5(1), 40-48.

Fellenz, M. R. (2006). Toward fairness in assessing student groupwork: A protocol for peer evaluation of individual contributions. *Journal of Management Education*, 30(4), 570-591.

Freeman, M., & McKenzie, J. (2002). SPARK, a confidential web-based template for self and peer assessment of student teamwork: benefits of evaluating across different subjects. *British Journal of Educational Technology*, 33(5), 551-569.

Topping, K. (1998). Peer assessment between students in colleges and universities. *Review of educational Research*, 68(3), 249-276.

Zhang, B., Johnston, L., & Kilic, G. B. (2008). Assessing the reliability of self-and peer rating in student group work. *Assessment & Evaluation in Higher Education*, 33(3), 329-340.

MOTIVATING STUDENTS: EXPLORING WAYS TO ENCOURAGE CLASS ATTENDANCE

William B. Pollard, Appalachian State University, Boone, NC 28608, pollardwb@appstate.edu

INTRODUCTION

Students learn in a variety of ways. Students can take courses online, or they can choose to be part of a classroom setting. Combinations whereby students watch lectures online and then attend a type of problem-oriented lab session are also proving popular. However, for a classroom-setting course where the teaching methods are often intertwined with actual class attendance by the students, the question arises: How can class attendance be encouraged? This paper first discusses attendance policies in general and then explores several techniques designed to encourage students to pattern themselves to attend class on a regular basis. Included are discussions on clearly presenting attendance policies and consequences of absences in the syllabus, the possible consequences of having no attendance policy at all, the role of a roll and the use of seating charts, bonus points, pop quizzes and other random assignments to encourage attendance.

TOP PRIORITY

The top priority for attendance policies, of course, is to reflect the college or university policy for class attendance. Some colleges and universities have strict policies. For example, one university I attended had a policy whereby over six absences equated to an automatic grade of F. Another university where I taught had a rule that a student could not pass the course unless the student attended at least 75% of the classes. When the final grade was reported, the number of absences was also reported and the computer would override the grade if class attendance was less than 75% and would replace the reported grade with an F. Both of those policies did encourage the minimum attendance – seldom did a student miss over six times and seldom did a student miss more than 75% of the classes. However, students can too often interpret these types of policies as meaning that they can miss six times or up to 25% of the classes and it will not have a meaningful impact on their grade in the class. Another university with which I have been associated has no official attendance policy, but the catalog states that the university will support the attendance policy that is on the syllabus. The university does expect a professor to allow at least two absences without a negative consequence to the grade and also strongly discourages any exams during the last week of classes (unless shown on the course syllabus) and requires attendance at the final exam as scheduled by the university.

OTHER WAYS TO ENCOURAGE ATTENDANCE

The Syllabus

The syllabus should reflect the basic premise of responsibility accounting: combining the highly desirable attribute (from a student's perspective) of a student being in control of determining his or her grade (as much as possible), with the less desirable consequence of students being held responsible for actions taken. The syllabus should clearly state the attendance policy and the consequences class attendance will have directly on the grade, such as in the following example:

ATTENDANCE POLICY: Students are expected to attend every meeting of their classes and are responsible for class attendance and for information covered during all classes. Attendance will count, as follows, in determination of the grade for the course:

Days Absent	0	1	2	3	4	5	6	7 or more
Points	10	10	10	5	5	0	0	-5 for each miss

If a student fails to sign the attendance sheet, he or she will be counted absent. (for example, 9 misses = -15)

The syllabus, of course, should then be followed as closely as possible throughout the course. There may also be indirect consequences since usually (and there are exceptions) there is a positive correlation with class attendance and the grade on an exam. Since class attendance sometimes peaks early, class attendance should be strongly emphasized on the first day of class and reemphasized periodically – with the best time often actually being at exam time, since students with even the worst attendance records do tend to show up for exams. Consequently, a one-minute reminder about attendance requirements at exam time – with particular emphasis on negative points possibilities, or default F grade possibilities – will at least deliver the message to those who need to hear it most. Any other time, it is like “preaching to the choir” since the students who need to hear the attendance message the most, of course, are not there.

What About No Attendance Policy At All?

Some professors, and certainly some students, prefer no attendance policy at all. This is clearly an alternative – but does it encourage attendance? One semester during my early teaching career, I had such negative comments about the attendance policy on my teaching evaluations from students that I decided the next semester to have no attendance policy at all. It was much easier for me from a record-keeping perspective, but the student evaluations were even more negative with no attendance policy than with one. Fortunately it turned out that I had many more students attending classes and wanting some (even small) credit for doing so than I had students who were not attending and who did not want to be penalized. (Of course, it could also be that the students in the latter group were not there on evaluation day!) Another problem with no attendance policy at all are situations that arise – even at universities with no official attendance policy – whereby the registrar’s office sends an email wanting to know a student’s last day of attendance for withdrawal consideration purposes, or the Veterans Affairs office requests verification of attendance for purposes of payments of student benefits. So, even if a professor does not want to monitor attendance, it may be required if needed to comply with federal laws, etc.

The Role of A Roll

As noted above, it may be handy to send a blank piece of paper around for the students to sign just in case it is needed for attendance verification for withdrawal, Veterans Affairs, Financial Aid, or other external purposes. If a roll is officially needed to determine points towards a grade, it can be more efficient to make an alphabetical roll with a “sign line” by each student’s name. This makes attendance easy to compile and also removes the difficulty of reading (deciphering?) a student’s signature. In fact, if a blank piece of paper is used, it is often a good idea to tell students to print their names. Also, when passing a roll around, it is handy to always give the roll initially to the same student to the point that he or she routinely puts the date on the roll – because without the date, it can be a real problem. Also, it is advisable to count signatures and students from time to time to ensure that the number of students in attendance equals the number of signatures on the roll. (If not, void the roll and send another one around.) This rarely happens, but when it does, I do not throw the first roll away and I do not make an

issue of it in class – However, back in the privacy of my office, I can match the rolls and see who was signed in but not there. (This is not to really say anything to the student since the student obviously was not there and truly may not know who signed the roll – but mainly to readily verify the student’s attendance in the future.)

What Are Problems That Might Arise with a Roll?

One problem is excused absences. What if a student is missing class because of a field trip with the Economics Club or Beta Gamma Sigma? I have found it best to tell the student to let me know on the first class meeting after the trip and I will find the roll and let the student sign it. Letting a student sign a roll beforehand has not proven workable. (The roll with one signature on it is sometimes too hard to locate at the next class meeting.)

Another problem that arises is students arriving late and leaving early. Given the parking situation where I currently teach, a few minutes late arrival is sometimes unavoidable. Signing the roll and leaving early, however, is unacceptable. I tell the students on the first day of class that I am like a referee and I have the responsibility of ensuring that all students are treated equally. Accordingly, if someone signs the roll and leaves early, I reserve the right to void any roll and send another roll around for official attendance purposes. Also, I usually send the roll around during the last ten minutes or so of class to reduce the temptation of leaving early. During one summer session, I had several students from a large class leave early on a Friday. On the following Monday, I pointed out that I sent the roll around a few minutes before class ended for the benefit of the students – not so they could leave early as some had done on Friday. I then told the students that if someone was going to leave early, it would be me, the professor – So, that Monday I finished teaching and then took a roll out and said that if they wanted to sign it they could come down to the front of the class and sign it – I was leaving and would come back later and get the roll. On Tuesday, the students informed me (in a very good-natured way, if fact) that if I would send the roll around early, no one would leave early – and they proved true to their word.

What About Calling the Roll or Using Seating Charts?

Calling the roll can prove problematic. As mentioned earlier, students can sometimes arrive a few minutes late – plus, with a large class, calling the roll not only takes longer, but a “here” can also be harder to detect. I personally like having a student’s signature to verify his or her attendance. In line with responsibility accounting, it puts the responsibility of signing the roll on the students instead of on the professor to hear the students’ responses to their called names. However, on the plus side, especially with a large class, calling the roll certainly helps in learning the students’ names more quickly and also helps in learning to pronounce the students’ names correctly. Seating charts can also be very useful. One disadvantage is that it allows little flexibility in a student moving from one seat to another. However, once students have found their favorite location, they do tend to sit in the same seat throughout the semester anyway. Accordingly, with a seating chart, it may be best to let the students know a chart will be used, but then wait until about the third class meeting to officially set the seating arrangement to allow for students to decide where they can sit to see or hear the best, or where they will not be in a draft, or whatever other classroom inconvenience they may want to avoid.

What About Bonus Points for Attendance?

I have found that bonus points (a few – often less than 2% of the total grade) can be very motivating. Students, especially freshmen and sophomores, sometimes need an excuse to do the right thing. On

several occasions I have heard a student say, “I can’t miss class, I need the attendance (or bonus) points.” Again, the attendance points were very few in total, but very motivating for some students. However, a word of caution is in order – bonus points can be too motivating! At one point I had an attendance policy whereby if a student came to class every time with zero misses, he or she would qualify for a five point bonus (out of a total of over 300 points). One extremely cold and icy day (when the university did not call off classes, but probably should have) I walked to class and only had one of over 30 students show up. The student who did show up lived about 35 miles away and had driven through treacherous (perhaps life-threatening) conditions. When I asked why he had made such an effort to come to class, he said he needed the bonus points! I commended his commitment, but then apologized for inadvertently encouraging him to endanger himself and assured him he would get the five point bonus, even if he missed a class in the future. In fact, since that semester, I have awarded the bonus with zero or one miss – and I tell the students not to put their life (or anyone else’s life) in danger in pursuit of the bonus – let me know and we will work things out.

What About Pop Quizzes Or Other Random Assignments In Lieu of Taking Roll?

Several professors with whom I teach have very successful pop quiz opportunities for points and random patterns for giving quizzes that encourage attendance. One problem, of course, is the time involved in giving and grading pop quizzes and recording the pop quiz scores – which can sometimes be partially resolved if graduate assistantship help is available and allowed to be used for grading. Another problem that can arise is where a professor teaches multiple sections of the same course and students communicate whether a particular day is a “pop quiz” day. As an alternative, the random activity does not have to be a test. One very successful attendance strategy used by an art professor with late afternoon Tuesday/Thursday classes has been to have students view a work of art and write a two-minute (about one-half page) write-up of their reaction to the artwork – for points under class participation. I often heard students talk about needing to get to class (and on time) to be sure to get their write-up completed for each class. It not only encouraged attendance, but the students seemed to enjoy the artwork reaction activity.

What About Graduate Students?

Freshmen and sophomores often need attendance points (including bonus points) to encourage class attendance. Juniors and seniors, especially when taking classes in their majors should need much less encouragement – I usually have some, but fewer attendance points and no bonus points. Graduate students, on the other hand, should not miss a class – unless it is an extenuating, unavoidable circumstance. Basically, I view attendance for a graduate class as expected. I explain to my graduate students that about one-third of the material they will get from me. About one-third of the material they will discover through their own research. The final one-third of the material they will get from each other – through the presentation of papers, completing group projects and through class interaction. Accordingly, a major part of the course is connected with attendance. Also, to ensure that a student finds out what was missed – such as the content of presentations made by other students when the student was absent – I require a student who misses a graduate class to turn in a three-page paper on the information covered during the missed class. I have found that this also encourages attendance. Fortunately, I have also found that the majority of graduate students do not need encouragement to attend class because by the time they get to graduate school, they rarely miss classes anyway.

SUMMARY AND CONCLUSIONS

Fortunately, many students need no extra encouragement to attend class. Many have learned that the time and effort needed to independently capture what was covered in class far exceeds the time demanded by regular class attendance. Others, however, have yet to discover this. The dilemma of finding ways to motivate some students to get their tuition money's worth by attending class continues. Presented in this paper were several possibilities, including a focus on responsibility accounting whereby students are reminded on the first day of class and then periodically throughout the semester that they have a lot of control in determining their grades. But, along with that control, comes the consequence of being held responsible for actions taken – such as the negative impact of missing class on the grade through a combination of lost attendance points plus the possibility of a lower test grade because of information missed due to the class absence. Hopefully, through reminders about the consequences of absences, plus a focus on rolls, pop quizzes and other grade-consequence techniques, students will be motivated to attend classes early in their collegiate careers to the point that, as they become upperclassmen and then graduate students, they will find that they have positively patterned themselves to attend classes on a regular basis. With these improved time management skills, students should not only do better in their courses, but also should be better prepared for the job market where attendance is not optional.

It's What You Say That Counts

George S. Lowry¹, John W. McManus², Edward D. Showalter¹

¹Department of Economics, Business, and Accounting, ²Department of Computer Science
Randolph-Macon College, Ashland, Virginia

Abstract

Through experimental research, this project further explores the impact of words used as verbal reinforcers when delivered to participants as they progress through a series of repeated cognitive tasks. Using an operant conditioning (reward training) paradigm, two different variable ratio schedules of reinforcement apply two differing magnitudes of reinforcers in a 2 X 2 (with control group) factorial design.

This current project replicates the design of two prior studies, however revised and validated sets of verbal reinforcers are included along with an updated version of the task. In addition, human voices are used to deliver the reinforcers rather than the originally used speech synthesizer.

The task consists of iteratively matching individually presented geometric shapes (stimuli) with an array of different shapes (response) in a computer-mediated environment. Correct responses are rewarded with vocalized single word reinforcers via auditory headsets according to one of five reinforcement conditions (two schedules, two magnitudes of reinforcers, one control group with no vocalized reinforcers).

The reinforcers are positively regarded words validated in three prior, independent studies. One set was routinely rated significantly higher in magnitude than the other, designated as HMR (high magnitude reinforcer) and LMR (low magnitude reinforcer). Schedules include a VR-5 and VR-15 (variable ratio 5 and 15) and are employed to differentiate impact where HMRs and LMRs are employed in each schedule under separate treatments (HMR with VR-5; HMR with VR-15; LMR with VR-5; LMR with VR-15; and a control group with no vocalized reinforcer).

Two outcomes measure number of correct responses (implicitly measuring error rates) and time on task. As in prior studies, performance under high magnitude reinforcers is expected to dominate low under both schedules, and outcomes with either set of vocalized reinforcers are expected to dominate those of the control group.

The implications of this research extend to the practice of management where managers and co-workers can positively influence the outcomes in the work environment by using appropriate words and the timing of their delivery. Over-use or effusiveness may be important in the training phase, but maintenance of behaviors may require less of both. This stream of research aims to address these and other questions.

A Proposed Study of Job Satisfaction and Organizational Commitment: Public versus Private

Joyce Beggs, University of North Carolina at Charlotte; Edward Jernigan, University of North Carolina at Charlotte

Introduction

It is sometimes assumed that there are meaningful differences in work attitudes, values, and beliefs between individuals who pursue public sector careers and those who choose careers in the private sector. For example, some assume that public sector employees are less committed to their employing organizations, less motivated, perform at lower levels, and are generally less satisfied with their jobs. Given the importance of the public sector such as police and fire departments to the community, maintaining a stable workforce with a positive attitude toward their work would be in the public interest. Similarly, many contend that job attitudes such as satisfaction and commitment are equally important to motivation and performance in the private sector. In more pragmatic terms, having both private and public employees who are committed to their organizations and satisfied with their jobs may result in reduced turnover, lower absenteeism, and increased productivity. The purpose of this study was to test for differences in levels of job satisfaction and organizational commitment for a sample of public sector employees and private sector employees.

Job Satisfaction

Job satisfaction represents an expression of one's overall sense of satisfaction – or dissatisfaction – with a job. Job satisfaction has been defined as “a pleasurable or positive emotional state resulting from the appraisal of one's job or job experiences (Locke, 1976, p. 1300).” Job

satisfaction is a global attitude that individuals maintain about their jobs based on perceptions of their jobs (Reilly, Chatham, & Caldwell, 1991).

Much attention has been given to the relationship between organizational commitment and job satisfaction. We think that findings from this study may be useful in developing a deeper understanding of work attitude differences public and private sector employees.

Organizational Commitment

Many researchers suggest that organizational commitment represents both an attitude that describes an individual's linkage to the organization and a set of behaviors by which individuals manifest that link. According to Lee and Olshfski (2002), commitment to the organization reinforces the role that an individual has taken in the community and serves as a source of motivation. Researchers have examined a wide range of issues important to the understanding of organizational commitment such as job satisfaction and causality (Bateman & Strasser, 1984; Vandenberg & Lance, 1992), intention to leave the organization (Lee & Mitchell, 1991; Jaros, Jermier, Koehler & Sincich, 1993; Cohen, 1993), the influence of personal characteristics on dimensions of organizational commitment (Abdulla & Shaw, 1999), intrinsic motivation and affective commitment (Eby, Freeman, Rush & Lance, 1999), bases and foci of commitment (Clugston, Howell & Dorfman, 2000), and the dimensionality of commitment (Penley & Gould, 1988; Allen & Meyer, 1990; Meyer, Allen & Smith, 1993; Jaros, et. al., 1993).

The multidimensionality of organizational commitment is widely accepted and well established (e.g., Etzioni, 1961; Kanter, 1968; Penley & Gould, 1988; Allen & Meyer, 1990; Meyer, Allen & Smith, 1993; Jaros, Jermier, Koehler & Sincich, 1993; Meyer & Allen, 1997). Several studies used the model of commitment developed by Meyer and Allen (1997) that

identifies three components of commitment – affective, continuance, and normative. Affective commitment “...refers to the employee’s attachment to, identification with, and involvement in the organization.” Continuance commitment “...refers to an awareness of the costs associated with leaving the organization.” Normative commitment “...reflects a feeling of obligation to continue employment (p. 11).” According to Meyer and Allen, “Employees with a strong affective commitment continue employment with an organization because they want to do so. Employees whose primary link to the organization is based on continuance commitment remain because they need to do so. Employees with a high level of normative commitment feel they ought to remain with the organization (p. 11).”

The model of commitment developed by Penley and Gould (1988) takes a slightly different approach from the Meyer and Allen model. Based on Etzioni's (1961) multiform conceptualization of organizational involvement, Penley and Gould endorse that an individual’s commitment to an organization exists in both affective and instrumental forms. One can be morally committed, calculatively committed, or alienatively committed to an organization. Moral commitment is described as a highly positive affective form characterized by acceptance of and identification with organizational goals. Calculative commitment is an instrumental form essentially focused on one's satisfaction with the exchange relationship. Alienative commitment is described as a highly negative affective form that is a consequence of a lack of control over the internal organizational environment and of a perceived absence of alternatives for organizational commitment. Employees who express alienative commitment continue to engage in work behaviors that indicate a desire to continue their membership in the organization. In essence,

they ensure their work performance at least meets minimal standards, and their interaction with managers and co-workers communicates that they do not want to leave.

The Penley and Gould model seems appropriate for this study. Public sector organizations are often stereotyped as highly bureaucratic organizations where promotions and pay raises are usually slow in coming and based on seniority. The highly bureaucratic environment may produce a feeling of powerlessness among individual employees. In addition, the frequent criticism of the public sector by the media, politicians, and community groups could add to a sense of alienation either in terms of sunk costs, or a sense of “separation” from the larger community in the case of police officers. The result may be a higher potential for a lower sense of commitment. Powerlessness is important because it may lead to job dissatisfaction, burnout, and lower commitment (Ross & Wright, 1998; Wilson & Laschinger, 1994; Chandler, 1986; Bush, 1988).

Research Question

This paper focused on a single research question. Do public sector employees express significantly different job satisfaction and organizational commitment as compared to private sector employees? We address this question by evaluating data from approximately 200 public and private sector employees.

Method

Setting, Sample, and Procedure

This study was conducted in a southeastern metropolitan area. The public sector sample included police officers, utility district employees, and firefighters. The private sector sample consisted of non-managerial employees at a regional bank working in branch operations roles.

Police officers employed in the investigations bureau and in a patrol district were invited to participate in the study. With the support of supervisors in each division, questionnaires were distributed to 60 police officers in their work setting. With the support of the Fire Department Chief, surveys were distributed directly to a sample of 65 firefighters. With the support of the Director of the metropolitan area utility district, surveys were distributed to a sample of 50 employees. The utility district was the principal supplier of water and sewer service in the metropolitan area and faced competition from several private water and sewer companies in the region. The police and fire departments were the largest in the area and offered the most attractive compensation and benefits packages in the region. The fire department was the only fulltime, non-volunteer department in the county. Prior to distributing surveys, the researcher explained the purpose of the study and assured participants of the confidentiality of their responses. In all cases, completed surveys were returned to the researcher in a sealed envelope.

Survey Instrumentation:

Commitment was measured using the Organizational Commitment Scale (OCS) developed by Penley and Gould (1988). The OCS is a 15 item seven-point Likert scale that measures organizational commitment on three dimensions: moral, calculative, and alienative. All three dimensions of commitment are measured using subscales consisting of five items. A sample moral commitment item is: "I feel it is my duty to support this organization." A sample calculative commitment item is: "I will give my best when I know it will be seen by the 'right' people in this organization." A sample alienative commitment item is: "I feel trapped here." Coefficient alphas for the three sub-scales were moral commitment, .81; alienative commitment, .75; and calculative commitment, .66. Penley and Gould (1988) reported coefficient alphas of .80 (moral), .82 (alienative), and .67 (calculative).

Job satisfaction was measured using the Index of Job Satisfaction developed by Brayfield and Rothe (Cook, Hepworth, Wall, & Warr, 1981). The index consisted of eighteen items of which half were reverse scored ($\alpha = .87$). Originally formulated with a 5 point agreedisagree scale, the index was modified to a 7-point (very strongly agree to very strongly disagree) scale in order to make it consistent with the other measures employed in this study.

Sample items from the index include: “My job is like a hobby to me,” “I am often bored with my job (R),” and “I find real enjoyment in my work.”

The following demographic information was solicited for each participating police officer: current job (patrol officer, investigator, or supervisor), age, number of years in the current job, number of years as a police officer, marital status, work shift (first, second, or third), and education. The following demographic information was collected from each firefighter: current job title (firefighter, engineer, captain), age, number of years in the current job, number of years as a firefighter, marital status, and education. The shift question was eliminated for firefighters because all worked the same schedule. Bank and utility district employees were asked to provide demographic information similar to firefighters except job titles differed.

Analysis:

Basic relationships will be examined first using correlation analysis. T-tests will be used to test for differences in organizational commitment and job satisfaction between the samples.

References

Abdulla, M. H. A. & Shaw, J. D. (1999). “Personal factors and organizational commitment: Main and interactive effects in the United Arab Emirates”, *Journal of Managerial Issues*, 11, 1, pp. 77-93

- Allen, N. J. & Meyer, J. P. (1990). "The measurement and antecedents of affective, continuance and normative commitment to the organization", *Journal of Occupational Psychology*, 63, pp. 1-18.
- Bateman, T. S. & Strasser S. (1984). "A longitudinal analysis of the antecedents of organizational commitment", *Academy of Management Journal*, 27, 1, pp. 95-112.
- Bush, J. P. (1988). "Job satisfaction, powerlessness, and locus of control," *Western Journal of Nursing Research*, 10, pp. 718-731.
- Chandler, G. E. (1986). The relationship of nursing work environment to empowerment and powerlessness. Unpublished doctoral dissertation. Salt Lake City: University of Utah.
- Clugston, M., Howell, J. P. & Dorfman, P. W. (2000). "Does cultural socialization predict multiple bases and foci of commitment?", *Journal of Management*, 26, 1, pp. 5-30.
- Cohen, A. (1993). "Organizational commitment and turnover: A meta-analysis", *Academy of Management Journal*, 36, 5, pp. 1140-1157.
- Eby, L. T., Freeman, D. M., Rush, M. C. & Lance, C. E. (1999). "Motivational bases of affective organizational commitment: A partial test of an integrative theoretical model", *Journal of Occupational and Organizational Psychology*, 72, pp. 463-483.
- Etzioni, A. (1961). A comparative analysis of complex organizations. Glencoe, NY: Free Press.
- Jaros, S. J., Jermier, J. M., Koehler, J. W. & Sincich, T. (1993). "Effects of continuance, affective and moral commitment on the withdrawal process: An evaluation of eight structural equation models", *Academy of Management Journal*, 36, 5, pp. 951-995.
- Kanter, R. M. (1968). "Commitment and social organization: A study of commitment mechanisms in utopian communities", *American Sociological Review*, 33, 4, pp. 499-517.
- Lee, S. & Olshfski, D. (2002). "Employee commitment and firefighters: It's my job", *Public Administration Review*, 62, SI, pp. 108-114.
- Lee, T. W. & Mitchell, T. R. (1991). "The unfolding effects of organizational commitment and anticipated job satisfaction on voluntary employee turnover", *Motivation and Emotion*, 15, 1, pp. 99-121.
- Locke, E. A. (1976). "The nature and causes of job satisfaction", In M. D. Dunnette (ed.), *Handbook of Industrial and Organizational Psychology*. New York: Wiley, pp. 1297 – 1351.

- Meyer, J. P. & Allen, N. J. (1997). *Commitment in the Workplace: Theory, Research and Application*. Thousand Oaks, CA: Sage Publications.
- Meyer, J. P., Allen, N. J. & Smith, C. A. (1993). "Commitment to organizations and occupations: Extension and test of a three-component conceptualization", *Journal of Applied Psychology*, 78, 4, pp. 538-551.
- Penley, L. E. & Gould, S. (1988). "Etzioni's model of organizational involvement: A perspective for understanding commitment to organizations", *Journal of Organizational Behavior*, 9, pp. 43-59.
- Reilly, C., Chatham, J., & Caldwell, D. J. (1991). People and organizational culture: A profile comparison approach to assessing person-organizational fit. *Academy of Management Journal*, 9, 487-516.
- Ross, C. E. & Wright, M. P. (1998). "Women's work, men's work, and the sense of control", *Work and Occupations*, 25, 3, pp. 333-355.
- Vandenberg, R. J. & Lance, C. E. (1992). Examining the causal order of job satisfaction and organizational commitment" *Journal of Management*, 18, 1, pp. 153-167.
- Wilson, B. & Laschinger, H. K. S. (1994). "Staff nurses' perception of job empowerment and organizational commitment: A test of Kanter's theory of structural power in organizations", *Journal of Nursing Administration*, 24, 4S, pp. 39-47.

Conceptualizing Service Structure

Harry Katzan, Jr.
Webster University, USA

This paper combines an ontological description of the subject of service with some early work on service collectivism, service duality theory, and collaboration. The notions of provider set, service set, and client set are introduced. The paper includes numerous examples and should be considered a working paper on the development of a theory of service.

KEYWORDS: Service collectivism, collaboration, duality theory, theory of service.

1. Introduction

At the operations level, the notion of service has been well developed as a provider/client interaction that co-creates value. The provider and client benefit from a service and resources are necessary to sustain a service event. The service object can be distinct from the client in the case where the object is something over which the client has social or legal responsibility. Similarly, the provider role can be subjugated to an artifact, such as an element of software or a tool of some genre. A service is a spatiotemporal event that requires explicit or implicit communication between the service participants. The roles of the provider and the client are complementary in the sense that both participants are required to instantiate a service.

1.1 Service Universe

A *service universe* is a collection of services under consideration at a given point in time by a person, group, organization, or even a society. A service universe is typically a set of services, organized in some fashion to achieve a discernable purpose, or exist as a disparate collection of temporal service events. There are alternate points of view on exactly what constitutes a service, as evidenced by the following list: (Katzan 2009)

1. An action performed by one person or group on behalf of another person, organization, or group.
2. A generic type of action, such as a medical service or a web service.
3. The process of performing some action classified as a service.
4. The result of an action – typically a change affecting an object or person.
5. The utility of a change affecting a person or object – the value proposition.
6. An organization behaving in a prescribed way to benefit or operate in the best interests of a person or group.
7. A promise, contractual agreement, or obligation to perform a specified action in the future as a response to a triggering event.
8. The deployment of service assets for the benefit of service participants, commonly regarded as provider and client.

Services can be viewed through two lenses: the global view and the local view. The *global view* refers to the notion of a system comprised of interacting and complementary components. One could consider the global view as an external service description, useful for determining how a collection of services functions in order to benefit various people, organizations, and business processes. The *local view* describes and delineates the steps in a distinct service process, emphasizing the service participants and the complementary roles they play in the service event. We are going to adopt a global view, for the most part, in this paper. (Katzan 2010)

1.2 Service Systems

A *service system* is a collection of resources, economic entities, and other services capable of engaging in and supporting one or more service events. Service processes may interact individually or they may be included in a service value chain. This is a recursive definition of a service system that would support the following modalities of

service operation: *tell me, show me, help me, and do it for me*. Service systems are inherently multidisciplinary, since a single service provider may not have the knowledge, skill, time, resources, and inclination to perform all of the steps in a service process and require the services of an additional or external service provider.

More specifically, a service system is an assembly of primary, secondary, and auxiliary service resources designed and synthesized to satisfy a well-defined social purpose; that purpose is to collectively engender a service. Service systems can be placed into explicit categories through a set of rigid descriptors that are systematically linked to underlying concepts. A service system is analogous to other real-world systems, such as missile systems, publishing systems, and computer systems, and does not include the object of the inherent functionality in order to exist from an ontological perspective. This point of view is adopted for identifying collections of services. There is a certain amount of affinity between a set of service providers, a set of services, and a set of clients. We are going to use this phenomenon to provide a basis for a theory of service.

It is possible to conceptualize service systems as falling into two quasi-distinct categories: singular service systems and connected service systems.

1.2.1 Singular Service System

A singular service system is a single purpose provider or group of providers that provides a singular service to a set of clients. Examples: (1) A doctor or group of doctors and secondary service providers that supplies a set of services, such as family medicine, to a set of patients; (2) A landscaping service that supplies developmental and maintenance service to a group of home owners; and (3) An auto maintenance group that supplies auto maintenance and repair services to a set of automobile customers.

1.2.3 Connected Service System

A connected service system is a hierarchical arrangement of service systems that possess a degree of connectedness through administrative control, shared infrastructure and resources, or a common set of clients. Examples: (1) A university that provides academic and social services to a set of students; (2) A newspaper that provides informational services to a set of readers; and (3) A governmental body that provides administrative, legal, and social services to a set of citizens.

1.3 Service Value Chain

A *service value chain* is a progression of activities adopted to materialize a service. Not all service resources perform functions that are specifically evident in a provider/client interaction. In fact, there are three major stages in a service value chain: service commitment, service production, and service delivery. We are going to collectively refer to the three stages as *service provisioning* and add a fourth component regarded as a service delivery vehicle.

1.3.1 Service Commitment

Service commitment is a guarantee by a principal to provide a set of actions that constitutes a service. A common example might be the promise of a mayor of a town to provide fire service to his constituents. (Ferrario and Guardino 2008, Katzan 2009) The principal can be an organization, such as a government, a medical group, an educational institution, a private service business, a consulting firm with a service-level agreement, and an ad hoc entity that provides service to other service entities. The committed service may not, and probably will not, be performed by the principal, who may rely on a service producer and an ensuing service provider known as a *service agent* to actually execute the service process. Thus, a service agent provides a service to the principal and to the service object. The service principal, producer, and provider may coincide or be distinct.

1.3.2 Service Production

Service production supports a service commitment by establishing service facilities, such as time, location, availability, infrastructure, provisioning, record keeping, and legal compliance and certification. The principle element in service production is maintenance of the service infrastructure, consisting of physical facilities,

operational procedures, satisfaction of legal requirements, competent provider provisioning, and dependable auxiliary service provisioning. (Alter 2008) Effective service production promotes service sustainability.

1.3.3 Service Delivery

In order for a service provider and a client to co-create a service event, there must be some degree of locality to the situation, in the sense that the client travels to the provider, the provider travels to the client, the client and provider execute the service event in a third-party location, or they communicate via some form of interactive device and its corresponding media. Time and location are key factors in service delivery that are summarized through a service DNA, which partitions the service domain into mutually exclusive service categories. (Katzan 2008b) Location is basic to service provisioning. When the client travels to the provider site, the location is termed a *service factory* and the client or the service object remain in the service factory for the duration of the service transaction. When the service object is left in the provider's facilities, the location is known as a *service shop*. The provider may travel to *client facilities*, as in the cases of custodial work or nursing care. With information service, the provider entity may reside in a remote facility and provide access through a service portal.

1.3.4 Service Delivery Vehicle

A service delivery vehicle is a conduit for providing a category of service, as in the examples of physician's assistant, practical nurse, computer software, or physical tool or artifact. Some economists feel that all products are essentially services, and that a product is a means of delivering the inherent service. The notion of a service delivery vehicle is a fundamental concept in modern economics. (Vargo and Akaka *op cit.*) An online computer facility that provides an information service is a service delivery vehicle, and an ATM or an airport check-in terminal is also a service delivery vehicle.

2. Service Collective

A *provider set* is a set of service systems designed to support a particular endeavor in its respective domain, such as a university, medical group, or even a newspaper. Each element in the set provides a service to a client. Associated with the provider set is a *client set* composed of elements that functions in a complementary manner with provider set elements to instantiate a service event. A service is an interaction between an element from the provider set and an element from the client set, represented as a mapping between the sets. A collection of the mappings is a *service set*. Accordingly, a *service collective* is a 3-tuple consisting of a provider set, a client set, and a service set, all of which can interact through an eclectic platform designed to sustain a unified service system.. A unified service system is created when a client set is combined with the provider and service sets, and the inherent process is called *unification*.

2.1 Rules of Engagement

The provider set typically supplies several kinds of services to the client set. All services in the service set are not provided by all providers in the provider set and are not received by all clients in the client set. A list of viable service engagements is divided into three categories: elementary forms, diverse forms, and temporal forms.

(Elementary Forms)

- A provider may supply service to one client.
- A provider may supply service to multiple clients.
- A client receives no service.
- A client may receive service from one provider.
- A client may receive service from multiple providers.

(Diverse Forms)

- A provider may supply different services to one client.
- A provider may supply different services to multiple clients.
- A client may receive different services from one provider.
- A client may receive different services from multiple providers.

(Temporal Forms)

- A provider may supply the same service to a client multiple times.
- A provider may supply the same service to multiple clients multiple times.
- A client may receive the same service from one provider multiple times.
- A client may receive the same service from multiple providers multiple times.

The extent to which a provider set can supply multiple services is a measure of its diversity. The extent to which a client can receive service from multiple providers in the same collective is a measure of its uniqueness.

2.2 Service Diversity

The *service diversity* of a provider set reflects the capability of the members of the set to provide multiple services. Consider the case of a consulting firm charged with the task of supplying services to a client. Individuals with diverse skills are needed. T-shaped individuals are required to establish a virtual workforce comprised of people with a wide range of skills with one or more major specialties. Two considerations are relevant: the diversity rank of each provider and the capability index for each service.

Clearly, each provider is an agent of the principal through its service commitment, and the quality of service (CoS) of each service engagement is a reflection of the efficacy of the workforce diversity management.

2.3 Service Partitioning

In many cases, the provider set is a connected service system that interacts through shared information to provide a service. Two forms are evident: flow and interactive. In a *flow system*, information is passed between service providers in a sequential basis. Adjacent providers are coupled to provide service delivery, where coupling reflects dependency and cohesion reflects stickiness. In an *interactive system*, a collection of providers interact on a needs basis to provide a service. Thus, the provider set can be viewed as a partitioned set in which service sections demonstrate coupling or cohesion. Thus, providers in different sections of a collective interact to enhance service provisioning and communicate about client services and services in general. Discrete services are usually transaction based, and collective services are commitment based.

2.4 Service Uniqueness and Mappings

The set of mappings between provider and service sets is conceptualized as the service set. Clearly, a mapping is a function, as in elementary set theory. (Biggs 2002) The mapping between the provider and service sets is denoted by:

$$\mathbf{S}: P \rightarrow C$$

The service (\mathbf{S}) assigns to each provider p in P an element c in C .

We are going to look at the elementary forms given previously in the section on rules of engagement and leave the diverse and temporal forms as research topics. In mathematical function theory, three forms are identified: surjection, injection, and bijection. With surjection, every element in C is a service interaction for at least one provider in P . With injection, every element in C is a service interaction for at most one provider in P . The relationship is a bijection if it is a surjection and an injection for all elements in P and C . So clearly, the second mapping, wherein a provider may supply service to multiple clients, does not exactly represent a mathematical function, unless a temporal form is established.

We are primarily interested in the bijection form that serves as the basis for the notion of service duality.

3. Service Duality

3.1 Introduction

Most transactions between entities in modern society involve services that adhere to the provider/client model. As an example, consider a medical example. A physician can be conceptualized as a person who executes the medical profession by keeping up with the discipline, interacting with colleagues, dealing with governing bodies, handling business needs, and providing services to patients. Without patients, however, the practice is not self-sustaining. There is a dependency between a doctor and a patient. The patient needs the doctor and the doctor needs the patient. Clearly, this is a form of service duality. The roles are not symmetrical, but the patient provides a reciprocal service to the doctor. Service duality is frequently associated with service collectivism. It is possible that all services possess a service duality.

3.2 Role Formalization

A *service collective* (SC) with provider set $P = \{p_1, p_2, \dots\}$ provides an **active** service (s_j) to a client set $C = \{c_1, c_2, \dots\}$ if the service is available so that an element of the client set can take advantage of it. A client (c_i) provides a **passive** service to P by participating in an active service from the service set $s = \{s_1, s_2, \dots\}$. Typically, the service collective provides several services to which the client can subscribe.

Each c_i must subscribe to at least one s_k in order to be affiliated with SC. Clearly, each provider entity is a agent of the service collective.

3.3 An Open question on Service Duality

An open question is, “Is the concept of service duality worth anything?” It would seem, on the surface, that the rewards often given to good customers is related to service duality in the sense presented thus far. It is possible that service duality is a form of exchangeable value in service.

4. Collaborative Services

4.1 Basic Ideas

Heretofore in this paper, the emphasis has been on a member of the provider set (p_i) supplying a service from the service set (s_j) to a member of the client set (c_k). A *collaborative service* exists when a provider set (P), as a whole, supplies a totality of services from the service set (S) to the complete client set (C). The basic idea is that collaboration requires total representation from the complete unified service system.

4.2 Elements of Collaboration

When service entities team up to achieve something, you have collaboration. The members of the team are called the *collaboration group*. In a collaboration group, the members team up to the common good or for a member of the group. Group formation is a key concept.

4.2.1 Ad Hoc Collaboration Group

In an ad hoc group, entities assemble dynamically a rule acquired through evolution or social custom. In a service sense, the members disband afterwards.

4.2.2 Permanent Collaboration Group

In a permanent group, entities coalesce on a “social need” basis. The entities do not disband afterwards.

4.3 Common Examples of Collaboration

In collaboration group operation, services are executed by the group and for the group. It would seem that collaboration services are common in natural and social forms of aggregation.

4.3.1 Animal Behavior

One of the most common forms of collaboration in nature occurs when animals (such as a pride of lions) team up to bring down an animal of prey (such as a giraffe). The collaboration group collectively benefits from the activity and disbands afterwards.

4.3.2 Early Families

In early families, everyone had a job. One person did the hunting and fishing. Another person took charge of the growing, cooking and household. Others did the chores and helped with the various tasks. The persons performed services for the common good and for themselves.

4.3.3. Social Events

In the execution of a concert or play, there are two collaboration groups: the performers and the audience. Both groups are required. Usually, the audience disbands afterwards, and performers do not disband in the same time domain. The audience and the performers coalesce for the common good and for their personal benefit.

4.3.4 Running Race

In a prototypical running race, there are two groups of participants: the event management team and the group of runners. Both groups are required, and they collaboratively execute the event. The event management team combines sponsors, suppliers, volunteers, and staff. The runners perform the following activities: travel to the event, pay the fees, and participate. In the most general sense, the two groups collaborate to stage the event.

4.4 Law of Service Collaboration

A service is something a service entity doesn't usually do for itself. When service entities collaborate, member of the group perform a task for the group. The basic law of service collaboration follows:

An entity performs a service for a group (of similar entities).
 That entity is a member of the group.
 Therefore, an entity performs a service for itself.
 [By the law of Modus Ponens]

Here is an example:

In an early society, the families in a community collaborate to build a barn for another family in the community. Perhaps, a fire has occurred. Assume every family in the community participates in the event. The men build. The women cook and talk. The boys and girls help. The community collaborates to build a barn for the receiving family that also participates in the activity. Of course, they would participate. Otherwise, the others would say, "Why should be work when they sit around and drink coffee?"

This is an example of self service and service duality.

5. Brief Summary

The paper presents some early steps to a theory of services by presenting some definitive information on service collectivism, duality theory, and collaboration. This should be considered a working paper on this important subject.

6. References

1. Alter, S. 2008. Service system fundamentals: Work system, value chain, and life cycle. *IBM System Journal*, 47(1): 71-85.
2. Biggs, N. 2002. *Discrete Mathematics*. Oxford and New York: Oxford University Press.

3. Ferrario, R. and N. Guardino. 2008. Towards an Ontological Foundation for Services Science. *Proceedings of the Future Internet Symposium*, Vienna Austria, 28-30 September 2008.
4. Katzan, H. 2008a. *A Manager's Guide to Service Science*. New York: iUniverse.
5. Katzan, H. 2008b. *Service Science: Concepts, Technology, Management*. New York: iUniverse.
6. Katzan, H. 2009. Principles of Service Systems: An Ontological Approach. *Journal of Service Science*, 2(2):35-52.
7. Katzan, H. 2010. Service Analysis and Design. *International Applied Business Research Conference*. Orlando, FL- January 4-6, 2010.
8. Sampson, S. and C. Froehle. 2006. Foundations and Implications of a Proposed Unified Services Theory. *Productions and Operations Management*, 15(2): 329-343.
9. Vargo, S. and M. Akaka. 2009. Service-Dominant Logic as a Foundation for Service Science: Clarifications. *Service Science*, 1(1):32-41.

Author Information

Professor Harry Katzan, Jr. is the author of books and papers on computer science, service science, cybersecurity, and terrorism. He teaches in the graduate program at Webster University.

FLEXIBLE FACILITY LOCATION-ALLOCATION DESIGN PROBLEM UNDER THE RISK OF DISRUPTIONS

Jae-Dong Hong, Industrial Engineering, South Carolina State University
Orangeburg, SC 29117, jhong@scsu.edu

ABSTRACT

Most of the conventional facility location-allocation (FLA) decision models assume that the facilities are always available or the demand is lost with facility disruption. Contrary to this conventional assumption, we introduce the concept of the backup/secondary facilities that can satisfy the demand, if the primal facility can't satisfy the demand due to its disruptions. We call it a flexible FLA (FFLA) model and consider two performance metrics, the total relevant costs and the expected number of demands satisfied/covered. Using a multi-objective programming model, we investigate the effect of the backup/secondary facilities on the FLA design problem using a case study.

INTRODUCTION

Traditionally, the facility location-allocation (FLA) problem has been a foundation for the efficient supply chain design. FLA decisions inherently consist of two kinds of decision plans. One is a strategic decision plan on the facility location, while the other one is an operational decision plan on the facility allocation. Daskin [8] emphasizes the importance of facility location problems by asserting in his recent book that *in short, the success or failure of both private and public sector facilities depends in part on the locations chosen for those facilities*. Facility allocation decisions are also as important as the facility location decisions to run supply chain network efficiently. As several recent review papers (see Snyder [15], Arabani et al. [2], and Farahani et al. [9]) on FLA imply, many authors have studied FLA problems by modeling them in various forms to answer to a lot of different questions since Cooper [3] initially set an FLA problem as a mathematical programming model and studied it.

Traditional FLA models consider an objective of minimizing the total logistics cost, such as the fixed cost of opening/using the facility plus the transportation or shipping cost. Some authors (Askin, Baffo, and Xia [1] and Manatkar, Kathick, Kumar and Tiwari [12]) consider also maintaining desired service level in addition to reducing the total logistics cost (TLC). Contrary to the most single-period FLA problem, Manzini and Gebennini [13] and Mantkar et al. [12] apply mixed integer programming optimization models to design and manage multi-period, multi-stage, and multi-commodity FLA problem. As many references cited in Current et al. [4], Daskin [5], Farahani et al. [8], and Fang and Li [7] indicate, many researchers have worked on multi-objective/criteria facility location-allocation (MOFLA) problems whose objectives sometimes conflict with each other in nature. However, many of those references ignored the disruption risks, which implies that facilities are always available (see Peng et al. [14]). Garcia-Herreros et al. [11] cite that a fire accident at the Philips microchip plant in Albuquerque, New Mexico, is one of the emblematic cases of supply chain network resilience. When the fire cut off the supply of a key component for cell phone manufacturers Nokia and Ericsson, Nokia's production lines were able to adapt quickly by using alternative suppliers, whereas Ericsson lost in revenue of \$400 million.

When the facilities are under the risk of disruptions, the expected number of demands satisfied/covered (ENDS) would be one of the most important performance measures. Thus, contrary to the conventional total cost minimization approaches, we will formulate FLA problem as the multi-objective programming (MOP) model with the objective of simultaneously maximizing ENDS and minimizing the total relevant cost (TRC).

When a specific facility becomes unavailable or shut down due to disruption, to enhance the flexibility of FLA schemes, other facilities instead of the initially assigned facility under disruptions would satisfy the demands of sites. We call the initially assigned facility to cover the demand points (DPs) as the primary distribution facility (PDF) and other facilities, which can cover the DP in the case of PDF being unavailable, as the backup/secondary distribution facilities (BDFs). This scenario of using BDFs obviously will increase the distribution cost, inventory holding cost, and transportation time in supplying items to the DPs. But it will increase ENDS and reduce the penalty cost incurred for unsatisfied demand. We add this flexibility to the conventional FLA model and call it a flexible facility location-allocation (FFLA) model.

In the next section, we provide a brief introduce to general FLA models with MOP with the minimax objective approach. Next, we apply our proposed FFLA model to a case study using an actual data in South Carolina (SC) to demonstrate the applicability of our approach and to show the benefits of our proposed FFLA model. The last section summarizes the proposed approach and research findings. It also provides recommendations for future research directions.

BACKGROUND

Combined FLA model with MOP with minimax objective approach

The following nomenclature is used:

Sets:

M : index set of potential facility sites ($j = 1, 2, \dots, M$ and $m = 1, 2 \dots M$)

Parameters:

b_j : minimum number of sites that facility j can cover

B_j : maximum number of sites that facility j can cover

c_{jm} : cost of shipping one unit of demand per mile from facility j to demand point m

C^{max} : maximum number of facilities can be built

CAP_j^{max} : capacity of facility j

d_{jm} : distance between facility j and site m

D_m : demand of site m

f_j : fixed cost for constructing and operating facility j

h_j : holding cost per item per unit time at facility j

L_j : replenishment lead time at facility j

S_j : ordering cost for facility j to place an order

u : unit penalty cost per unsatisfied demand

σ_m : standard deviation of demand per unit time at site m

Decision Variables:

C_j : binary variable deciding whether a facility is located at site j

y_{jm} : binary variable deciding whether site m is covered by facility j

In above nomenclature, facility j denotes the facility located at site j . We assume that a_{jm} and d_{jm} equal to zero if $j = m$ and that each facility follows an (r, Q) policy to maintain its inventory and carries a safety stock to maintain a desired service level of β .

Let us consider the first case (Case I) where only PDFs satisfy the demand. The total logistics cost, TLC_p , which has been the traditional objective of most FLA models, consists of the fixed cost of locating facilities, the transportation/shipping cost from PDFs to the DPs, cycle stock cost, and safe stock cost to maintain the desired service level of β , as shown below:

$$\begin{aligned} TLC_p &= [\text{fixed cost for facilities}] + [\text{shipping cost}] + [\text{cycle stock cost}] + [\text{safe stock cost}] \\ &= \sum_{j \in M} f_j C_j + \sum_{j \in M} \sum_{m \in M} D_m d_{jm} y_{jm} c_{jm} \\ &\quad + \sum_{j \in M} C_j \left[\sqrt{2S_j h_j \sum_{m \in M} D_m y_{jm}} + h_j z_\beta \sqrt{\sum_{m \in M} L_j \sigma_m^2 y_{jm}} \right]. \end{aligned} \quad (1)$$

To enhance facility's resilience, it would be important to locate facilities to the locations with the lowest probabilities of disruption if possible, so that the chances of facilities' being disrupted are minimized. We assume that if a facility is disrupted, it is shut down or unavailable, so it can't handle the supplies being delivered to the DPs. Letting p_j denotes the risk probability of facility's being disrupted, which is located at site j , we express the expected number of demands satisfied ($ENDS_p$) from PDFs as

$$ENDS_p = \sum_{j \in M} C_j (1 - p_j) \sum_{m \in M} (y_{jm} D_m), \quad (2)$$

Then, the total penalty cost for unsatisfied demand, TPC_p , is expressed as

$$TPC_p = u \left[\sum_{m \in M} D_m - \sum_{j \in M} (1 - p_j) \sum_{m \in M} D_m C_j * y_{jm} \right] \quad (3)$$

Let the total relevant cost (TRC) be the sum of the total logistics cost given (1) and the total penalty cost in (3), as shown below:

$$TRC_p = TLC_p \text{ in (1)} + TPC_p \text{ in (3)}. \quad (4)$$

Let the non-negative deviation variables, $\delta_{TRC_p}^+$ and $\delta_{ENDS_p}^-$, denote the amounts by which each value of TRC_p and $ENDS_p$ deviates from the minimum value of TRC_p , TRC_p^{Min} , and maximum values of $ENDS$, $ENDS_p^{Max}$, respectively. Then, the deviation variables are given by

$$\delta_{TRC_p}^+ = TRC_p \text{ in (4)} - TRC_p^{Min},$$

$$\delta_{ENDS_p}^- = ENDS_p^{Max} - ENDS_p \text{ in (2)}.$$

The formulation for MOFLA model with the minimax objective is given as follows:

$$\text{Minimize } Q = \text{Max} \left\{ \alpha_1^+ \frac{\delta_{TRC_p}^+}{TRC_p^{Min}}, \alpha_2^- \frac{\delta_{ENDS_p}^-}{ENDS_p^{Max}} \right\}. \quad (5)$$

subject to

$$\alpha_1^+ \frac{\delta_{TRC_P}^+}{TRC_P^{Min}} \leq Q, \quad (6)$$

$$\alpha_2^- \frac{\delta_{ENDS_P}^-}{ENDS_P^{Max}} \leq Q, \quad (7)$$

$$\sum_{j \in M} y_{jm} = 1, \quad \forall m \in M \quad (8)$$

$$\sum_{j \in M} C_j \leq C^{max}, \quad (9)$$

$$y_{jm} \leq C_j, \quad \forall j \text{ and } \forall m \in M \quad (10)$$

$$C_j \cdot b_j \leq \sum_{m \in M} y_{jm} \leq C_j \cdot B_j, \quad \forall j \in M \quad (11)$$

$$\sum_{m \in M} D_m y_{jm} \leq CAP_{j(P)}^{max} \cdot C_j, \quad \forall j \in M \quad (12)$$

Let ES_P^ω denote the efficiency score (ES) for the ω^{th} option generated by solving the MOPs, where $\omega = 1, 2, \dots, \Omega$. Then, by definition, ES_P^ω is given by

$$ES_P^\omega = \frac{ENDS_P^\omega}{TRC_P^\omega}. \quad (13)$$

For the maximum efficiency score to be equal to one (1.000), we use normalized efficiency score (NES) as follows:

$$NES_P^\omega = \frac{ES_P^\omega}{\text{Max}_{\kappa \in \{1, \dots, \Omega\}} ES_P^\kappa}. \quad (14)$$

Now, let us consider the second case (Case II) where BDFs can cover the DP when the PDF is disrupted. We assume that a BDP can cover the site if the site is located within the maximum coverage distance (MCD). Letting D^c denote the MCD, we define the indicator parameters, a_{jm} , as

$$a_{jm} = \begin{cases} 1, & \text{if } d_{jm} \leq D^c \\ 0, & \text{if not} \end{cases} \quad (15)$$

Here we assume that all backup shipping costs from BDFs to DPs will be the product of maximum unit shipping cost per mile and MCD, $D^c * c_{.m}$, where $c_{.m} = \max\{c_{jm}\}, \forall j$. It is an emergency backup supply, so the shipping cost would be expected to be higher than the regular shipping cost from PDFs, $d_{jm} * c_{jm}$. In fact, the backup shipping cost is an upper bound of the regular shipping cost. Now, we add the extra inventory cycle cost, which is expressed as

$$EXICC = \sum_{j \in M} C_j \left[\sqrt{2S_j h_j \sum_{m \in M} D_m a_{jm} (1 - y_{jm})} \right]. \quad (16)$$

The expected value of shipping/distribution cost is

$$ESDC_T = \sum_{j \in M} q_j \left[\sum_{m \in M} D_m d_{jm} y_{jm} c_{jm} \right] + \sum_{m=1}^M (D^c * c_{\bullet m}) ENDS_B^m. \quad (17)$$

The total logistics cost for Case II, TLC_T , is given by

$$\begin{aligned} TLC_T = & [\text{fixed cost for facilities in (1)}] \\ & + [ESDC_T \text{ in (17)}] + [\text{cycle stock cost in (1)} + EXICC \text{ in (16)}] \\ & + [\text{safe stock cost in (1)}]. \end{aligned} \quad (18)$$

Thus, the total relevant cost for Case II, TRC_T is expressed as

$$TRC_T = TLC_T \text{ in (18)} + TPC_T (\text{see Hong [10]}), \quad (19)$$

The ES and normalized ES for Case II are similarly given like in (13) and (14). In addition, the following inequality for the extra capacity should hold for this case:

$$\sum_{m \in M} D_m a_{jm} (1 - y_{jm}) \leq CAP_{j(B)}^{max} \cdot C_j. \quad (20)$$

Let B'_j denote the maximum number of sites that facility j as a BDF can cover, the following inequality should also hold for Case II:

$$\sum_{m \in M} C_j a_{jm} (1 - y_{jm}) \leq B'_j. \quad (21)$$

CASE STUDY AND OBSERVATIONS

The MOP model can be solved by a variety of optimization software packages, such as LINDO, LINGO, or GAMS. We use spreadsheet modeling, since Microsoft Excel spreadsheet-based optimization modeling has become so popular. Several powerful software packages based on the Excel spreadsheet model, such as Solver, What's Best!, CPLEX, etc., make spreadsheet-based modeling more attractive. In this paper, Excel Analytic Solver Platform is used to solve the proposed MOP model.

To demonstrate the applicability of the mathematical models and the framework presented, we conduct a case study using major disaster declaration records in South Carolina (SC). Historic flooding tore through SC in October 2015 when numerous rivers burst their banks, washing away roads, bridges, vehicles, and homes. Hundreds of people required rescue and the state's emergency management department urged everyone in the state not to travel. The Federal Emergency Management Agency (FEMA) opened disaster recovery centers (DRCs) in several SC counties to help SC flood survivors. We use the problem of locating DRCs in SC as our case study. Forty-six (46) counties are clustered based on proximity and populations

into twenty counties. Then, one city from each clustered county based on a centroid approach was chosen. We assume that all population within the clustered county exists in that city. The distance between these cities is considered to be the distance between counties. We assume that when a major disaster is declared, the DRC in that county can't function due to the damaged facility and supply items and closed or unsafe roads and highways. Based on the historical record from FEMA database and the assumption, the risk probability for each site (a county or a clustered county) is calculated. See Hong [10] for details. For the case study, we hypothetically pre-determine and list the input parameters in Table 1.

Using Excel Analytical Risk Solver Platform, we solve the MOP model for various values of α , where each weight changes between 0 and 1 with an increment of 0.01. There are 101 configurations arising out of the combinations of the setting of α . After 101 runs, we reduce 101 configurations into 21, 13, 13, and 12 consolidated configurations for $u = \$10.00$ and $\$15.00$, respectively, based on the values of the performance measures. In Table 2, we report those configuration schemes, along with the set of weights, $\alpha = (\alpha_1^+, \alpha_2^-)$ and the values of several performance values explained in the previous section, TRC, ENDS, ES, and PSDT, for each case. For example, the FLA scheme #18 in Case I for $u = \$0.00$ is generated by solving the MOP model with weight values ranging from $\alpha = (0.86, 0.14)$ to $\alpha = (0.93, 0.07)$. Indeed, this scheme turns out to be the most efficient one with ES_p^{18} of 0.136 when backup supply is not allowed. To see the effects of backup supply which allows BDFs to cover the unsatisfied demands due to the disrupted PDFs, we compute the corresponding values of performance measures for Case II. If backup supply from BDFs is allowed, the scheme #21 rather than #18 becomes the most efficient one in Case II, yielding a higher TRCs but also a higher ENDS than #18 in Case I and a same ENDS, but a lower TRC than #18 in Case II. We observe that when the unit penalty cost is zero or negligible, there is no need for backup supply unless ENDS really matters, since the scheme #18 in Case I yields the highest ES of 0.136, whereas #21 in Case II yields 0.132 as ES.

TABLE 1. INPUT DATA USED FOR THE CASE STUDY

Symbol	Meaning	Value
b_j	A minimum number of sites that DRC j as a PDF can cover	2, $\forall j$
B_j	A maximum number of sites that DRC j as a PDF can cover	7, $\forall j$
B'_j	A maximum number of sites that DRC j as a BDF can cover	7, $\forall j$
c_{jm}	Cost of shipping one unit of demand per mile from DRC j to site m	$\$0.10$, $\forall j$ and m
C^{max}	Maximum number of DRCs to be built	5
$CAP_{j(B)}^{max}$	Extra Capacity for BDF j in addition to $CAP_{j(P)}^{max}$	1,000, $\forall j$
$CAP_{j(P)}^{max}$	Capacity for PDF j	1,500, $\forall j$
D^c	Maximum distance that a facility covers a DP as a BDF	97 miles
h_j	Holding cost per item per unit time at DRC j	$\$5.00$, $\forall j$
L_j	Replenishment lead time at DRC j	0.01, $\forall j$
S_j	Ordering cost for DRC j to place an order	$\$500.00$, $\forall j$
u	Unit penalty cost for the unsatisfied demand	$\$0.00$, $\$5.00$, $\$10.00$, $\$15.00$
β	Desired service level for all DRCs	0.95
σ_m	Standard deviation of demand per unit time at site m.	10K, $\forall m$

As the unit penalty cost increases, the effect of backup supply by BDFs on the performance measures becomes significant. For example, when $u = \$0.00$, all the schemes in Case II yield higher TRCs than those in Case I, i.e., $TRC_T > TRC_P, \forall \omega$. As u increases, the number of schemes with $TRC_T < TRC_P$ increases. In terms of the efficiency score (ES), we observe that the effect of backup supply by BDFs becomes evident

as the unit penalty cost, u , increases. Thus, if the unit penalty cost is significant, it seems that the proposed FFLA schemes with backup supply are more efficient than the FLA schemes without backup supply.

In Figure 1, we depict the DRC location-allocation for the most efficient schemes for each case. In Figure 1, a solid arrow line represents the distribution from a PDF to a site while a green dashed arrow line represents the distribution from an BDF to a site if the PDF is disrupted. For $u = \$10.00$ or $\$15.00$, the two efficient schemes select four common locations for DRCs, {Beaufort, Conway, Greenville, Lexington}. The efficient schemes in Case I select {Anderson} as the fifth DRC, whereas the scheme #13 in Case II selects {Charleston}. We see that DRC {Charleston} in Case II covers sites {Charleston, Moncks Corner} that DRC {Beaufort} covers in Case I. In addition, sites {Anderson, McCormick, Greenwood, Spartanburg} are covered by DRC {Greenville} in Case II, where the three sites {Anderson, Greenwood, McCormick} are covered by DRC {Anderson} in Case I. Another difference between Case I and Case II is that a site {Florence} is covered by DRC {Conway} and backed by DRC {Lexington} in Case II rather than a DRC {Lexington} in Case I. For Case II, PDF {Lexington} will serve as a BDF for seven sites. Note that some sites are backed up more than one BDF. For example, the sites {Hampton, Moncks Corner, Orangeburg, Walterboro} are covered more than one BDF. For an example, for $u = \$10.00$ or $\$15.00$, a site {Orangeburg} is covered by PDF {Beaufort} and by BDFs {Charleston} and {Lexington}. An interesting observation is that DRCs {Beaufort} and {Columbia} cover each other as BDFs. We observe that the sites {Anderson, Columbia, Aiken, Georgetown, Bennettsville} are not covered by any BDFs due to either the constraint of extra capacities for BDFs or the constraint of the maximum coverage distance (MCD), or both. In this case example, an extra capacity for BDF j , $CAP_{j(B)}^{max}$, for all j , is 1,000 (in thousands) and the MCD that any BDF can feed, D^c , is 97 miles. For example, BDF {Lexington} could feed a site {Anderson} rather than {Spartanburg}, since the demand of {Anderson} is greater than that of {Spartanburg} and the extra capacity of {Lexington} is enough to feed {Anderson}. But the distance between {Lexington} and {Anderson} is 121 miles, which exceeds D^c of 97 miles. If the constraints of D^c and $CAP_{j(B)}^{max}$ are relaxed, a BDF {Lexington} could feed both {Anderson} and {Spartanburg}.

SUMMARY AND CONCLUSIONS

In this paper, we study a facility location-allocation (FLA) design problem under the risk of disruptions. We consider two major performance metrics: the total relevant cost (TRC) and the expected number of demands satisfied/covered (ENDS). The TRC consists of the fixed cost of locating facilities, the transportation cost, cycle stock cost, safe stock cost, and the penalty cost for unsatisfied demand. The efficiency score is defined to be the ratio of ENDS to TRC. We develop a multi-objective programming (MOP) model for the FLA problem, taking these two performance metrics into consideration simultaneously.

To enhance the flexibility of facility in FLA problem, we propose that the backup/secondary distribution facility (BDF) would cover the demand points if the primary distribution facility (PDF) is unavailable or shut down due to disruptions. Through the case study using actual major disaster records in South Carolina, we demonstrate the applicability of our proposed flexible FLA (FFLA) approach. From the numerical results, we observe that the FFLA approach performs well in terms of reducing the TRC and increasing ENDS simultaneously, and consequently yielding the higher efficiency scores. The proposed FFLA model would help decision makers design and select more efficient FLA schemes.

As shown in the case study, some sites are backed up by more than one facility, whereas some other sites are not backed up by any facility. For future research, it would enhance this research to consider a different backup supply approach where all of the sites are backed up at least one facility. It would be interesting to include other goals, such as minimizing the maximum coverage distance such that each site is covered by

one of the facilities within the endogenously determined distance and minimizing the maximum demand-weighted coverage distance.

REFERENCES

- [1] Askin, R. G., Baffo, I. and Xia, M. "Multi-Commodity Warehouse Location and Distribution Planning with Inventory Consideration." *International Journal of Production Research*, 2014, 52(7), 1897-1910.
- [2] Arabani, A. B. and Farahani, R. Z. "Facility Location Dynamics: An Overview of Classifications and Applications." *Computers & Industrial Engineering*, 2012, 62, 408-420.
- [3] Cooper, L. "Location-Allocation Problem." *Operations Research*, 1963, 11(3), 331-344.
- [4] Current, J., Min, H. and Schilling, D. "Multi-Objective Analysis of Facility Location Decisions." *European Journal of Operational Research*, 1990, 49 (3): 295-307.
- [5] Daskin, M.S. 2008. "What You Should Know About Location Modeling." *Naval Research Logistics*, 2008, 55(4), 283-294.
- [6] Daskin, M.S. *Network and Discrete Location: Models, Algorithms, and Applications*. 2nd Ed, New York: John Wiley, 2013.
- [7] Fang, L. and Li, H.C. "Multi-criteria Decision Analysis for Efficient Location-Allocation Problem Combining DEA and Goal Programming." *RAIRO-Operations Research*, 2015, 49(4), 753-772.
- [8] Farahani, R. Z. and Hekmatfar, M. *Facility Location: Concepts, Models, Algorithms and Case Studies*, Berlin: Springer-Verlag, 2009.
- [9] Farahani, R. Z., SteadieSeifi, M. and Asgari, N. "Multiple Criteria Facility Location Problems: A Survey." *Applied Mathematical Modelling*, 2010, 34 (7): 1689-1709.
- [10] Hong, J.D. "Efficient Facility Location-Allocation Design Problem with Facility Disruptions." *Working Paper #17-002*, Industrial Engineering Program, South Carolina State University, Orangeburg, SC, 2017.
- [11] Garcia-Herreros, P., Wassick, J. M. and Grossman, I.E. "Design of Resilient Supply Chains with Risk of Facility Disruptions." *Industrial & Engineering Chemistry Research*, 2014, 53(44), 17240-17251.
- [12] Manatkar, R.P., Karthik, K., Kumar, S. K. and Tiwari, M. K. "An Integrated Inventory Optimization Model for Facility Location-Allocation Problem." *International Journal of Production Research*, 2016, 54(12): 3640-3658.
- [13] Manzini, R., and Gebennini, E. "Optimization Models for the Dynamic Facility Location and Allocation Problem." *International Journal of Production Research*, 2008, 46(8): 2061-2086.
- [14] Peng, P., L. Snyder, V., Lim, A. and Liu, Z. "Reliable Logistics Networks Design with Facility Disruptions." *Transportation Research Part B*, 2011, 45, 1190-1211.
- [15] Snyder, L.V. "Facility Location Under Uncertainty: A Review." *IIE Transactions*, 2006, 38, 537-554.

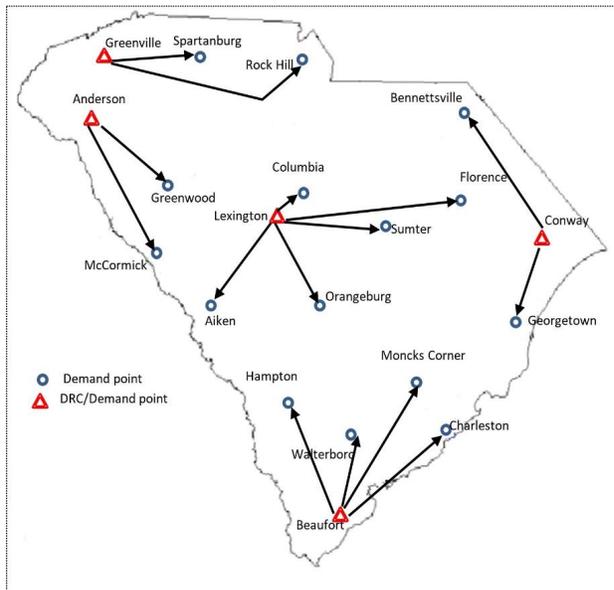
TABLE 2. NUMERICAL RESULTS

Unit Penalty Cost (u) = \$10.00										
Scheme	α_1^+	α_2^-	Case I				Case II			
			TRC_P	$ENDS_P$	NES_P^ω	ES_P^ω	TRC_T	$ENDS_T$	NES_T^ω ()	ES_T^ω
1	0.00	1.00	\$43,694.87	3727.08	0.881	0.085	\$42,411.51	3935.80	0.862	0.093
2	0.01	0.99	\$42,284.78	3727.08	0.911	0.088	\$41,252.06	3935.80	0.886	0.095
3	0.03	0.97	\$42,021.93	3711.70	0.912	0.088	\$40,942.30	3935.80	0.892	0.096
4	0.06	0.94	\$41,930.57	3694.83	0.910	0.088	\$40,841.91	3935.80	0.895	0.096
5	0.17	0.83	\$39,920.52	3610.83	0.934	0.090	\$38,603.14	3783.61	0.910	0.098
6	0.2	0.8	\$39,970.48	3610.83	0.933	0.090	\$39,147.46	3907.86	0.927	0.100
7	0.24	0.76	\$39,086.76	3609.27	0.954	0.092	\$38,219.94	3907.86	0.949	0.102
8	0.28	0.72	\$37,918.68	3607.60	0.983	0.095	\$37,565.77	3907.86	0.966	0.104
9	0.38	0.62	\$37,212.69	3602.40	1.000	0.097	\$37,206.49	3907.86	0.975	0.105
10	0.56	0.44	\$37,025.45	3560.21	0.993	0.096	\$37,143.59	3907.86	0.977	0.105
11	0.68	0.32	\$36,574.78	3506.39	0.990	0.096	\$36,514.89	3852.15	0.979	0.105
12	0.79	0.21	\$35,989.03	3473.10	0.997	0.097	\$35,863.30	3852.15	0.997	0.107
13	0.96	0.04	\$35,873.82	3461.48	0.997	0.096	\$35,763.08	3852.15	1.000	0.108

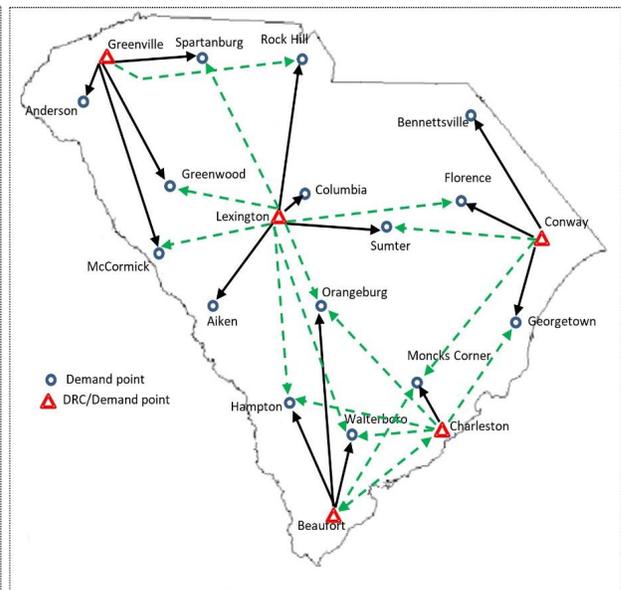
Unit Penalty Cost (u) = \$15.00										
Scheme	α_1^+	α_2^-	Case I				Case II			
			TRC_P	$ENDS_P$	NES_P^ω	ES_P^ω	TRC_T	$ENDS_T$	NES_T^ω	ES_T^ω
1	0.00	1.00	\$47,539.48	3727.08	0.907	0.078	\$45,212.53	3935.80	0.881	0.087
2	0.01	0.99	\$46,129.39	3727.08	0.935	0.081	\$44,053.08	3935.80	0.904	0.089
3	0.04	0.96	\$45,943.41	3711.70	0.935	0.081	\$43,743.32	3935.80	0.911	0.090
4	0.22	0.78	\$45,690.34	3610.83	0.914	0.079	\$43,262.56	3783.61	0.885	0.087
5	0.23	0.77	\$44,346.38	3610.83	0.942	0.081	\$42,165.11	3783.61	0.908	0.090
6	0.3	0.7	\$43,520.40	3609.27	0.960	0.083	\$42,088.17	3907.86	0.940	0.093
7	0.37	0.63	\$42,360.67	3607.60	0.985	0.085	\$41,160.65	3907.86	0.961	0.095
8	0.52	0.48	\$41,680.70	3602.40	1.000	0.086	\$40,506.48	3907.86	0.976	0.096
9	0.76	0.24	\$41,704.38	3560.21	0.988	0.085	\$40,084.30	3907.86	0.987	0.097
10	0.83	0.17	\$41,522.83	3506.39	0.977	0.084	\$39,734.13	3852.15	0.981	0.097
11	0.86	0.14	\$41,103.52	3473.10	0.978	0.084	\$39,082.54	3852.15	0.997	0.098
12	0.99	0.01	\$41,046.43	3461.48	0.976	0.084	\$38,982.32	3852.15	1.000	0.099

FIGURE 1: EFFICIENT DRC LOCATION-ALLOCATION NETWORKS

(Scheme #9 in Case I for $u = \$10.00$)
 (Scheme #8 in Case I for $u = \$15.00$)



(Scheme #13 in Case II for $u = \$10.00$)
 (Scheme #12 in Case II for $u = \$15.00$)



HOW THE PRACTICE OF OPTIMIZATION EXTENDS BEYOND THE DECISION SCIENCES

Richard Martin, Coastal Carolina University; Jay Teets, Virginia Tech; Richard Monroe,
Longwood University

ABSTRACT

This paper began from a request to present an overview of what optimization is (from the view of decision sciences), its role and how businesses use optimization practices. It was quickly realized that that might be a dry subject for creating student interest in enrolling in an optimization course. What evolved was a review of how optimization practices and philosophies have migrated beyond the domain of Operations Research and are applied to other business fields often under different names. This paper will attempt to trace this expansion of OR concepts into current business practices and highlight how business has benefited from the mathematical and conceptual world of traditional Operations Research being applied in operations management roles.

Keywords: optimization, quality, TOC

INTRODUCTION

Operations Research can be described as the application of advanced analytical methods to help make better decisions. The general business employee or employer probably is not aware of how some of the tenets in their world's day-to-day business were borrowed or influenced by the developments of OR whose beginnings are traced back to 1936 with the British Government's effort to develop radar technology [1]. Some researches point to Archimedes' studies employing empirical data and mathematics in developing defenses for the Roman siege to Syracuse in 213 B.C.[2] as OR first application. By the 1950's, OR had established itself as a profession that utilized mathematical concepts that lead to the beginnings of linear programming, inventory theory, search and queuing theory [1]. Much of the focus on OR in its earlier application was in optimization of resources due to material shortages during WWII. Worker and process efficiency were equally important. Sequential analysis was developed in response to the practices of quality control inspectors. [1] At the end of World War II, a number of British operations research workers moved to government and industry and took with them this focus on operational efficiency. Nationalization of several British industries; coal production, electricity generation and transportation benefited from this transfer of the military focus to the civilian [3]. Objectives of decision sciences would include;

- a. Decision making and the quality of that decision
- b. Determining an optimum solution
- c. Minimization of cost or maximization of profit
- d. Improvements in productivity
- e. Improving the objectivity of an analysis.

Today, operations research plays important roles in a variety of industries such as:

- a. airline - scheduling planes and crews, ticket prices, reservations, and fleet size,
- b. pharmaceuticals - R& D management,
- c. logistics companies - routing and planning,
- d. local government – location and deployment of emergency services, and
- e. regulation - environmental pollution, and air traffic.

The results of OR are apparent in numerous industrial applications.

1. With the Japanese entrance into the US auto market, their ability to compete was supported by practices termed JIT (Just in Time) which reduced the need for large inventories thus reducing cost and optimizing that process. The full practices of JIT became Lean management and further reduced inventories with the use of Kanban's.
2. Job shop sequencing optimized the process of material through a series of machines / people /processes determining which sequencing rule would provide the total shortest processing time or would best match a promised delivery date.
3. Network routing is the process of selecting paths through a production process with a goal of congestion reduction, and transporting material in the most efficient method possible. It concept has expanded with the digital age and the movement of data packets across the internet.
4. Transportation routing involves designing the most efficient route to move material from point to point. It often considers how material is packaged and varies by transport mode.
5. Queuing theory is a mathematical study in lines considering the arrival of items into the line and the ability of that line to process the arriving items with a focus of cost reduction to process the items. It is affected by both internal and external factors.
6. Numerical analysis and simulation in wearing parts replacement to determine the optimum time to replace parts to maximize usage but to avoid unexpected part failure.

7. Theory of Constraints developed by Eliyahu Goldratt in his book “The Goal” considers a process of sequential steps to determine which step blocks increase production through the total process.
8. The focus on product, process and service quality is closely associated with the JIT and Lean philosophies. Quality supports the implementation of both JIT and Lean by focusing on the material, machines, workers ability to deliver the required quantity with no waste as in scrap, rework or excess inventory.
9. Yield management as applied to scheduling airline passengers to maximize each flight for an airline or the maximize hotel booking. Price reduction or product promotion is applied to fill each seat or room at some price.

To be further developed

REFERENCES

1. History of OR: Useful history of operations research, William Thomas, <https://www.informs.org/ORMS-Today/Public-Articles/June-Volume-42-Number-3/History-of-OR-Useful-history-of-operations-research>, download 6/15/17
2. <http://alphanumericjournal.com/article/historical-development-of-operations-research-and-its-features/>
3. Encyclopedia Britannica <https://www.britannica.com/topic/operations-research/History>

Exploring the Fragility Approach for Assessing the Results of Tests Involving Counts and Proportions

C. Clinton Harshaw
Presbyterian College
charshaw@presby.edu

Clay E. Harshaw
Winston-Salem State University
harshawce@wssu.edu

October 2017

Introduction

A statistical test of hypothesis is often used to assess differences in a dichotomous outcome based on a dichotomous categorical variable. The results of the test are typically measured using a p -value, which is the value associated with the probability of observing values in the 2×2 table which are at least as contradictory to a null hypothesis of independence as that which was observed. There are, however, issues related to the study which the p -value fails to capture. The reported p -value does not provide an indication of the sizes of the sampled groups. Results which are deemed statistically significant may not be of meaningful importance. The reliance on traditional significance levels as an *a priori* cut-point can lead the investigator to very difference conclusions for very small differences in p -value. Statistically significant results may be very “fragile” to the number of units in each of the two groups. That is, if the outcome of a few members of one group is changed from one outcome status to the other outcome status, the study is no longer statistically significant. The Fragility Index, proposed by Walsh, *et al.*, is a metric defined as the minimum number of subjects within a group whose status is needed to change from non-event to event in order for the test to lose significance. There is increasing research and advocacy for the use of the Fragility Index along with the p -value when reporting on the results of a test. However, the Fragility Index, as proposed by Walsh *et al.*, is limited to the standard treatment-control 2×2 randomized control trial. This research investigates an extension of the Fragility Index approach to other common scenarios involving hypothesis testing that involves counts or proportions. We advocate for the inclusion of fragility in Business Statistics classes.

Background and Literature Review

The American Statistical Association[5] advocates, among its principles, “Scientific conclusions and business or policy decisions should not be based only on whether a p -value passes a specific threshold.” They go on to write, “ p -values alone cannot ensure that a decision based on that p -value are going to be correct or incorrect.” Additionally, Wasserstein, *et al.*[5] declare that the p -value alone does not provide a good measure of evidence for or against a model or hypothesis. Context and additional evidence is needed. As Greenland, *et al.*[3] noted, “There are no interpretations of these concepts that are at once simple, intuitive, correct, and foolproof.” While alternative investigative strategies, such as estimation of confidence or prediction intervals, are suggested, we propose including the addition of an approach analogous to Walsh’s Fragility Index in testing protocols involving counts and proportions.

When running regression diagnostics, Cook’s[1] D developed a metric to assess the influence of single observations on the computed regression coefficients. Cook’s D is computed by re-running the regression

without individual observations and measuring how much the resulting regression coefficients change. High values of Cook's D mean the observation bears further investigation as to the nature of the influence.

Feinstein[2] proposed a metric, the Unit Fragility Index, as a supplement to the comparison of two binomial proportions which result in statistical significance. A 2×2 table showing the dichotomous outcomes by two samples would be of the form:

	Event	Non-Event	Totals
Sample 1	a	b	$n_1 = a + b$
Sample 2	c	d	$n_2 = c + d$
Totals	$a + c$	$b + d$	$N = n_1 + n_2$

The probability of observing the event of interest by conditioning on the sample is then:

$$p_1 = P(\text{Event}|\text{Sample 1}) = \frac{a}{n_1} \qquad p_2 = P(\text{Event}|\text{Sample 2}) = \frac{c}{n_2}.$$

Define $e = p_1 - p_2$. If we fix the row marginals, and change the outcome status of one subject in Sample 1 from non-event to event of interest, and the outcome status of one subject in Sample 2 from event to the non-event result, then we have the following table:

	Event	Non-Event	Totals
Sample 1	$a + 1$	$b - 1$	$n_1 = a + b$
Sample 2	$c - 1$	$d + 1$	$n_2 = c + d$
Totals	$a + c$	$b + d$	$N = n_1 + n_2$

The new probability of observing the event of interest by conditioning on the sample will be:

$$p'_1 = P(\text{Event}|\text{Sample 1}) = \frac{a + 1}{n_1} \qquad p'_2 = P(\text{Event}|\text{Sample 2}) = \frac{c - 1}{n_2}.$$

Compute $e' = p'_1 - p'_2$, the difference in conditional probabilities of event status among each of Sample 1 and Sample 2. Feinstein's Unit Fragility Index, denoted f , is then taken to be:

$$\begin{aligned} f &= e' - e \\ &= (p'_1 - p'_2) - (p_1 - p_2) \\ &= \left(\frac{a + 1}{n_1} - \frac{c - 1}{n_2} \right) - \left(\frac{a}{n_1} - \frac{c}{n_2} \right) \\ &= \frac{a + 1 - a}{n_1} - \frac{c - 1 - c}{n_2} \\ &= \frac{1}{n_1} + \frac{1}{n_2} \\ &= \frac{n_1 + n_2}{n_1 n_2} \\ &= \frac{N}{n_1 n_2}. \end{aligned}$$

Feinstein[2] also considered the unit decrement, which results in a value of $f = -\frac{N}{n_1 n_2}$. The resulting Unit Fragility index, as proposed by Feinstein[2] is of the form:

$$|f| = \frac{N}{n_1 n_2}$$

Thus Feinstein's Unit Fragility Index may be considered to be "excess fraction" that a one subject increase (or decrease) in positive events from Sample 1 with a corresponding unit decrease (or increase) in positive event outcome from Sample 2.

For a given total sample size, N , the values of n_1 and n_2 may be determined such that Feinstein's Unit Fragility Index, $f(n_1, n_2) = \frac{N}{n_1 n_2}$ is minimized, and the resulting minimum Unit Fragility Index computed.

Since $n_1 + n_2 = N$, we have $n_2 = N - n_1$ reducing our Unit Fragility Index to a function of one variable only:

$$f(n_1) = \frac{N}{n_1(N - n_1)}.$$

Differentiating with respect to n_1 we have:

$$\begin{aligned} f'(n_1) &= -N [n_1(N - n_1)]^{-2} (N - 2n_1) \\ &= \frac{-N(N - 2n_1)}{[n_1(N - n_1)]^2}. \end{aligned}$$

Setting $f'(n_1) = 0$ we have:

$$\begin{aligned} \frac{-N(N - 2n_1)}{[n_1(N - n_1)]^2} &\stackrel{set}{=} 0 \\ N(N - 2n_1) &= 0 \\ N &= 2n_1 \\ \therefore n_1 = n_2 &= \frac{N}{2}. \end{aligned}$$

Next, investigate the second derivative of $f(n_1)$ to determine the nature of concavity of the fragility function:

$$\begin{aligned} f''(n_1) &= \frac{[n_1(N - n_1)]^2 \cdot \frac{d}{dn_1}[-N(N - 2n_1)] + N(N - 2n_1) \cdot \frac{d}{dn_1}\{[n_1(N - n_1)]^2\}}{[n_1(N - n_1)]^4} \\ &= \frac{2N[n_1(N - n_1)]^2 + N(N - 2n_1)2n_1(N - n_1)(N - 2n_1)}{[n_1(N - n_1)]^4} \\ &= \frac{2N[n_1(N - n_1)]^2 + N(N - 2n_1)^2 2n_1(N - n_1)}{[n_1(N - n_1)]^4} > 0; \forall n_1, N \end{aligned}$$

Thus, an investigation of Feinstein's Unit Fragility Index, f , provides us with additional reason to strive for balanced designs, since f is minimized when the study is balanced with equal sample sizes, and the resulting minimum f is computed to be:

$$\min f = \frac{N}{\frac{N}{2} \cdot \frac{N}{2}} = \frac{4}{N}$$

While Feinstein's Unit Fragility Index has appeal when comparing the fragility of 2×2 table analyses based solely on the total sample size and the size of each of the two groups, the value of f fails to make use of the individual table entries, a, b, c, d .

In contrast to Feinstein's Unit Fragility Index, Walsh, *et al.*[4] defined the use of a Fragility Index in randomized controlled trials to convey how many subjects' outcome status would be required for a statistically significant study to lose its statistical significance. The Fragility Index defined is based on a randomized controlled trial¹ as follows:

	Event	Non-Event	Totals
Sample 1	a	b	$a + b$
Sample 2	c	d	$c + d$

Holding the row marginals fixed, the Fragility Index is the minimum number of subjects in the smallest event group to have a switched outcome status for the study to lose significance. That is, the Fragility Index is the minimum non-negative integer value of f so that a previously statistically significant study with a $p < 0.05$ will result in a $p \geq 0.05$, and a loss of statistical significance.

	Event	Non-Event	Totals
Sample 1	$a + f$	$b - f$	$a + b$
Sample 2	c	d	$c + d$

Consider the following two motivating examples of 2×2 tables provided by Walsh[4]. In the first study, there is one subject from Sample 1 (i.e. a treated patient) experiencing the event outcome, while among the subjects in Sample 2 (i.e. the placebo group), 9 of 100 subjects experienced the event outcome.

	Event	Non-Event	Totals
Sample 1	1	99	100
Sample 2	9	91	100

The p -value for this study using Fisher's Exact Test will be $p = 0.02$, which is statistically significant using the typically chosen $\alpha = 0.05$. However, if the status of only one subject from Sample 1 changes from non-event to event, the study's resulting p -value of $p = 0.06$ is no longer significant at $\alpha = 0.05$. This study is said to have a Fragility Index of 1, meaning if only one patient has a switched outcome status from non-event to event, the study will lose its statistical significance.

	Event	Non-Event	Totals
Sample 1	$1 + 1 = 2$	$99 - 1 = 98$	100
Sample 2	9	91	100

A second study with 200 of 4000 treated patients experiencing the event outcome and 250 of 4000 control patients experiencing the event outcome is considered. Again using Fisher's Exact Test, the study has a resulting significant p -value of $p = 0.02$, just as the first study.

	Event	Non-Event	Totals
Sample 1	200	3800	4000
Sample 2	250	3750	4000

¹In a clinical trial setting, we may take Sample 1 as the treated patients, and Sample 2 to be the patients in our control or placebo group.

This second study would, however, require a minimum of nine additional treated patients to experience the event outcome for the study to lose its significance with a resulting p -value of $p = 0.0547$.

	Event	Non-Event	Totals
Sample 1	$200 + 9 = 209$	$3800 - 9 = 3791$	4000
Sample 2	250	3750	4000

While both studies are statistically significant with a p -value of $p = 0.02$, the first study is clearly much more “fragile.” This fragile nature of the first study leads the reader to doubt the presence of a true treatment effect based solely on these results. The reproducibility of the study’s results is in question.

Walsh, *et al.*[4] defended the use of a Fragility Index in randomized controlled trials through an investigation of 399 randomized controlled trials which were deemed statistically significant. All 399 of these studies had resulting p -values < 0.05 and 53% of these even had p -values < 0.01 . They found 25% of their studies had resulting Fragility Index values of 3 or less. Small sample sizes were found to be associated with small values of the Fragility Index, but not exclusively so. There were some trials with large sample sizes with very low Fragility Index values. The Leicester Intravenous Magnesium Intervention Trial[6], for example, had 2316 patients, a significant p -value of 0.04, but a Fragility Index of only 1.

Much of the motivating literature in our investigation comes from the application and advocacy of the Fragility Index in clinical trials and epidemiological studies. However, decisions made in a management and business context, will also be enhanced with an understanding of a measure of fragility of tests. This research seeks to provide examples of the use of Fragility Index appropriate and suitable for introduction into the Business Statistics curriculum, and extend the approach to fragility to additional tests about counts and proportions.

The Fragility Index for Two-Way Table Analysis

Track managers would like to know if there is a relationship between souvenirs purchased by race fans and the concessions those fans purchase. A 2017 online survey of purchasing habits of motorsports race attendees tested for the independence of the two variables. The data from a 2017 online survey of race fans who attended races in 2016 are summarized in the table below.

	Souvenirs Purchased	Souvenirs Not Purchased	Totals
Concessions Purchased	96	48	144
Concessions Not Purchased	17	19	36

Consider the “event” variable to be Souvenirs Purchased, and the “intervention” variable to be Concessions Purchased. With software², test for independence using Fisher’s Exact Test. The resulting p -values is significant at $p = 0.035$, supporting the claim that there is some dependency present between the two dichotomous factors. However, Fisher’s Exact Test fails to tell us the nature of the dependency. An investigation of the probabilities of fans purchasing souvenirs by conditioning on the status of concessions reveals the nature of the apparent dependency. Among fans who purchased concessions, 67% also purchased souvenirs, while among fans who did not purchase concessions, a much lower 47.2% purchased souvenirs. In the absence of any additional metric regarding the fragility of the study, a track manager may make expensive venue changes to the layout and offerings in an attempt to increase sales. However, a further investigation of the original data set reveals that if only one fan who did not purchase concessions were change their souvenir

²The R Statistical Environment was used for analysis.

status from a “no purchase” to a “purchase,” the statistical significance of the study will be broken, with a p -value from Fisher’s Exact Test of $p = 0.083$. The study, while statistically significant, is highly fragile with a Fragility Index of 1, and the apparent dependency should be treated with suspicion.

	Souvenirs Purchased	Souvenirs Not Purchased	Totals
Concessions Purchased	96	48	144
Concessions Not Purchased	$17 + 1 = 18$	$19 - 1 = 18$	36

The Fragility Index for Tests Involving a Single Proportion

While Walsh’s Fragility Index is the minimum number of subjects required to change outcome status for a significant test to lose its significance, the Reverse Fragility Index will be the metric associated with the minimum number of subjects required to change outcome status for a non-significant test to change to one that is statistically significant. The following example illustrates three extensions to Walsh’s approach. Readers should note the Walsh approach can be extended to address the fragility of one-sided tests, tests of a single proportion, and a “reverse fragility concept,” for investigating the minimum number of outcome status changes for a test with a non-significant conclusion to change to a significant conclusion.

Consider a chain of coffee shops interested in expanding their service to include a pour-over method of brewing a cup of coffee, in addition to a traditional drip method for brewing a pot of coffee. A random sample of 50 customers is chosen for a double-blind taste test of the two methods. Among the 50 customers participating in the taste test, 32 express a preference for the pour-over method. Is there enough evidence to conclude that more than 55% of the customers will prefer the pour-over method? Use $\alpha = 0.05$.

The resulting Z -test will have a test statistic, $z = 1.279$ and non-significant p -value of $p = 0.1004 \not< \alpha = 0.05$. How fragile is the study? That is, how many participants who preferred the traditional method would have to change their mind to reverse the non-significance of the test? If we re-run the analysis, but with 33 participants expressing a preference for the pour-over method, then the resulting test statistic will be $z = 1.56$ with $p = 0.059$, which is still non-significant. However with 34 participants expressing a preference for the pour-over method, the resulting test statistic will be $z = 1.85$ with $p = 0.032$, which is significant. Thus this study would have a Reverse Fragility Index of 2.

The Fragility Index for Two Large-Sample Proportions

Our next example illustrates the Walsh approach to the Fragility Index as applied to a one-tailed test of two-proportions.

Consider the scenario where a race track is preparing for an upcoming race. Some long-term dedicated race fan customers are mailed a coupon for an additional discount on the purchase of tickets, while other long-term dedicated race fan customers are mailed only an announcement of the race, but did not get the additional discount coupon for tickets. Management will want to know if the coupons are effective at increasing ticket sales. Suppose 40 prior ticket holders were mailed the ticket sale advertisement with the coupon and an equal number of customers received only the ticket sale advertisement. After the race, management reviewed the results of the experiment and learned there were 15 customers who made a ticket purchase among those receiving the discount coupon, while there were 5 customers who made a ticket purchase among those receiving only the advertisement. The resulting contingency table is below:

	Ad Only	Ad and Coupon	Totals
Purchase	5	15	20
No Purchase	35	25	60
Totals	40	40	80

Further summarizing by computing empirical probabilities after conditioning on the group we have:

Sampled Population	n	X	$\hat{p} = \frac{X}{n}$
Ad Only	40	5	$\frac{5}{40} = 0.125$
Ad and Coupon	40	15	$\frac{15}{40} = 0.375$

Is the addition of the coupon effective at increasing sales among customers receiving ads?

The test statistic for testing the one-sided alternative, $H_A : p_{\text{Ad+Coupon}} > p_{\text{Ad}}$, results in $z = 2.58$ which is statistically significant with a p -value of $p = 0.005 < \alpha = 0.05$. How fragile is this statistically significant result? By extending Walsh's approach, we'll incrementally increase the smaller event group (ad only), compute the test statistic and corresponding p -value for each until we achieve a non-significant value for p .

X , Ad Only	Test Statistic, z	p -value
5	2.58	0.005
6	2.27	0.011
7	2.00	0.023
8	1.73	0.042
9	1.46	0.072

It would require four additional ticket purchasers among the Ad Only group for the test to change from significance to non-significance. Thus the Fragility Index for this test is 4.

Conclusion and Recommendations

Given the misconceptions and misunderstandings of the traditional p -value when interpreting tests of hypotheses, an additional – easy to understand – metric to assess the reproducibility of a study is needed. Extending Walsh's Fragility Index approach to tests of hypothesis beyond 1:1 randomized control trials is sensible to do, as well as easy to compute with today's software.

Further work should be carried out to implement the Fragility Index approach to logistic regression modeling.

Lastly, the distribution of the Fragility Index should be explored. While the form of the distribution is undetermined, and will depend on the nature of the test, a bootstrap approach should reveal important characteristics of the distribution of this metric.

References

- [1] R. Dennis Cook. Detection of influential observation in linear regression. *Technometrics*, 19(1):15–18, February 1977.
- [2] Alvan R. Feinstein. The unit fragility index: an additional appraisal of "statistical significance" for a contrast of two proportions. *Journal of Clinical Epidemiology*, 43(2):201–209, 1990.
- [3] Sander Greenland, Stephen J. Senn, Kenneth J. Rothman, John B. Carlin, Charles Poole, Steven N. Goodman, and Douglas G. Altman. Statistical tests, p values, confidence intervals, and power: a guide to misinterpretations. *European Journal of Epidemiology*, 31:337–350, 2016.
- [4] Michael Walsh, Sadeesh K. Srinathan, Daniel F. McAuley, Marko Mrkobrada, Oren Levine, Christine Ribic, Amber O. Molnar, Neil D. Dattani, Andrew Burke, Gordon Guyatt, Lehana Thabane, Stephen D. Walter, Janice Pogue, and P.J. Devereaux. The statistical significance of randomized controlled trial results is frequently fragile: a case for a Fragility Index. *Journal of Clinical Epidemiology*, 67:622–628, 2014.
- [5] Ronald L. Wasserstein and Nicole A. Lazar. The ASA's Statement on p-values: Context, Process, and Purpose. *The American Statistician*, 70(2):129–133, 2016.
- [6] K.L. Woods, S. Fletcher, C. Roffe, and Y. Haider. Intravenous magnesium sulphate in suspected acute myocardial infarction: results of the second Leicester Intravenous Magnesium Intervention Trial (LIMIT-2). *Lancet*, 339(8809):1553–1558, June 1992.

THE EFFECT OF FAST FASHION ON THE SUSTAINABILITY MOVEMENT

Dick Crandall, Appalachian State University

Introduction

This paper is about fast fashion and its relationship with sustainability. Fast fashion is a term associated with the most recent trend in the apparel fashion industry. It implies that the apparel displayed in retail stores is the most current fashion and, at the same time, is inexpensive. As a result of falling prices, streamlined operations and increased consumer spending, clothing production has doubled from 2000 to 2014, and the number of garments purchased each year by the average consumer has increased by 60 percent. In 2014, this amounted to about 14 items for each person on earth. The improving economies in emerging economies have joined the buying; apparel sales in Brazil, China, India, Mexico, and Russia grew eight times as fast as in Canada, Germany, United Kingdom, and the United States. The increased buying has also led to increased disposal of clothing, as consumers keep clothing only about half as long as they did 15 years ago, often discarding them after only a few wearings (Remy, Speelman and Swartz, 2016).

What is not as obvious is that fast fashion supply chains also contribute to an increase in materials being disposed of in landfills and utilize some suppliers who pay substandard wages and fail to provide safe working conditions. Innovation in the way clothes are made has not kept pace with the way they are designed and marketed. “Fast fashion is now a large, sophisticated business fed by a fragmented and relatively low-tech production system.” (Remy, Speelman and Swartz, 2016) Unfortunately, while some companies are beginning to recognize the need to confront the negative impact on the environment and social responsibilities, the change depends on the consumers’ willingness to pay the higher prices that will likely result (McNeil and Moore, 2015).

This paper is organized as follows. The first section will describe the fast fashion movement and the attributes that relate to the sustainability movement. Next, we will cover the key elements of the

sustainability movement. Then, we will examine the links between fast fashion and apparel supply chains to see their potential effects on sustainability. The next section will list the positives and negatives generally attributed to fast fashion. Following that, we will identify our recommendations, especially those that will improve the contribution of fast fashion to sustainability. Finally, we will suggest research areas that will enhance the understanding of the future for fast fashion and sustainability.

Fashion Stages

Apparel fashion, especially those for women's clothing and accessories, have passed through several stages. As Teri Agens (1999, p.7) puts it: "Fashion, by definition, is ephemeral and elusive, a target that keeps moving. A clothing style becomes fashionable when enough people accept it at any given time. And conversely, fashions go out of style when people quit wearing them. Traditionally, the fashion system has revolved around the imperative of planned obsolescence – the most familiar examples being the rise and fall in skirt lengths, and for men, the widening and narrowing of trousers and neckties. Every few years, when the silhouettes change, women and men have been compelled to go shopping and to rebuild their wardrobes to stay in style."

Table 1 approximates the major fashion periods. From prehistoric times when animal skins were used to cover humans until the invention of the sewing machines in the later part of the 19th century, most apparel was cut and sewn by hand by members of the immediate family. Even the materials could be obtained locally if the family raised sheep for wool or planted cotton. Through World War II, when many women were engaged in production of war goods, much of the clothing for the general public was made by family members or local seamstresses. The primary concern was to make clothing that was suitable for work or church.

Designer-driven. In the late 19th century, the couture industry, created to design unique and elaborate wardrobes for the rich and royalty, was created to stimulate the French economy. French fashion was designed for snob appeal and the height of elegance for ladies whose lives revolved around their wardrobes. As long as sales were brisk, there was no need for French companies to design and make

clothing for the mass market (Agens, 1999).

Production-driven. As the general public became more affluent, and manufacturing methods improved, companies began making “knockoffs” to sell to the general public at much lower prices. The emphasis shifted from the designer to the manufacturer and retailer. Initially, the lower prices could be satisfied with domestic production. However, as competition increased, the pressure to reduce prices caused many manufacturers to outsource production to low labor-cost countries. This extended supply chains and increased the time required to move from the design stage to the finished product stage. Retailers had to forecast demand, not only in total but in style, size, color and finish, at least a year in advance. Needless to say, the result was often too little or too much of individual items, hence, better inventory control and forecasting was needed.

Logistics-driven. By the 1980s, low price was no longer enough to satisfy consumers; manufacturers were being pressed to reduce response time to changes. Retailers wanted to reduce inventories and respond to design changes faster. As a result, supply chains were reviewed to see what could be done to reduce the time from production to the retail store. The Quick-Response system, patterned after the Just-in-Time concept originated in the automobile industry, was developed to reduce the time required to make clothing (Hunter, 1990). Garment suppliers were pressured to work faster, canals were widened to support larger ships, distribution centers were automated, and information systems were integrated in an attempt to reduce response time; all this, while continuing to maintain the lowest possible costs. It was not surprising then, that the quality of the clothing began to deteriorate as the focus switched more to cost containment strategies.

Consumer-driven. As the 21st century neared, high fashion designers were losing their position as the dictators of fashion. Consumers were taking over. With access to the Internet and social media sites, young female buyers in particular were deciding what they liked and wanted to wear (Morgan and Birtwistle, 2009). Employees stopped “dressing up” as many companies allowed, and even encouraged,

more casual dress at work. People's value changed; if the price was low enough and it looked like a new fashion, who cared if the garment only lasted for one or two wearings? As all of these factors converged, the fast fashion movement emerged. "Cheap fashion has fundamentally changed the way most Americans dress. Retailers are producing clothes at enormous volumes in order to get prices down and profits up, and they've turned clothing into a disposable good. After all, we have little reason to keep wearing and repairing clothes we already own when styles change so fast and it's cheaper to just buy more." (Cline, 2012)

Table 1 - Changes in Apparel Fashions over Time

Fashion Period	Time Period	Driver	Type of Supply Chain
Process-driven	Prehistoric to 1950	Function or need	Local
Designer-driven	1880s to 1980s	High style	Local and Regional
Production-driven	1960s to present	Low price	Global
Logistics-driven	1980s to present	Fast response time	Global/regional
Consumer-driven	2000 to present	Style, price, response time	Integrated blend

Adapted from Crandall (2017)

A Review of Sustainability

The concept of sustainability has also changed over the years. One of the most widely quoted is the Brundtland Commission's report that defined sustainable development as "development which meets the needs of current generations without compromising the ability of future generations to meet their own needs" (Brundtland Commission Report, 1987, p. 16).

John Elkington is generally credited with coining the term, "triple bottom line", to describe the scope of sustainability to include economic prosperity, environmental quality and social justice. "To refuse the challenge implied by the triple bottom line is to risk extinction. Nor are these simply issues for major transnational corporations; they will increasingly be forced to pass the pressure on down their supply chains, to smaller suppliers and contractors." (Elkington, 1998, p. 2)

Others support the idea that sustainability has broad implications. "The issue of supply chain management has to be broadened to include environmental, social and economic issues to become

sustainable.” (Ageron, Gunasekaran and Spalanzani, 2012) “Sustainability is a complex term that can encompass environmental, economic, and societal issues.” (Malhotra, Melville and Watson, 2013).

There is a growing consensus that environmental sustainability is dependent on economic well-being. If businesses aren't successful, they cannot afford to support the programs necessary to improve environmental sustainability. In addition, if businesses are to be successful, they must demonstrate corporate social responsibility (CSR). The result is a convergence of ideas about sustainability that requires a stakeholder perspective to include collaboration among special interest groups, businesses, governments, and individuals to be successful.

Because of its multiple demands on low costs and fast response times, fast fashion has focused the attention of both suppliers and consumers on its effect on sustainability, both positive and negative. One of the contradictions among fast fashion consumers is their attitude toward sustainability – they share a concern for environmental issues while at the same time, are not inclined to be active recyclers (Joy et.al. 2012).

Effect of fast fashion on the Triple Bottom Line

Fast fashion has had mixed results on triple bottom line elements. The economic results are mixed; the effects on the environment are generally negative; and the results in social responsibility are also somewhat mixed.

Economic. For those retailers that have moved to the fast fashion mode, such as Inditex (Zara) and H&M, the results have been positive, as both sales and profits have increased. The rapid changes in fashion motivate shoppers to buy quickly for fear of not seeing the item on their next visit. This means stores sell with fewer discounts and attract the customer to visit the store more often to see the rapidly changing fashions (Turker and Altuntas, 2014).

On the other hand, for retailers that have continued to operate in a more traditional manner, especially department stores, the results have been negative, in some cases, disastrous. Prominent retailers such as Macy's, JCPenney and Sears have announced

major store closings. In addition, women's apparel chain Bebe Stores announced it will close its remaining 170 stores and sell only online while teen retailer Rue21 plans to close about 400 of its 1,100 locations (SCDigest, 2017).

Surviving department stores have migrated to continuous discounting to the point where even the most naïve shopper waits for an item to be discounted (Shell, 2009). The dilemma is to decide what the true price should be. On the other hand, some chains, such as TJMaxx, have made a very successful business of buying overproduced garments and reselling them.

Environment. Increased sales have come from selling an increased number of clothing apparel, as selling prices have continued to decline. As more clothing has been sold, the number of items to be disposed of has correspondingly increased. This increase in the flow of goods has overwhelmed the capability of resale and recycle businesses. As a result, more clothing is going to landfills, where some of the newer synthetic materials will set for years before decomposing. Extended supply chains have also increased the energy needed to move goods from a remote supplier to the retail floor and on to the consumer. While the natural materials – wool and cotton – are more desirable from a disposal point of view, they require resources to produce. Cotton represents about 30 percent of all textile consumption and growing it requires a lot of water, pesticides and fertilizer. Since countries with large fabric and apparel industries use fossil fuel. McKinsey estimates that making 1 kilogram of fabric generates an average of 23 kilograms of greenhouse gases (Remy, Speelman and Swartz, 2016). The synthetic materials are often made from petroleum products and, while cheaper, present disposal problems.

Social Responsibility. On the positive side, outsourcing has provided jobs in emerging economies. This has lifted some workers out of poverty. On the negative side, often these workers are forced to work long hours in unsafe conditions. As supply chains have expanded throughout the world, it has become more difficult for retailers to know with certainty who is making the products for them. Extended supply chains have also resulted in increased energy use for transportation of goods between continents (Carey and

Cervellon, 2014). Table 2 summarizes this discussion on the effects of fast-fashion on the triple bottom line.

Table 2 - Effect of Fast Fashion on Triple Bottom Line (TBL) Elements

TBL Elements	Positive Results	Negative Results
Economic	Increases sales and profits for fast fashion companies	Reduces sales for laggards, especially department stores
Environment		Increases amount of goods to be disposed of Increases energy use in producing and transporting
Social Responsibility	Provides jobs in emerging economies	Increases output standards and unsafe working conditions Creates a throwaway mentality, encouraging waste

Fast fashion and the Supply Chain

In order to fully appreciate the impact that fast fashion has had on sustainability efforts in the apparel industries, it is necessary to see how supply chains have changed during the period that fast fashion has emerged and become dominant in the fashion world. There have been changes in the supply chain organization structure, materials used, manufacturing locations, supplier structure, transportation modes, and retailing methods.

Organization

One of the major changes has been the movement of the apparel design function from a separate, often sheltered, position to inclusion in an integrated team where design no longer dictates, but participates in the fashion design along with manufacturing, supply chain and marketing participants. Retail companies have grown larger; as a result, the position of power has shifted from manufacturing to retailing. As competition has driven down prices, outsourcing to remote suppliers in search of lower costs, has

extended supply chains around the world.

Materials Used

In general, natural fibers, such as cotton, wool and silk have been partially displaced by synthetic fibers. While this has reduced costs, it has increased the complexity of supply chains and made disposal of used clothing more difficult.

Manufacturing Locations

The textile part of the supply chain – making the yarn – has been heavily automated but the cutting, sewing and finishing manufacture is still labor intensive (Desai, Nassar and Chertow, 2012). This is the reason many manufacturers continue to seek suppliers in low cost countries. Even in low cost economies, suppliers are pressured to produce more efficiently. This pressure often results in long hours at low pay in unsafe working conditions. The result is often the dreaded Race to the Bottom, whereby factories in emerging countries compete solely on the basis of cost per unit, and in the process, sacrifice worker human rights and environmental standards (Crandall, Parnell, and Crandall, 2015).

As supply chains have been extended throughout the world, it has become almost impossible for the focal company, usually the retailer, to keep track of all the suppliers. In some cases, intermediaries select and effectively manage sub-suppliers, sometimes with undesirable results.

Transportation Modes

Global supply chains require multiple modes of transportation – truck, rail, and ship. Often all modes are required for one shipment. In some cases, even air transportation is used to reduce the response time when faster shipments are necessary. Larger ships are being built; as a result, canals (Suez and Panama) are being widened and river channels to access inland ports are being deepened. Ports are being automated and truck traffic continues to increase and pose traffic problems, especially in city traffic. Scheduling shipments to minimize travel time and delays is becoming a critical requirement for most supply chains.

Retailing Methods

The big change in retailing methods is the transition to online buying. Amazon is leading the way and traditional retailers are feeling the pinch. While most retailers report they have online capabilities, few are able to effectively compete on the same level as Amazon. Walmart is committing significant resources, including the purchase of Jet.com for \$3.3 billion and another \$0.5 billion for four smaller retailers. This commitment is designed to enable them to better compete with Amazon for online sales (Stone and Boyle, 2017).

Clothing Reuse, Recycle, Upcycle and Disposal

The fast fashion movement has resulted in an increase in the amount of apparel being produced and sold. In fact, the developed world is being overwhelmed with the amount of apparel that is being forced into the reverse logistics part of the supply chain. What happens to these items once the consumer is through with them? There are a number of choices that help reduce the amount of goods going to landfills.

Clothing is returned to the retailer. One of the more recent actions by some retailers is to take back the clothing from customers to be recycled or remade into clothing. H&M has been doing this since 2013 and Patagonia is another company that recycles and sells used products in its stores (Tan, 2016).

Clothing is sold to thrift resellers, and other small co-signer companies. A number of businesses have been started to resell apparel items at discounted prices. Usually the individual places their unwanted items with the business and receives a commission when the item is sold.

Clothing is donated to charity resellers. Some resellers have a more charitable inclination, such as Goodwill Industries. These organizations also resell a variety of items, including clothing, and donate what they cannot sell. It is estimated that only about 20 percent of the used clothing is disposed of in this manner (Cline, 2013).

Clothing is donated to the needy through charitable organizations. Another recycling avenue is to donate the items to a charity that in turn donates the items to needy recipients. These include many local

agencies, as well as some that have an international reach, such as the Red Cross, Salvation Army and Samaritan's Purse. These organizations are especially active during major emergencies – earthquakes, hurricanes and mass disease epidemics.

Clothing is recycled. Some organizations have built businesses around this alternate use. Recycling involves taking the clothing and re-processing it into something of equal or lesser value. For example, taking a cotton t-shirt and turning it into a cleaning cloth would be considered recycling. Recycling businesses may vary by type of material. In Kandla, India, for example, starting with 800-lb. bales of compressed apparel of all types, sari-clad women sort cast-off clothing from the U.S. into piles of T-shirts, jeans, underwear, sweaters, coats, and even furs. Usable items, about 30 percent of the total, are shipped to other countries for resale (sales are banned in India). After removal of buttons, zippers and snaps, the remaining 70 percent are cut into rags for factories. If not suitable for rags, the fabric is dumped into machines that grind them down into fibers that are treated and respun into yarn (Bellman, 2016).

Clothing is upcycled. The example above illustrates recycling. Upcycling on the other hand involves taking the clothing item and making it into an item of equal or higher value. Upcycling involves making the item into a more valuable product than its original use (Sung and Cooper, 2015). One form of upcycling takes the original clothing item and modifies it into something slightly different from the original. For example, taking a men's shirt and transforming it into a child's dress. Another form of upcycling takes the material from used clothing and transforms it into an accessory such as a scarf, ruffle or belt (Shearing, 2009).

Clothing is moved to landfills. As a last resort, apparel items that cannot be put to a good use are eventually moved to landfills. McKinsey estimates that about 60 percent of apparel items find their way into landfills each year (Remy, Speelman and Swartz, 2016). Because of the composite materials that are used, especially in the petroleum-based synthetic materials, such as polyester, it often takes years before

decomposition is complete. While many landfills have developed processes for handling paper, plastics and metals, many are still searching for the best way to handle fabrics.

Recommendations

We offer the following recommendations to increase the compatibility of the apparel industry's fast fashion and sustainability objectives. We summarize them into general approaches: Establish sustainability as a core value in the apparel industry; increase transparency along supply chains; reduce the length of supply chains; modify designs to increase wearability; and find better ways to recycle.

1. Establish sustainability as a core value in the apparel industry

If the present rate of production and consumption of apparel continues, the impact on environmental and social concerns will increase (Cataldi, Dickson and Grover, 2010). "To break this vicious cycle, sustainability should become the core value in the fashion industry currently driven by speed, artificial newness, and planned obsolescence." (Ertekin and Atik, 2014, p. 66)

Two of the leaders in the fast fashion industry – Inditex (Zara) and H&M have made commitments to improve their sustainability programs. In their 2015 Annual Report, Inditex reaffirmed their commitment to sustainable development: "Inditex has strengthened its sustainability commitments to protecting human rights in all of its activities by embracing the route to sustainable proposed by the United Nations in its seventeen Sustainable Development Goals (SDGs)... The goals encompass the three elements of sustainable development: economic growth, social inclusion and environmental protection... In its Annual Report, Inditex has linked each of its priorities to the SDGs it impacts... The company has also instituted sustainability policies that are integrated with value creation in its business model and represent another step toward achieving the SDGs and their targets." (Inditex, 2015, p. 24)

H&M has also made a strong commitment with the following statement in their 2015 Annual Report:

"Sustainability is an integral part of our business. As a company with strong values and a long-term approach, we use our size and influence to bring about better conditions for people

and to minimise environmental impact throughout the value chain. Progress is achieved through collaborations, innovation and greater transparency. Along with customers, suppliers, business partners, scientists, interest groups, decision makers and other companies, we work all along the line – from creating the conditions for sustainable cotton production and promoting fair living wages in the textile industry, through using electricity from renewable sources, to encouraging customers to be climate smart when washing clothes and to recycle old clothing. For us, the goal is to continue to grow and create the best offering for our customers, to be an attractive employer of committed employees, create new jobs and contribute to positive development in society.” (H&M 2015 Annual Report, p. 12)

2. Increase transparency along supply chains

Many writers advocate the need for increased transparency along the apparel supply chain. The first benefit, from a sustainability perspective, would be increased knowledge of environmental issues and unfair labor practices. From an economic viewpoint, it would increase identification of potential cost savings and untapped markets (Desai, Nassar and Chetow, 2012).

As supply chains become more transparent and information is more readily available, new data handling techniques, such as machine learning and artificial intelligence, can be used to understand how demand signals, forecasts, replenishment plans, production and inventory all impact each other. This added insight can reduce costs and also reduce overproduction and aggravated disposal flows (Crawford, 2017)

The Human Rights Watch (2017) reports a growing trend of global apparel companies adopting supply chain transparency. This will aid consumers who have often lacked meaningful information about where their apparel was made.

The Fashion Revolution has developed a Transparency Index in which they rank 100 companies in the textile and apparel industries.” Today, both people and the environment suffer as a result of the way fashion is made, sourced and consumed. It’s time for a Fashion Revolution, and we believe that the

beginning of this process is greater transparency.” (Fashion Revolution, 2017, p.6)

3. Reduce the length of supply chains

As the gap in labor costs between developed and emerging economies narrows, companies are finding that local or regional manufacturing may be an economically feasible way to reduce lead times, while only marginally increasing costs. Zara has used this approach almost from its beginning: It produces fashion-sensitive clothes with regional manufacturers while outsourcing core designs that only change incrementally to remote, low cost countries.

Fashionating World (2017c) reports in 2015 the United States imported about \$88 billion in apparel goods, mainly from Asian and South American countries. Conversely, they exported only about \$6 billion. This difference represented almost a quarter of the total trade deficit. While some small businesses are helping preserve garment centers in New York and Los Angeles, the feasibility for reshoring major portions of the garment industry appears remote.

As a possibility from advanced technology, Amazon has won a patent for “on-demand apparel manufacturing” in which machines only start making a garment after the order has been received. The computerized system would include manufacture and shipping. In addition to clothing, the inventors of the system, founders of a 3D printing startup, expect the system could work in other categories, such as footwear, bedding, curtains, and towels and be made of materials including but not limited to paper, plastic, leather, and rubber. (SupplyChain247, 2017).

Conceivably, such a system could be designed to satisfy regional markets, thereby reducing the distance finished goods would have to travel.

4. Modify designs to increase wearability and reduce the amount of buying

Increasing wearability has several connotations, including improving quality, reducing style changes, and modifying the attitude of consumers.

Increase the quality of apparel so they last longer. Quality is a function of both materials and manufacturing processes. Increased quality will take longer and cost more, but, in the long run, it will

reduce the “cost per wearing” by making it possible to wear the garment more times. Fast fashion consumers might be more inclined to recycle if clothes were of higher quality (Joung, 2014).

Reduce the trivial changes in styles; conversely, retain some basic styles that consumers can wear at any time and not feel “out of style,” such as the “little black dress” or a navy blue suit.

Change the attitude of the consumer to adapt to the idea that higher quality will fit better, look better, and reduce the negative effects on the environment. It will also lead to higher skills and higher wages, and improved working conditions for employees who make the better apparel.

These changes should reduce the number of items sold. While this may reduce the revenues for retailers initially, the higher quality will also enable retailers to charge higher prices, which should increase revenue. If fewer items are sold, it will reduce the volume of goods that need to be recycled.

5. Find better ways to recycle

Better clothes will lead to a higher percentage being resold through thrift outlets. More careful selection of materials will reduce the difficulties in recycling into fibers that can be reused. Improved transparency concerning the kind of materials being used will make it easier for their eventual disposition in landfills.

One of the changes that is reducing the opportunity to recycle used clothing to emerging economies is the increase in the standard of living in these countries. As economic conditions improve, citizens are less interested in wearing used clothing and more interested in buying new clothing (Remy, Speelman, and Swartz, 2016).

Deakin University researchers developed a 'circular denim' to reduce the huge environmental impact of denim production. As part of their entry into the Global Change Award, they developed a unique process that produces ultrafine particles from used denim, and then coats or prints the color particles to create typical denim appearance. Denim recycling is a huge issue worldwide and currently, old denim products are dumped in landfills, and dye runoff from denim production can pollute local water supplies. The new

circular denim process is unique in that it not only recycles the fibers but also the dye (Fashionating World, May 9, 2017a).

The Circular Fibres Initiative, launched at the Copenhagen Fashion Summit, aims at bringing together leading businesses, NGOs, philanthropic organizations and public bodies to create a vision for a new global textiles system that will replace the linear, take-make-dispose model dominating the industry. Nike and H&M are the first corporate partners to support the initiative, led by circular economy think tank, the Ellen MacArthur Foundation, with participation from the C&A Foundation, the Danish Fashion Institute, Fashion for Good, Cradle to Cradle and Mistra Future Fashion. (Fashionating World, May 17, 2017b)

Conclusions

Fashion companies are beginning to recognize and act on the need to improve their sustainability programs; however, consumers have been slow to make the conversion, although there are some indications that a movement counter to fast fashion, called slow fashion, is taking hold.

The term slow fashion was put forth by Kate Fletcher in 2007. She offers the following comparison of fast and slow fashion.

“Fast fashion isn’t really about speed, but greed: selling more, making more money. Time is just one factor of production, along with labour, capital and natural resources that get juggled and squeezed in the pursuit of maximum profits. But fast is not free. Short lead times and cheap clothes are only made possible by exploitation of labour and natural resources.

Yet it doesn’t have to be this way. We can design a different system for ourselves that makes money while respecting the rights of workers and the environment, and produces beautiful and conscientious garments.

Slow fashion is about designing, producing, consuming and living better. Slow fashion is not time-based but quality-based (which has some time components). Slow is not the opposite of fast – there is no dualism – but a different approach in which designers, buyers, retailers and consumers are more aware of the impacts of products on workers, communities and ecosystems.

The concept of slow fashion borrows heavily from the Slow Food Movement. Founded by Carlo Petrini in Italy in 1986, Slow Food links pleasure and food with awareness and responsibility. It defends biodiversity in our food supply by opposing the standardization of taste, defends the need for consumer information and protects cultural identities tied to food. It has spawned a wealth of other slow movements. Slow Cities, for example, design with slow values but within the context of a town or city and a commitment to improve its citizens’ quality of life.

Slow fashion is a glimpse of a different – and more sustainable – future for the textile and clothing sector and an opportunity for business to be done in a way that respects workers, environment and

consumers in equal measure. Such a future is but a garment away.” (Fletcher, 2007)

Lisa Arnett (2016) reports that some of the principles of slow fashion include: (1) acknowledge that a person made your clothing; (2) Use what you have; (3) Resist the “deal”; (4) Invest in better quality; (5) Take care of what you have; (6) Buy responsibly; (7) Buy vintage or gently used; and (8) Swap or rent.

While slow fashion holds promise, there is a lack of clear information about the sustainability impact; it is difficult to compare fibers and processes; and the overall awareness is still low and limited to a few countries. (Cataldi, Dickson and Grover, 2010).

Ertekin and Atik (2014) identify the following barriers to mobilization of a sustainable (slow) fashion system:

Globalization and lack of transparency; the desire for economic growth; inconvenience and lack of resources; lack of knowledge and awareness; lack of trust in fashion companies; attitude-behavior gap on the consumer side; and concerns about aesthetic.

In Table 3, we have added an additional fashion period that is beginning to attract a significant audience. It is the result of activists who want to counter some of the negatives of the fast fashion periods, while making apparel fashion a more enjoyable and satisfying experience for consumers.

Table 3 - Changes in Apparel Fashions in the Future

Fashion Period	Time Period	Driver	Type of Supply Chain
Process-driven	Prehistoric to 1950	Function or need	Local
Designer-driven	1880s to 1980s	High style	Local and Regional
Production-driven	1960s to present	Low price	Global
Logistics-driven	1980s to present	Fast response time	Global/regional
Consumer-driven	2000 to present	Style, price, response time	Integrated blend
Society-driven	2010 ongoing	Social consciousness – environmental sustainability	Triple-bottom-line (TBL) sensitive

In the following section, we outline our thoughts about possible areas of research that could help further clarify the compatibility between the fashion industry and sustainability and provide direction to companies

that want to become more sustainable.

Research Opportunities

The following areas of research that could be beneficial to apparel companies in deciding where to put their efforts.

Comparing natural versus synthetic materials. A research stream that ranks the relative positions of natural vs. synthetic materials along a sustainability scale would be worthwhile. For example, there appears to be considerable effort being devoted to developing more sustainable cotton (H&M Annual Report, 2016).

Evaluating technology in the fashion industry. Examining new technology that could be used to reduce environmental damage and/or improve working conditions, while maintaining or improving the economic performance of a company would be useful.

Developing case studies that compare economic, environmental and social performance.

- With a longitudinal study, trace the progress of companies such as Patagonia and Nike to develop a model that could be used by other companies.
- Compare two fast fashion companies such as Zara and H&M to identify and evaluate their contributions to sustainability.
- Compare a successful fast fashion company with a traditional, and faltering, retailer – a department store – to determine their relative levels of sustainability efforts.

Evaluating the sustainability metrics of slow-fashion vs. fast-fashion. While fast-fashion does put strains on the environment, particularly in regards to producing waste, slow-fashion is also in need of an overhaul on sustainability practices. For example, both slow and fast fashion use chemical dyes and other toxic cleaners that can be harmful to the environment, and hence, affect long-term sustainability. Both fashions require low-technology inputs, questionable labor practices, and similar supply chain channels.

In conclusion, the linkage between the fashion industry and sustainability appears to be an attractive area for research that could be beneficial to both consumers and businesses.

References

1. Agins, Teri (1999). *The End of Fashion, the mass marketing of the clothing business*, William Morrow and Company, Inc., New York.
2. Arnett, L. (2016, Jan 11). 8 Ways to lead a slow fashion life. *Crain's Chicago Business*, 39, 25.
3. Bellman, E. (2016, Jun 27). Fashion feeds a recycling network --- clothes discarded in rich nations end up in developing world for resale or reprocessing. *Wall Street Journal*.
4. Brundtland Commission (1987). *Report of the World Commission on Environment and Development: Our Common Future*, Brundtland Commission Report to the United Nations, <http://www.un-documents.net/our-common-future.pdf>, accessed May 6, 2017.
5. Carey, L., & Cervellon, M. (2014). Ethical fashion dimensions: Pictorial and auditory depictions through three cultural perspectives. *Journal of Fashion Marketing and Management*, 18(4), 483-506.
6. Cataldi, Carlotta, Maureen Dickson and Crystal Grover (2010). *Slow Fashion: Tailoring a Strategic Approach towards Sustainability*, Master's Thesis, School of Engineering, Blekinge Institute of Technology, Karlskrona, Sweden.
7. Cline, Elizabeth L. (2012). *Overdressed, The Shockingly High Cost of Cheap Fashion*, Penguin Books, Ltd., London, England.
8. Crandall, Richard E. (Sept., 2017). Fast Fashion and the Supply Chain, *APICS Magazine*, 27(4).
9. Crandall, W. R., Parnell, J. A., & Crandall, R. E. (2015). Modern slavery in the supply chain: An uncomfortable reality. *Proceedings of the 2015 Meeting of the Academy of International Business – Southeast Chapter*, Savannah, GA, IL.
10. Crawford, Alison (May 1, 2017). Machine Learning, Little Black Dress or Accessory? *SupplyChain247*, http://www.supplychain247.com/article/machine_learning_little_black_dress_or_accessory/one_network_enterprises?ajs_uid=2460I7072034A9V, accessed May 4, 2017.
11. Desai, A., Nassar, N., & Chertow, M. (2012). American seams: An exploration of hybrid fast fashion and domestic manufacturing models in relocalised apparel production. *The Journal of Corporate Citizenship*, (45), 53-78.
12. Elkington, John (1998). *Cannibals with Forks: The Triple Bottom Line of 21st Century Business*. New Society Publishers, Gabriola Island BC, Canada.
13. Ertekin, Z. O., & Atik, D. (2015). Sustainable markets: Motivating factors, barriers, and remedies for mobilization of slow fashion. *Journal of Macromarketing*, 35(1), 53.
14. *Fashionating World* (May 9, 2017a). DEAKIN UNIVERSITY RESEARCHERS DEVELOP 'CIRCULAR DENIM', <https://www.fashionatingworld.com/new1-2/deakin-university-researchers-develop-circular-denim>, accessed May 13, 2017.
15. *Fashionating World* (May 17, 2017b). THE NEW CIRCULAR FIBRES INITIATIVE LOOKS AT TAKE-MAKE-DISPOSE MODEL, <http://www.fashionatingworld.com/new1-2/the-new-circular-fibres-initiative-looks-at-take-make-dispose-model>, accessed May 17, 2017.
16. *Fashionating World* (May 4, 2017c). NEARSHORING, COULD THAT BE ANSWER TO THE REVIVAL OF US TEXTILE MANUFACTURING, <http://www.fashionatingworld.com/new1-2/nearshoring-could-that-be-answer-to-the-revival-of-us-textile-manufacturing>, accessed May 5, 2017.
17. *Fashion Revolution* (2017). Fashion Transparency Index 2017, https://issuu.com/fashionrevolution/docs/fr_fashiontransparencyindex2017?e=25766662/47726047, accessed April 24, 2017.
18. Fletcher, K. (June 1, 2007), Slow fashion, *Ecologist*, http://www.theecologist.org/green_green_living/clothing/269245/slow_fashion.html, accessed May 11, 2017.
19. H&M Annual Report 2015,

- <https://about.hm.com/content/dam/hmgroup/groupsite/documents/masterlanguage/Annual%20Report/Annual%20Report%202015.pdf>, accessed May 1, 2017.
20. Human Rights Watch (May 30, 2016). Human Rights in Supply Chains, http://www.supplychain247.com/paper/human_rights_in_supply_chains?ajs_uid=2460I7072034A_9V, assessed April 27, 2017.
 21. Hunter, N. Alan, (1990). *Quick Response in Apparel Manufacturing*, The Textile Institute, Manchester.
 22. Intidex Annual Report 2015.
https://www.inditex.com/documents/10279/205236/Inditex+Annual+Report+2015+web.pdf/99790_97b-9e63-489a-ad16-a141b6b665b4, accessed May 1, 2017.
 23. Joung, H. (2014). Fast-fashion consumers' post-purchase behaviours. *International Journal of Retail & Distribution Management*, 42(8), 688-697.
 24. Joy, Annamma, John F. Sherry, Jr, Alladi Venkatesh, Jeff Wang and Ricky Chan, Fast Fashion, Sustainability, and the Ethical Appeal of Luxury Brands, <https://www3.nd.edu/~jsherry/pdf/2012/FastFashionSustainability.pdf>, accessed April 24, 2017.
 25. Lee, Matilda (Feb. 6, 2009). What's the Most Sustainable Fabric? *The Ecologist*, http://www.theecologist.org/green_green_living/clothing/268798/whats_the_most_sustainable_fabric.html, accessed April 24, 2017.
 26. McNeill, L., & Moore, R. (2015). Sustainable fashion consumption and the fast fashion conundrum: Fashionable consumers and attitudes to sustainability in clothing choice. *International Journal of Consumer Studies*, 39(3), 212-222.
doi:<http://dx.doi.org/10.1111/ijcs.12169>.
 27. Morgan, L.R., & Birtwistle, G. (2009). An investigation of you fashion consumers' disposal habits. *International Journal of Consumer Studies*, 33, 190-198.
 28. Remy, Nathalie, Eveline Speelman, and Steven Swartz (Oct. 2016). Style that's sustainable: A new fast-fashion formula, <http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/style-thats-sustainable-a-new-fast-fashion-formula>, accessed April 24, 2017.
 29. Shearing, S. (2009, December). Upcycling in fashion and staying legal. *ART+law*, 4-5.
 30. Shell, Ellen Ruppel (2009). *Cheap: The High Cost of Discount Culture*, New York: Penguin.
 31. Stone, Brad and Matthew Boyle (May 8, 2017). Amazon Won't Know What Hit 'Em! *Bloomberg Business Week*, 42-47.
 32. Sung, K., & Cooper, T. (2015). Sarah Turner – Eco-artist and designer through craft-based recycling. *Craft Research*, 6(1), 113-122.
 33. *Supply Chain Digest* (April 24, 2017). Supply Chain News: Retail Landscape Transforming before Our Eyes, as Store Closings Continue at Breakneck Pace, <http://www.scdigest.com/ontarget/17-04-24-1.php?cid=12309>, accessed April 26, 2017.
 34. SupplyChain24/7 Staff (April 19, 2017). Amazon Wins Patent for On-Demand Apparel Manufacturing Warehouse, *Supply Chain 24/7*, http://www.supplychain247.com/article/amazon_wins_patent_for_on_demand_apparel_manufacturing_warehouse/zebra_technologies?ajs_uid=2460I7072034A9V, accessed April 19, 2017.
 35. Tan, Zhai Tun (April 10, 2016). What Happens When Fashion Becomes Fast, Disposable And Cheap? *NPR*, <http://www.npr.org/2016/04/08/473513620/what-happens-when-fashion-becomes-fast-disposable-and-cheap>, accessed April 29, 2016.
 36. Turker, D., & Altuntas, C. (2014). Sustainable supply chain management in the fast-fashion industry: An analysis of corporate reports. *European Management Journal*, 32(5), 837.

SHUT UP!? FREEDOM OF EXPRESSION VERSUS FREEDOM NOT TO HEAR

Claire R. La Roche, Longwood University, 201 High Street, Farmville, VA 23901

ABSTRACT

A timely educational and legal issue with significant personal and professional implications is the scope of free speech on public universities. Efforts by state supported schools to limit freedom of expression through free speech codes, free speech zones and other restrictions are commonplace. The law relating to First Amendment restrictions is reviewed. In the spring of 2017, the author conducted the Free Speech Survey of 89 undergraduate students and the results of the survey are discussed. The boundaries of freedom of expression at public universities are discussed. Suggestions are made for the free exchange of ideas.

Introduction

The constitutionally protected rights under the First Amendment apply to all public colleges and universities. Despite these binding obligations to protect free speech, in 2016, The Foundation for Individual Rights in Education (FIRE) “found that the vast majority of our nation’s colleges and universities violate students’ and faculty members’ right of freedom of expression.” (FIRE, 2016) The boundaries of freedom of expression on college and university campuses are being drawn. “Talk blocking” and violent tactics are being used to stop the free exchange of ideas. “Trigger warnings” and “safe places” are protecting students from the consequences of speech that they may find offensive. The President of the University of Chicago, Hanna Holborn Gray, observed that: “education should not be intended to make people comfortable, it is meant to make them think. Universities should be expected to provide the conditions within which hard thought, and therefore strong disagreement, independent judgment, and the questioning of stubborn assumptions, can flourish in an environment of the greatest freedom.” (UC, 2014) This paper will examine the status of free speech on university campuses – both in the classroom and beyond. Specific cases and incidents involving professors and students are examined. Constitutional law and case law interpreting the First Amendment freedoms and rights are discussed.

Academic Freedom and the First Amendment

Universities should be bastions of free speech – an environment that challenges students to think critically and explore new ideas. The exercise of academic freedom allows students to decide which ideas have merit. In part, tenure was created to promote academic freedom and freedom of expression. “The common good depends upon the free search for truth and its free exposition.” (AAUP, 1940) The First Amendment permits the exchange of ideas and provides an opportunity to challenge conflicting viewpoints. Arguably, the protection of controversial speech or ideas that are not supported by the majority is the most important purpose of the First Amendment.

In a recent incident, the University of Tampa fired a visiting professor, Kenneth Storey, for a tweet made in the wake of the devastation caused by Hurricane Harvey. Storey’s tweet was: “I don’t believe in instant Karma but this kinda feels like it for Texas. Hopefully this will help them realize the GOP doesn’t care about them.” (Phillips, 2017) Although Storey’s insensitive comments were denounced by the school, simply because comments are hurtful or offensive does not mean that they can be banned. In this instance, Storey did not enjoy the protection of tenure.

In *Rosenberg v. Rector & Visitors of the University of Virginia*, 515US 819, 836 (1995), the US Supreme Court noted that:

“For the University, by regulation, to cast disapproval on particular viewpoints of its students risks the suppression of free speech and creative inquiry in one of the vital centers for the Nation’s intellectual life, its colleges and university campuses.”

What speech is not protected on a public university campus? It is legal to restrict four types of speech: harassment, true threats, obscenity and defamatory remarks.

1. Although the First Amendment does not protect “harassment”, harassment in the educational environment is very different from harassment in the workplace. In the educational environment, harassment requires more than rude or insensitive remarks. Specifically, in *Davis v. Monroe County Board of Education*, 526 U.S. 629, 633 (1999), the Supreme Court defined harassment in the educational context as “so severely pervasive, and objectively offensive that it effectively bars the victim’s access to an educational opportunity or benefit.” This definition of harassment requires more than merely offensive comments or actions and is very different than sexual harassment in the workplace. In an effort to promote civil conduct on a university campus, it is important that the code of conduct not be overly restrictive.
2. “True threats” are not protected by the First Amendment and were defined by *Virginia v. Black*, 538 U.S. 343 (2003):

“True threats” encompass those statements where the speaker means to communicate serious expression of an intent to commit an act of unlawful violence to a particular individual or group of individuals.”

Brandenburg v. Ohio, 395 US 444 (1969) proscribed the standard for incitement and the US Supreme Court held that the state may not “forbid or proscribe advocacy of the use of force or of law violation except where such advocacy is **directed to inciting or producing imminent lawless action and is likely to incite or produce such action**” (emphasis added). Universities would like to foster an environment of civility; however, simply because words offend a student or could be considered to be provocative because they are hurtful or offensive, does not mean they can be legally banned.
3. Defamation is not a protected form of speech. Defamation includes written (libel) and oral (slander) untrue statements that harm a person’s reputation. It is important to note that truth is an absolute defense. In other words, if the statements are true, then they are not considered to be defamatory, even if someone’s reputation is harmed.
4. Obscene speech is not a protected form of expression under the First Amendment. As defined by *Miller v. California*, 413 US 15, 24 (1973), unprotected obscene speech must: “depict or describe sexual conduct and is limited to works which, taken as a whole, appeal to the prurient interest in sex, which portray sexual conduct in a patently offensive way, and which, taken as a whole, do not have serious literary, artistic, political or scientific value.”

Free Speech Codes and Zones

To foster a welcoming atmosphere, many colleges and universities attempt to encourage civility by using free speech codes that include disciplinary action for conduct or speech that the institution deems uncivil. At the very least, these rules may have a “chilling effect” on free speech. According to the AAUP’s 1994 statement *On Freedom of Expression and Campus Speech Codes*, “...rules that ban or punish speech based upon its content cannot be justified. An institution of higher learning fails to fulfill its mission if it asserts the power to proscribe ideas – and racial or ethnic slurs, sexist epithets, or homophobic insults almost always express ideas, however repugnant. Indeed, by proscribing any ideas, a university sets an example that profoundly disserves its academic mission.” (AAUP, 1994) As colleges encourage and even attempt to proscribe civil conduct, it is important to remember that “(M)ost uncivil or disrespectful speech is protected by the First Amendment” (FIRE, 2017) Thus, public universities as well as private universities that purport to respect students’ fundamental free speech rights, may not legally restrict speech that they consider to be “uncivil” with disciplinary action. To do so could subject the university to

liability under §1983 of the Civil Rights Act of 1964. There is also the potential personal liability under §1983 as well as liability on the part of the state for the plaintiff's attorney's fees.

Free speech zones are designated areas in which opinions may be expressed or students may gather at certain times. Universities frequently require a waiting period and prior permission to use these free speech zones and in effect, restrict freedom of assembly and speech. Free speech zones that require prior registration are clearly unconstitutional. According to the US Supreme Court:

“[i]t is offensive – not only to the values protected by the First Amendment, but to the very notion of a free society – that in the context of everyday public discourse a citizen must first inform the government of her desire to speak to her neighbors and then obtain a permit to do so.” *Watchtower Bible and Tract Society of NY, Inc., v. Village of Stratton*, 536 US 150, 165-166 (2002).

Time, place and manner restrictions on free speech may be legal. For instance, it would be inappropriate to disrupt a classroom. Lawns, quads, and other open campus spaces, on the other hand, should all be considered to be areas to exercise freedom of expression and assembly. These public areas should not require a waiting period or for the speakers to seek preregistration.

Talk Blocking

Although the First Amendment provides a means to challenge ideas that you don't like, it is a violation of the Constitution to “talk block” – to stop someone else's speech. The violent 2017 protests at Berkeley against a speech by Milo Yiannopoulos are difficult to forget. “Although the violence on February 1 was clearly instigated by outside agitators – “black bloc” anarchists who show up at events with their faces masked – at least some of the people behind the masks were Berkeley students who thought it was morally permissible to use violence to stop a lecture from taking place.” (Haidt, 2017) Perhaps more disturbing was an incident that occurred at Middlebury College a little over a month later. Middlebury students shouted down Charles Murray and gave his faculty host a concussion and whiplash. Unlike the Berkeley incident, “Murray is mild-mannered, came with co-sponsorship from the political-science department, and was there not to provoke but to talk about an issue that is central to students' moral and political concerns: social and economic inequality.” (Haidt, 2017)

The free and open exchange of ideas is a critical element in a learning environment. Protecting controversial speech is one of the most important functions of the First Amendment. As we go through life, we experience small offenses or maybe even large offenses. It is important to know how to appropriately deal with these uncomfortable experiences. If a speaker is presenting an offensive point of view, there are several options to talk blocking. One could ignore the offensive comment, turn your back on the speaker, engage the speaker during Q & A, or decline to attend.

In a June 2017 Senate Hearing on Campus Free Speech, Senator Dick Durbin, Democrat from Illinois posed the following hypotheticals: “Should I be able to stop a speaker because I am offended? No. Because I am intimidated? Yes. Should I be able to stop someone from speaking because he's unpopular? No. Because I find him menacing? Yes.” (Brown, 2017)

Do Students Know Their First Amendment Rights?

The First Amendment provides for freedom of religion, speech and the press and the rights of assembly and petition. In May 2017, 89 undergraduate students were surveyed. Of the respondents, four were exchange students. Students were generally aware of the rights guaranteed by the First Amendment. Of the 89 students surveyed, 87 (97.75%) could identify at least one right guaranteed by the First Amendment with the following results: 86 (freedom of speech), 74 (assembly and right to petition the

government), 70 (freedom of religion), 54 (freedom of the press). *Chart 1* below illustrates the breakdown.

Chart 1



Freedom of Expression on Campus

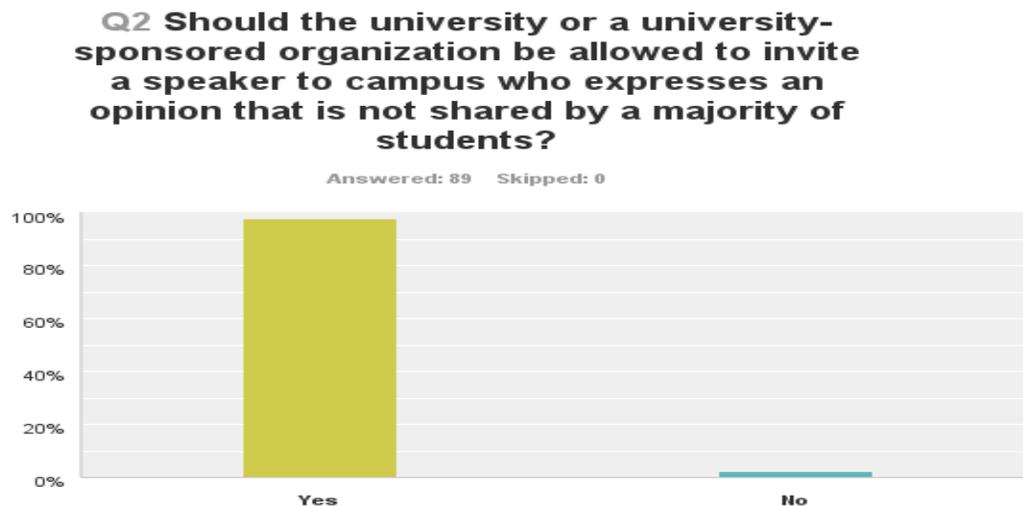
A late nineteenth and early twentieth century organic chemistry professor at University College of London is credited with the following observation:

*In free countries, every man is entitled to express his opinions
 and every other man is entitled not to listen.*

-- G. NORMAN COLLIE

Recent news reports are inundated with stories of speakers on universities being violently protested, uninvited, shouted down or otherwise prohibited from speaking. The survey respondents overwhelmingly (87/89 or 97.75%) support the proposition that a university or university-sponsored organization should be allowed to invite a speaker who expresses an opinion that is not shared by a majority of students.

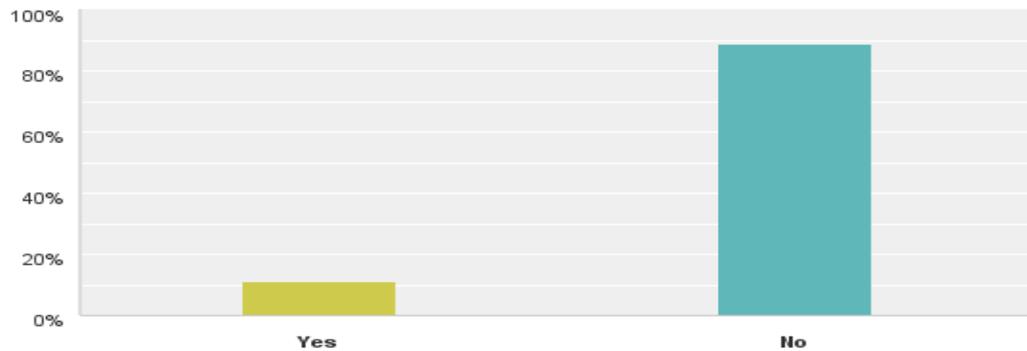
Chart 2.



In addition to the constitutionally protected right of freedom of speech and freedom of assembly, Virginia has passed a statute outlawing the establishment of so-called “free speech zones” at state supported universities. These “free speech zones” limit freedom of expression to a particular place, and frequently a particular time, and have appeared on many university campuses. When asked about “free speech zones”, 10 students (11.24%) agreed with this restriction.

Q3 "Free speech" on campus should be restricted to a specific area -- a free speech zone.

Answered: 89 Skipped: 0

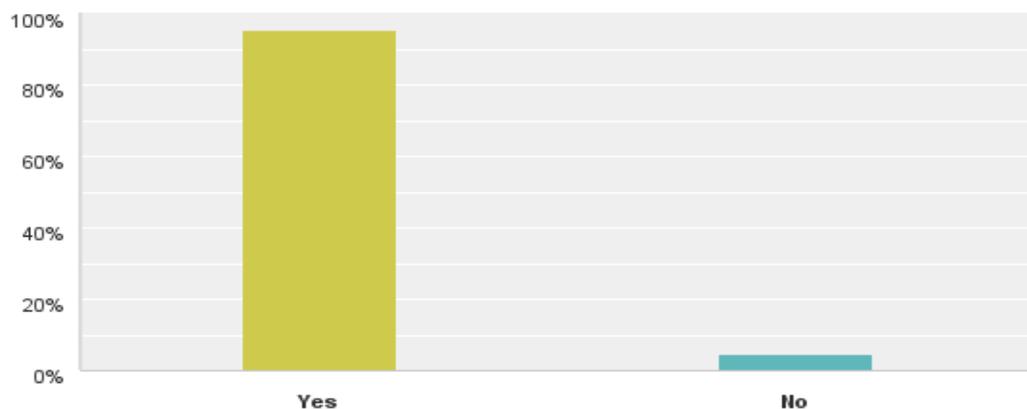


Of the undergraduates surveyed, 85 (95.51%) believe that students should be allowed to express their opinions or to peacefully assemble without first obtaining a permit and these results are indicated below in *Chart 4*.

Chart 4.

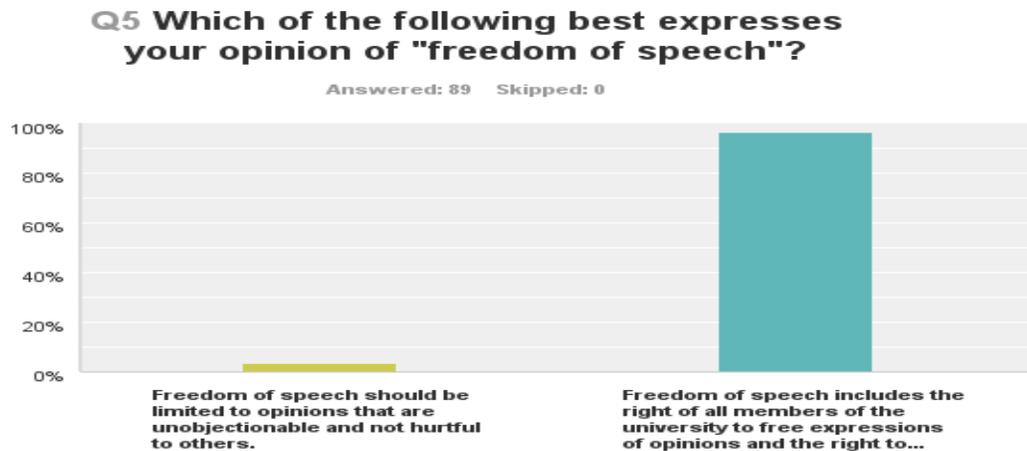
Q4 Students should be allowed to express their opinions or peacefully demonstrate without a permit.

Answered: 89 Skipped: 0



It is interesting to note that the overwhelming majority (86 or 96.64%) of students believe that “freedom of speech includes the right of all members of the university to free expressions of opinions and the right to hear the viewpoints of others. As shown in *Chart 5* below, only 3 students were of the opinion that “freedom of speech should be limited to opinions that are unobjectionable and not hurtful to others”.

Chart 5.



In the aftermath of the August 2017 violence in Charlottesville, the following appeared in the *Chronicle of Higher Education*: “Political violence is the antithesis of speech and must be met with punishment under the law, or more such violence will follow. But protected speech must remain free from punishment under the law, even when expressing hateful ideas, or else our First Amendment rights are only as powerful as the government permits them to be.” (Kruth, 2017)

Promoting Free Speech on Campus

In the search for truth, it is important to be open-minded and support the free expression of ideas. After all, the free and open exchange of ideas is a critical element of a learning environment. The University of Chicago has taken the lead on promoting freedom of expression and according to the Dean of Students, John Ellison: “Our commitment to academic freedom means that we do not support so-called ‘trigger warnings’, we do not cancel invited speakers because their topics might prove controversial, and we do not condone the creation of intellectual ‘safe spaces’ where individuals can retreat from ideas and perspectives at odds with their own.” (Vancouver, 2016) The following may help to encourage a civil atmosphere and the free exchange of ideas on campus:

- **Be a role model.** Question with boldness and condemn violent behavior. Instead of advocating or encouraging “talk blocking” or violent demonstrations, encourage students to confront speakers with well-reasoned questions (at the appropriate time), boycott an event or even turn their backs on an offensive speaker.
- **Principled leadership.** Speak up for academic freedom and free speech without regard to whether you agree with the viewpoint. In other words, be a principle-driven when advocating for the free exchange of ideas.
- **Free Speech on Your Campus.** Find out the status of free speech on your campus and encourage your university to seek “green light” status. FIRE has examined the status of First Amendment rights of almost all universities in the US. It is best to rely on persuasion and not

- sanctions that stifle the free exchange of ideas to create a civil learning environment.
- **Support the University of Chicago Statement on Free Expression (Appendix B).** Encourage your university to adopt the model Freedom of Expression Resolution based on the University of Chicago Statement (Appendix A).
 - **Consider whether it is wise to rent university space to outside groups.** This year, Auburn University and Texas A & M were ordered by judge to allow a white supremacist, Richard Spencer, to speak on their campuses. The court decision was based on the fact that both universities allowed outsiders to rent university space. Despite not being invited by any individual or group associated with these universities, the court said that Spencer had the right to rent the space on campus. The costs to the university associated the security concerns surrounding a speaker like Spencer would be prohibitive and perhaps it is time to “reconsider whether it is wise to monetize all of those facilities.” (Gluckman, 2017)

Conclusion

In an increasingly polarized environment, there is no doubt that issues relating to balancing freedom of expression and controversial speakers or groups will continue to be a challenge on university campuses. While dealing with this challenge, it is important to remember that on a university campus, “The common good depends upon the free search for truth and its free exposition.” (AAUP, 1940) As members of the academy, it is up to the faculty to promote civility and the free exchange of ideas. In part, this can be accomplished by ensuring that students understand the First Amendment and that the university does not infringe upon these rights. The AAUP has long endorsed a freedom of expression and in 1994, issued a statement *On Freedom of Expression and Campus Speech Codes* that in part states the following:

“Freedom of thought and expression is essential to any institution of higher learning. Universities and colleges exist not only to transmit knowledge. Equally, they interpret, explore, and expand that knowledge by testing the old and proposing the new. This mission guides learning outside the classroom quite as much as in the class, and often inspires vigorous debate on those social, economic and political issues that arouse the strongest passions. In the process, views will be expressed that may seem to many wrong, distasteful, or offensive. Such is the nature to sift and winnow ideas. On a campus that is free and open, no idea can be banned or forbidden. No viewpoint or message may be deemed so hateful or disturbing that it may not be expressed.” (AAUP, 1994)

Although speech (or conduct) that is considered to be a true threat, defamatory, obscene or harassment does not receive protection under the First Amendment, it is important to insure that students, faculty, and administrators understand the scope of these limitations. After all, protecting controversial speech is one of the most important functions of the First Amendment. According to Thomas Jefferson,

“For here we are not afraid to follow truth wherever it may lead, nor to tolerate any error so long as reason is left free to combat it.”

The freedom to express unpopular opinions has allowed us to grow and in many ways, to become more tolerant. The exposure to new ideas promotes creativity and is the foundation for the development of critical thinking skills.

References

AAUP. (1940) Statement of Principles on Academic Freedom and Tenure with 1970 Interpretive Comments. <https://www.aaup.org/report/1940-statement-principles-academic-freedom-and-tenure>

AAUP. On Freedom of Expression and Campus Speech Codes. (1994)
<https://www.aaup.org/report/freedom-expression-and-campus-speech-codes>

Brandenberg v. Ohio, 395 US 444 (1969)

Brown, Sarah. (2017) 4 Highlights From a U.S. Senate Hearing on Campus Free Speech. *The Chronicle of Higher Education*. <http://www.chronicle.com/article/4-Highlights-From-a-US/240400?cid=rdlink>

Davis v. Monroe County Board of Education, 526 U.S. 629, 633 (1999).

FIRE. Spotlight on Speech Codes 2017. <https://www.thefire.org/spotlight-on-speech-codes-2017/>
Kruth, Susan. (2017) On the violence in Charlottesville. <https://www.thefire.org/on-the-violence-in-charlottesville/>

Miller v. California, 413 U.S. 15 (1973)

Phillips, Kristine (2017) University fires professor who suggested Harvey was karma for Texas Republicans. <http://www.chicagotribune.com/news/nationworld/>

Rosenberger v. University of Virginia, 515 U.S. 819 (1994)

University of Chicago Report of the Committee on Freedom of Expression. <http://provost.uchicago.edu> (2014).

University of Chicago Statement on Principles of Free Expression.
<https://freeexpression.uchicago.edu/page/statement-principles-free-expression> Originally published on UChicago News (2012).

Vancouver, S.M. (2016). University of Chicago triggers a fresh debate about free speech on campus. *The Economist*, <https://www.economist.com/blogs/democracyinamerica/2016/08/content-may-cause-trauma>.

Appendix A

Because the [INSTITUTION] is committed to free and open inquiry in all matters, it guarantees all members of the [INSTITUTION] community the broadest possible latitude to speak, write, listen, challenge, and learn. Except insofar as limitations on that freedom are necessary to the functioning of the [INSTITUTION], the [INSTITUTION] fully respects and supports the freedom of all members of the [INSTITUTION] community “to discuss any problem that presents itself.”

Of course, the ideas of different members of the [INSTITUTION] community will often and quite naturally conflict. But it is not the proper role of the [INSTITUTION] to attempt to shield individuals from ideas and opinions they find unwelcome, disagreeable, or even deeply offensive. Although the [INSTITUTION] greatly values civility, and although all members of the [INSTITUTION] community share in the responsibility for maintaining a climate of mutual respect, concerns about civility and mutual respect can never be used as a justification for closing off discussion of ideas, however offensive or disagreeable those ideas may be to some members of our community.

The freedom to debate and discuss the merits of competing ideas does not, of course, mean that individuals may say whatever they wish, wherever they wish. The [INSTITUTION] may restrict expression that violates the law, that falsely defames a specific individual, that constitutes a genuine threat or harassment, that unjustifiably invades substantial privacy or confidentiality interests, or that is otherwise directly incompatible with the functioning of the [INSTITUTION]. In addition, the [INSTITUTION] may reasonably regulate the time, place, and manner of expression to ensure that it does not disrupt the ordinary activities of the [INSTITUTION]. But these are narrow exceptions to the general principle of freedom of expression, and it is vitally important that these exceptions never be used in a manner that is inconsistent with the [INSTITUTION]’s commitment to a completely free and open discussion of ideas.

In a word, the [INSTITUTION]’s fundamental commitment is to the principle that debate or deliberation may not be suppressed because the ideas put forth are thought by some or even by most members of the [INSTITUTION] community to be offensive, unwise, immoral, or wrong-headed. It is for the individual members of the [INSTITUTION] community, not for the [INSTITUTION] as an institution, to make those judgments for themselves, and to act on those judgments not by seeking to suppress speech, but by openly and vigorously contesting the ideas that they oppose. Indeed, fostering the ability of members of the [INSTITUTION] community to engage in such debate and deliberation in an effective and responsible manner is an essential part of the [INSTITUTION]’s educational mission.

As a corollary to the [INSTITUTION]’s commitment to protect and promote free expression, members of the [INSTITUTION] community must also act in conformity with the principle of free expression. Although members of the [INSTITUTION] community are free to criticize and contest the views expressed on campus, and to criticize and contest speakers who are invited to express their views on campus, they may not obstruct or otherwise interfere with the freedom of others to express views they reject or even loathe. To this end, the [INSTITUTION] has a solemn responsibility not only to promote a lively and fearless freedom of debate and deliberation, but also to protect that freedom when others attempt to restrict it.

Source: <https://www.thefire.org/model-freedom-of-expression-resolution-based-on-university-of-chicago-statement/>

Appendix B (Source: <https://freexpression.uchicago.edu/page/statement-principles-free-expression>)

The University of Chicago Statement on Principle of Free Expression

[Originally published on UChicago News](#)

The University of Chicago is an institution fully committed to the creation of knowledge across the spectrum of disciplines and professions, firm in its belief that a culture of intense inquiry and informed argument generates lasting ideas, and that the members of its community have a responsibility both to challenge and to listen. Geoffrey R. Stone, Edward H. Levi Distinguished Service Professor of Law and former Provost of the University, captures this ethos in his July 2012 statement of the aspirations of the University of Chicago:

Eighty years ago, a student organization at the University of Chicago invited William Z. Foster, the Communist Party's candidate for President, to lecture on campus. This triggered a storm of protest from critics both on and off campus. To those who condemned the University for allowing the event, University President Robert M. Hutchins responded that "our students . . . should have freedom to discuss any problem that presents itself." He insisted that the "cure" for ideas we oppose "lies through open discussion rather than through inhibition." On a later occasion, Hutchins added that "free inquiry is indispensable to the good life, that universities exist for the sake of such inquiry, [and] that without it they cease to be universities."

This incident captures both the spirit and the promise of the University of Chicago. Because the University is committed to free and open inquiry in all matters, it guarantees all members of the University community the broadest possible latitude to speak, write, listen, challenge and learn. Except insofar as limitations on that freedom are necessary to the functioning of the University, the University of Chicago fully respects and supports the freedom of all students, faculty and staff "to discuss any problem that presents itself," free of interference.

This is not to say that this freedom is absolute. In narrowly-defined circumstances, the University may properly restrict expression, for example, that violates the law, is threatening, harassing, or defamatory, or invades substantial privacy or confidentiality interests. Moreover, the University may reasonably regulate the time, place and manner of expression to ensure that it does not disrupt the ordinary activities of the University.

Fundamentally, however, the University is committed to the principle that it may not restrict debate or deliberation because the ideas put forth are thought to be offensive, unwise, immoral, or wrong-headed. It is for the members of the University community to make those judgments for themselves.

As a corollary to this commitment, members of the University community must also act in conformity with this principle. Although faculty, students and staff are free to criticize, contest and condemn the views expressed on campus, they may not obstruct, disrupt, or otherwise interfere with the freedom of others to express views they reject or even loathe.

For members of the University community, as for the University itself, the proper response to ideas they find offensive, unwarranted and dangerous is not interference, obstruction, or suppression. It is, instead, to engage in robust counter-speech that challenges the merits of those ideas and exposes them for what they are. To this end, the University has a solemn responsibility not only to promote a lively and fearless freedom of debate and deliberation, but also to protect that freedom when others attempt to restrict it.

As Robert M. Hutchins observed, without a vibrant commitment to free and open inquiry, a university ceases to be a university. The University of Chicago's long-standing commitment to this principle lies at the very core of the University's greatness.

College of Business Organizations: Analysis of Member Satisfaction

Written By: Christian Alesius

Advised By: Dr. Kurt Schimmel (Slippery Rock University)

Abstract

An analysis of the overall internal satisfaction and perceptions student led clubs and organizations of 164 students enrolled at a mid-sized regional state school in the east. This basic research is geared toward understanding the characteristics and benefits that clubs and organization offer to their members and which are the most important. Statistical analysis of student responses were used to create a list in descending importance the 29 organization characteristics and attributes that lead to member satisfaction within the organizations. The implications of this research will better help faculty advisors and student leaders gain insight into hosting events and planning activities that build the additional skill sets that will lead members to early success within their careers while also increasing member satisfaction.

Introduction

The choice of organization for a student to participate in, from the time they step on college campuses can become a daunting and challenging task. With so many different sports teams, fraternities and sororities, clubs, organizations, and other hobby groups, it can be overwhelming for incoming students, but; nonetheless, it is a choice that can have a major impact on the following years at the university or college. Becoming involved provides students with opportunities

to make friends, find new interests, break out of their comfort zones, and gain skills that can help them become better young professionals. The intrinsic and extrinsic rewards that come with becoming involved on campus play a key role in the overall college and future success of students.

Student satisfaction plays a part in the retention of students at colleges and universities. Recent studies have shown that 40% of admitted students leave without a degree, and that more than 75% of those students drop out within the first two years (Letcher & Neves). Student led organizations and other extracurricular activities on college campuses are some of the key factors that go into a successful college career because they increase the level of student satisfaction. They provide opportunities for students to expand their professional networks, as well as provide them with additional skills that will help them throughout their careers. Joining professional organizations help students put into practice tools they learn in the classroom and enhance preparation for their careers (Clark & Kemp, 2008). Participation in these organizations also play a key role in one's personal satisfaction with their overall college experience. What happens inside of the classroom and academic choices are not independent of the combination of all the other student experiences (Letcher & Neves, p. 3). Membership in campus organizations is part of this experience, which in return affects the overall satisfaction of students.

In addition to increasing the level of student overall satisfaction, student led organizations allow one to gain additional skills that go beyond the walls of the classroom. Participation in sports teams, clubs and organizations, or other extracurricular activities are starting to become one of the top things that recruiters and hiring managers look for when looking at applicant resumes. Recent studies have shown that experiences outside of academics such as internships, student employment, volunteering, and extracurricular activities rank higher in importance when evaluating graduates (Thompson, 2014). Extracurricular activities play a key role in helping to develop behavioral and interpersonal skills. The skills that come from interacting with other students, working in teams, and communicating effectively help to provide important skills that are required by many positions. In addition, the ability to work on these skills on a regular basis within an organization allows students to separate themselves from other applicants.

Despite all the benefits of joining clubs and organizations, there has been a trend of declining membership and the inability to retain current members for these organizations. The struggle to increase and maintain student membership in organizations on campus is one that challenges organization leaders and advisors. The solution lies within the current activities, or lack thereof, and how these activities either draw members in or turn them away. It also takes an understanding of members' current perceptions, attitudes, and outcomes that they hope to see

from joining these organization. This paper will describe the design of the survey, measurement and analysis, and results and conclusions.

Design

The overall scope of the research focused within the College of Business. By using Qualtrics' online survey platform, a survey was designed using the basic frameworks of current customer satisfaction and internal satisfaction surveys. The pool of survey respondents provided insight from multiple demographics such as gender, academic standing, and academic department of majors.

Respondent Demographics (Gender)	
	Percentage
Female	72.0
Male	28.0

Respondent Demographics (Academic Standing)		
	Frequency	Percentage
Freshman	18	12.7
Sophomore	21	14.8
Junior	37	26.1
Senior	62	43.7
Post Bac	4	2.8
Total	142	100.0

Respondent Demographics (Academic Department)	
	Percentage
Business	44.4
Communications	17.6
Safety Management	14.1
Sport Management	7.0
Other	16.9

Opening the survey reach created a diverse group of respondents that covered multiple sample cross-sections. The diverse sample pool of respondents allowed for a deeper understanding of analysis from multiple perspectives.

Females have different perspectives from males, desired outcomes change from freshman to post baccalaureate, and different departments have different behaviors and perceptions. It also allowed for additional analysis to be done on the differences between specific respondent groups. Understanding these difference would allow organizations to cater to various groups and position organizational goals to meet the desired outcomes of the different groups.

The survey constructs were aimed at analyzing the current behaviors, student perceptions, current attitudes and feelings, and desired outcomes. These constructs would help provide a basic understanding of the current membership(s) respondents were involved in, how they felt about their current membership, and what they hoped to get out of the membership. These constructs were measured by a variety of questions styles. A majority of the survey questions were questions

that provided a Likert scale. Since this project was aimed at measuring the attitudes and perceptions of students, this scaling method was able to provide an interval scale that could be used for thorough statistical analysis. The use of 1 to 7 Likert scales gauged accuracy of current behaviors, agreement of satisfaction, and likeliness of participation. The smaller scale provided a general overview of where respondents stood on these areas. The use of a larger Likert scale, 1 to 10, was used to gain a deeper understanding on the specific types of events, activities, and benefits of the respondents' organization. Since this correlates with the main focus of the project, a deeper analysis is needed to draw better conclusions that can later be generalized to other types of organizations.

Measurements

After the distribution and collection of survey results, the data was analyzed on the basis of twenty nine variables that included specific events, activities, aspects, and benefits of the student led organization. The twenty nine variables included: Scheduled Meetings, Fundraising Activities, Social Activities, Committee Meetings, Alumni Events, Annual Dinner/Banquets, Certificates, Competitions, Consulting Projects, Cover Letter Development, Etiquette Dinner, "Field" Trips to Companies, Finding Internships, Finding Jobs, Fundraising Experience, Leadership Development, Leadership Experience, LinkedIn Development, Local Conferences, National Conferences, Presentation Skills,

Professional Speakers, Regional Conferences, Resume Development, Skill Development, Social Events, Team/Group/Leader Skills, Travel, Volunteering/Service. This list of variables was determined by the relevance specifically for business majors and related fields, experiences in school, and general relevance to all majors and job applicants.

The data was analyzed through the use of IBM's SPSS Statistics software. More specifically, the measures that were taken were the frequency of responses of 1 to 10 for each variable, the mean value for each variable, and the standard deviation of each variable. Using these values, a master table was created to represent the overall data in a useful manner. The table is shown below:

Statistical Summary of Organization Variables												
Variable	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10	Mean	Standard Deviation
Scheduled Meetings	4	1	4	4	8	13	11	24	20	75	8.24	2.272
Fundraising Activities	9	4	6	7	12	12	26	24	20	44	7.25	2.636
Social Activities	3	2	8	2	17	12	12	39	26	43	7.66	2.274
Committee Meetings	4	3	7	6	19	11	20	23	23	48	7.48	2.453
Alumni Events	4	7	9	11	28	21	15	23	13	33	6.65	2.535

Annual Dinner/ Banquets	10	4	11	14	22	22	18	14	12	37	6.49	2.741
Certificates	11	6	7	11	22	10	19	16	22	40	6.81	2.838
Competitions	13	5	14	11	22	19	17	17	16	30	6.29	2.815
Consulting Projects	8	5	10	7	12	22	27	25	13	35	6.85	2.591
Cover Letter Development	6	5	7	10	13	10	25	23	19	46	7.27	2.605
Etiquette Dinner	14	3	9	15	21	26	12	21	12	31	6.33	2.761
"Field" Trips to Companies	6	4	4	7	15	14	15	23	25	51	7.54	2.539
Finding Internships	4	2	1	1	8	9	10	14	28	87	8.62	2.135
Finding Jobs	4	2	2	0	8	7	7	12	23	99	8.77	2.141
Fundraising Experience	9	2	8	8	12	16	22	26	17	44	7.20	2.623
Leadership Development	2	1	2	1	5	8	11	22	34	78	8.70	1.845
Leadership Experience	2	2	2	1	4	10	12	18	31	82	8.68	1.931
LinkedIn Development	4	4	6	2	9	9	20	26	22	62	7.95	2.387
Local Conferences	5	5	7	5	12	18	22	19	23	48	7.42	2.528
National Conferences	6	6	6	4	14	18	21	21	22	46	7.34	2.570
Presentation Skills	2	1	4	7	6	11	14	26	22	71	8.26	2.150
Professional Speakers	4	1	3	5	9	12	17	28	18	67	8.09	2.272

Regional Conferences	7	4	8	6	15	17	19	25	23	40	7.20	2.576
Resume Development	3	1	3	6	7	11	12	22	23	76	8.33	2.191
Skill Development	3	2	2	1	7	7	13	27	22	80	8.53	2.050
Social Events	2	4	3	3	12	19	22	29	17	53	7.77	2.203
Team/Group/Leader Skills	2	2	2	2	10	11	18	21	28	68	8.30	2.056
Travel	6	9	5	11	13	21	19	22	17	41	6.99	2.658
Volunteering/Service	3	4	1	8	14	9	19	28	26	52	7.81	2.288

Analysis

After collecting and organizing the data, it was ran through a descriptive analysis which provided an overall ranking of the variables based on the overall mean score. The higher the mean score, maximum of ten, the more important respondents felt the variable was in the organization. Oppositely, the lower the mean score, minimum of one, the least important respondents felt the variable was to the organization. The descriptive analysis table is shown below:

Descriptive Statistics		
	Mean	Std. Deviation
Finding jobs	8.77	2.141
Leadership development	8.70	1.845
Leadership experience	8.68	1.931
Finding internships	8.62	2.132
Skill development	8.53	2.050
Resume development	8.33	2.191
Team/group member/leader skills	8.30	2.056
Presentation skills	8.26	2.150
Scheduled meetings	8.24	2.272
Professional speakers	8.09	2.240
LinkedIn development	7.95	2.387
Volunteering/service	7.81	2.288
Social events	7.77	2.203
Social activities	7.66	2.274
“Field” trips to companies	7.54	2.539
Committee meetings	7.48	2.453
Local conference	7.42	2.528
National conference	7.34	2.570
Cover letter development	7.27	2.605
Fundraising activities	7.25	2.636
Fundraising experience	7.20	2.623

Regional conference	7.20	2.576
Travel	6.99	2.658
Consulting projects	6.85	2.591
Certificates	6.81	2.838
Alumni events	6.65	2.535
Annual dinner/banquet	6.49	2.741
Etiquette dinner	6.33	2.761
Competitions	6.29	2.815

After ranking the mean scores, it became apparent that some variables were more favorable than other. It is assumed that these key variables create additional value in the minds of students when it comes to joining and staying in an organization. The top ten results show that the activities and items that have a direct influence on a student's future career are carry a greater importance to students. Finding jobs and internships, developing leadership skills and experience, and additional skill development are all items that employers and recruiters look for in job applicants. Therefore, it is not surprising that these correlate to the research that shows that experiences outside of academics rank higher in importance when evaluating graduates (Thompson, 2014).

In contrast, there were variables that scored lower than others. Variables such as competitions, etiquette dinners and banquets, alumni events, and certificate all scored toward the bottom of the rankings. Many of the lower ranking variables are extrinsic benefits that do not directly correlate with future career opportunities.

There are some variables that ranked toward the bottom that provide students with opportunities to utilize what they learn in the classroom to real life situations.

Competitions and consulting projects were rank lower in the minds of the students, but these items allow additional skill sets that are overlooked by students, but are additional experience that employers look for that make applicants stand out.

Conclusion

In closing, student led organizations provide many activities and benefits to its members. Using the data and analysis presented in this paper can help to create improvements for not only Slippery Rock University School of Business clubs and organizations, but to other organizations as well. Understanding what activities and benefits rank highest and lowest in the minds of members will help clubs and organizations add activities that coincide with the higher ranking variables and eliminate the activities associated with lower ranking variables. By doing so, members will see added benefits to joining new organizations and maintaining membership in current ones, which will lead to higher student satisfaction.

Aside from the benefits reflected in the research, the experiential learning from extracurricular activities creates higher student engagement in the classroom. Experiential learning leads to stronger relationships between students and faculty, which leads to more interest in learning (Clark & Kemp, 2008). The enhancement

to clubs and organizations that the classroom provides, is reciprocated by the additional interest in learning that experiential learning provides. This trend also carries over into the relationship between extracurricular activities and employers. Due to the dissatisfaction with workers' behavioral skills, there is push in toward the argument that employers are more satisfied with technical and analytical capabilities than attitudes, interpersonal skills, and work related behavior (Rynes, Ilies, Trank, & Lawson, 2003). Due to this dissatisfaction, there has been an increase in business school courses that teach leadership, communication, HR management, ethics, and conflict resolution (Rynes, Ilies, Trank, & Lawson, 2003).

References

- Clark, W. R., & Kemp, K. J. (2008). Using the Six Principles of Influence to Increase Student Involvement in Professional Organizations: A Relationship Marketing Approach. *Journal for Advancement of Marketing Education*, 12, 1-10.
- Letcher, D. W., & Neves, J. S. (n.d.). Determinants of Undergraduate Business Student Satisfaction. *Research in Higher Education Journal*, 1-13.
- Rynes, S. L., Ilies, R., Trank, C. Q., & Lawson, A. M. (2003). Behavioral Coursework in Business Education: Growing Evidence of a Legitimacy Crisis. *The Academy of Management Learning and Education*, 1-14. Retrieved May 10, 2017.
- Thompson, D. (2014). The Thing Employers Look For When Hiring Recent Graduates. *The Atlantic*. Retrieved May 8, 2017.

Drones in the Supply Chain: A Detriment or Benefit

Megan Krimminger

Anderson University, Anderson, South Carolina, United States
1194 Potter Road Lancaster, SC, 29720
(803) 320-9319
mkrimminger136@andersonuniversity.edu

Kimberly Whitehead

Anderson University, Anderson, South Carolina, United States
(214) 592-6926
kwhitehead@andersonuniversity.edu

Faculty Sponsored Undergraduate Research

Drones in the Supply Chain: A Detriment or Benefit

Megan Krimminger, Anderson University, Anderson, South Carolina, United States

Abstract

Purpose: Supply chain management allows companies like Amazon.com, Inc., Domino's Pizza, Google, Inc., and United Postal Service of America, Inc. (UPS) to determine the most efficient and effective way to move materials internally among departments and externally to customers. The supply chain encompasses logistics management through efficiency practices (physically and informationally). Physical flows include movement of raw materials throughout a plant, while informational flows consist of plans (short-term or long-term) in regard to a numerical count on materials (mainly in day-to-day activities). Today, drones are the new and improved way to move materials, and/or completed products through a plant internally, or externally for consumers. This paper seeks to determine if the use of drones have a detrimental or beneficial effect on supply chain management.

Design/Methodology/Approach: All information within will come from scholarly literature already published. All articles will be reviewed and the information collected will then be analyzed and applied to the subject matter.

Findings: Scholarly literature shows both benefits and detriments for drones in the supply chain. This paper reveals the findings on the uses and future implications of drones on the supply chain process.

Keywords: Drones, Supply Chain Management, Literature, Uses, Future Expectations

Paper Type: Research Paper

Introduction

The future of supply chain management is heavily dependent on overcoming the obsolescence curve (Fawcett and Waller, 2014). With new ways to transport materials comes an end to previous ways that were once the most sustainable, efficient, and effective for a company. Fawcett and Waller (2014) discuss how drones will have an immense impact on the future of supply chain management, by highlighting the fact that in order to stay ahead companies must continually adapt and have “proactive preemption” to forecast the next big trend among other companies. Proactive preemption is the active use of current knowledge and facts to forecast (predict) happenings of the future.

Drones have a variety of uses among consumer, corporate manufacturing companies, and within the overall supply chain process. However, currently drones are being used mainly for product delivery. Dane Bamburly (2015) discusses how drones are a “disruptive technology ... [that is] on the verge of blowing a big hole in the supply-chain process”. He states that “big players are already skirmishing to get out in front [of the pack].” Bamburly (2015) goes on to look back over the past few years and the strides made within the fast-food industry as well as the various other industries, who are looking into drones as being more effective in the supply chain process. Drones were just a futuristic dream a few years ago, since they were only being used as a militaristic weapon, but now companies like Amazon.com, Inc., Google, Inc., United Postal Service of America, Inc. (UPS), and Domino’s Pizza are making headway in their drone development (Bamburly, 2015). He mentions Amazon.com, Inc. CEO Jeff Bezo’s announcement of an “Octocopter” that allows packages to be delivered in a 30-minute time frame and expected the product to be fully operational within five years. Shortly after Bezo’s announcement Google, Inc. and United Postal Service of America, Inc. (UPS) released a statement that they were also actively researching and investigating the use of a commercial-drone system (Bamburly, 2015). Google, Inc. will focus on the immediate medical supply industry, while United Postal Service of America, Inc. (UPS) desires to use a more militaristic style Unmanned Aerial Vehicle (UAV) within their warehouses (Bamburly, 2015).

Drones have a way of making a company’s system resilient and sustainable (Bamburly, 2015). Drones enable a company to become more resilient and sustainable by creating a better flow of materials internally among materials and externally to customers. They allow for my slack and lag time; therefore, increasing efficiency for the process as a whole. Fiksel (2003) claims that “a swarm of miniature unmanned surveillance drones may be less costly and more robust than a single conventional surveillance aircraft.” This is true not only in surveillance, but also in the maneuvering or delivering parts and packages to a consumer, or within a warehouse (Fiksel, 2003). As drones are used more a company will become resilient through sustainability. By being more efficient with practices in-house, companies will in turn be more efficient when providing a product or service to their customers. A sustainable supply chain process is valuable to any company; therefore, the use of a drone and the added benefits it brings will be a valuable asset to any company within the field (Fiksel, 2003).

Drones are also one of the new megatrends as named in Stank et al. (2015) paper. Specifically, drones are listed under “Megatrend 11: Inertia to Innovation to Transformation.” Within this trend the authors emphasize that “at the turn of the century ... the key priorities for a firm’s supply chain management organization was to deliver the perfect order – companies were intently focused on delivering valued output with consistent quality and high efficiency every single time.” This holds true today, since almost every company is desperately trying to use the most innovative, new, and high-tech gadgets to ensure that they are ahead of the obsolescence curve (Stank et al, 2015)

This paper aims to review the literature and address how drones will affect the supply chain process and will provide a discussion on the possible detriments and benefits they will create. This review is guided by the following three research questions:

RQ1: What is a drone and how is it used?

RQ2: How are drones being used in the supply chain process?

RQ3: What benefits and detriments do drones bring to supply chain management?

The rest of the paper is structured as follows. The next section will provide an outline on how the research paper was conducted followed by the results and findings. After the results and findings, a discussion on the benefits and detriments of the use of drones is provided.

Research methodology

Research papers identify key articles that aid in the explanation of a topic. Research papers require a thorough reading of the material and an accurate, concise, and unbiased paraphrase, which acts as a buffer for understanding. Essentially, research papers cut out the middle man. They allow researchers the ability to read one paper that discusses many different papers, thus removing the reading of multiple papers individually. The next section will elaborate on the steps taken, while writing the paper.

Step 1: Determine a thought provoking idea for undergraduate student research that pertains to Supply Chain Management. Drones are all the rage among millennials. They are the ultimate gift and the next big thing among transport. Therefore, a relevant topic to discuss about its current and future impact to the supply chain.

Step 2: Find relevant articles to support the topic. Relevant articles were found by using keywords. Keywords used for this research paper were “*drones*”, “*supply chain management*”, “*literature*”, “*uses*”, and “*future expectations*.” These keywords were used to find articles on Google Scholar and the OneSearch Database.

Step 3: Determine which articles from the query would be useful. The initial search for articles proved to be a challenge, since there is not much written about drones in the supply chain. Although searches on both databases offered a wide variety of articles, only few could be used in the format and information provided within them. Articles were eliminated by reading the abstracts to make sure that they were relevant to the research. Approximately, ten articles were found that could be used to relate drones back to the supply chain.

Review Process

Step 4: Once the articles were narrowed down to the ones that would be most useful, the next step was to determine which articles would be used to represent the research questions. Articles were thoroughly read for any information that could be used to determine and/or conclude any benefits or detriments of drones in the supply chain. Many articles vaguely mentioned drones, or unmanned aerial vehicles, so it was a definite task to find relevant material. Five papers were found that have direct relation to drones in the supply chain.

Step 5: The next phase was to start collecting, mostly, descriptive data, as well as a few statistics and quantitative data. Descriptive (qualitative) data was collected through notes in the margin of the papers, as well as highlighting any direct quotes that would prove beneficial to the paper. Quantitative data was recorded in a Word Document file and in a handwritten notebook. This was done in order to understand the literature, determine topics of discussion, and formulate a conclusion from both perspectives on the uses (or future uses) of drones. All findings are broken down into the three research questions as stated above.

What is a drone and how is it used?

A drone is an unmanned aerial vehicle (UAV), which is controlled by a remote control or autonomously. Drones do not have a pilot or passengers, but are equipped with a GPS (for navigation), a computer (for logistic directions), and a camera (for pictures, video, or live feeds). Drones have a range of useful performing activities. They are used personally, commercially, and by the government (Miller, 2016).

Personal Drones

Personal drones, specifically the quadcopter, are used to achieve an aerial shot of landscapes, events, or scenery. Personal drones (hobbyist drones) can fall into the following three broad categories as described by Miller (2016):

- “RTF, or ready-to-fly. An RTF drone comes with everything you need in a single box, including both the drone and the controller. There's nothing extra to buy.
- BNF, or bind-and-fly. BNF drones come completely assembled but lack the radio controller, which you need to purchase separately.
- ARF, or almost-ready-to-fly. These are drone kits that you have to assemble. Make sure you're good with your hands -- and in following directions!” (Miller, 2016)

The most popular brands of personal drones include, DJI, Parrot, and Yuneec (CNET, 2016).

Personal drones are the lifeblood of the future for drones in commercialized practice. Personal drones aid in the supply chain, indirectly, by providing an outlet for potential drone operators to receive an education on the overall controls. These drones also allow companies to toy with the idea of internal use on a low-cost basis and without going full force with commitments into a new transportation. They offer a general knowledge to the public about their use, as well as a research and development opportunity for companies like Amazon.com, Inc. to monitor the public's consensus on the technology.

Commercial Drones

Miller (2016) describes specifically how Amazon.com, Inc. and Domino's Pizza are using drones for product delivery. He suggests that commercial drones are faster and more accurate than your average day pizza deliveryman, since they are configured with coordinates in their memory and can fly above all traffic. Miller also states that commercial drones are equipped with a collision avoidance system, which allows the drones to navigate around tall buildings and recognize when something is getting in its flight path. Miller (2016) presents a scenario that describes what could be one of the main uses for drones in the supply chain. The scenario begins with a group of friends ordering a pizza off of a mobile app. The information for the order is then communicated to the pizza company, who then makes the pizza and once complete attaches the box to the next drone in line. The drone is then configured with the appropriate address and maps, after which it is set off into flight. Once the drone arrives at the specified address, the pizza is dropped off at the front door and returns back to its home base (Miller, 2016). Commercial drone use also includes, but is not limited to:

- Pipeline inspection
- Monitoring livestock
- Filmmaking (Miller, 2016)

Commercial drones create a low-cost alternative for occupations in the field of product delivery and companies that actively use a plant atmosphere (where parts or materials are transported internally) in their day-to-day operations. Product delivery and commercial drone use in relation to the supply chain process will be discussed in the latter portion of the paper.

Government Drones

Government drones in comparison to personal drones and commercial drones are much larger in size and number. Although, personal drones have had a sudden increase in the last five years, government drones have been around for quite some time. Government drones also have slightly different uses. They are mainly used for surveillance and attack (Miller, 2016).

Currently, there are over 50 countries that own drone programs. The United States has over 11,000 drones being used for reconnaissance and remote-control combat. Militaristic drones are used because they are cheaper than manned flights, safer since no personnel are hurt in a crash, and they can stay aloft longer (several days at a time) (Miller, 2016).

Within the United States arsenal of militaristic drones there are three drastically different sizes of UAVs, the MQ-9 Reaper has a 66-foot wingspan, MQ-1 Predator has a 27-foot wingspan, and the Raven has a 4.5-foot wingspan (Miller, 2016). The Reaper can reach up to speeds of 300 mph and can travel 3,200 nautical miles without stopping (Miller, 2016). Attacks made with the Reaper or Predator are executed manually; therefore, the correct department within the military communicates the decisions of bomb droppings to the drone (Miller, 2016). The Raven is used for remote reconnaissance (Miller, 2016). The directions are encoded into the computer aboard the aircraft and the GPS navigates the flight. The Raven can stay in flight for days at a time without much human interaction and is equipped with a live video feed camera (Miller, 2016).

On the home front, the United States Border Patrol uses drones as surveillance for the southern border in an attempt to stop illegal immigrants and drug traffickers. The United States has a \$39.4 million budget specifically for aerial surveillance within the Country and overseas. Local police use the basic surveillance feature of drones to monitor traffic problems, since it is less costly to operate a drone than a police helicopter. However, there is some backlash for domestic use of drones. Miller states in his article that, “local and state lawmakers across the country have passed or proposed legislation severely limiting how and when law enforcement can use drone aircrafts” (Miller, 2016).

Healthcare Drones

In the wake of the effects of Hurricane Harvey and Hurricane Irma to Texas and Florida, the discussion of drones in a healthcare environment have taken off. Carl Betterton posted an article to the Council of Supply Chain Management Professionals (CSCMP) website in relation to the most current supply chain question: “Could drones help some of those suffering people (Betterton, 2017)?”

Natural disasters create a barrier between those who need help and those who are offering to help. Citizens in need of help are often restricted by the dangers of loss of infrastructure and being in unpopulous regions of the state. In a normal situation aid would be able to deploy at a standard pace, but after complete devastation it is impossible (Betterton, 2017).

Walcutt has found a California-based company called Zipline who has created a medical drone that has saved lives in Rwanda. Since Rwanda’s roads and total infrastructure is poor, it takes approximately four hours for medical supplies to be delivered. Zipline’s medical drones have made it possible for the delivery times to be shortened to fifteen minutes. The drones are equipped to deliver

blood, so that patients get access to care almost immediately. Zipline's drones service is used by 21 hospitals throughout the country (Walcutt, 2017).

In a separate article, Walcutt introduces Windhorse Aeronatics drone called, Pouncer. This drone has the ability to fly with a pre-planned destination and carry essential supplies. Pouncer can carry food for up to 50 people, be used as kindling, and the plastic food covers can be used to build shelters (Walcutt, 2016).

In the Netherlands, a graduate student (Alec Momont) invented an ambulance drone. Momont's drone was equipped with a defibrillator, a camera, as well as a microphone and speakers (Husten, 2014). Momont designed the drone to be controlled by a paramedic in charge of helping with the emergency call. The drone would decrease travel time by one minute by traveling at 60 mph in the air; therefore, skipping traffic. Once the drone arrived on scene, the paramedic would then use the camera and microphone to speak with the people near the victim in order to give instructions. Once the defibrillator is attached it operates automatically (Husten, 2014).

Although it is too late to put any of the United States' drones into the air to help Hurricane flood victims, it is something to look forward to. It is good to see that there are research and development activities taking place somewhere in the world that will soon reach our region. It is innovators like Zipline, Windhorse Aeronatics, and Momont that allow for any humanitarian relief research to expand and thrive.

How are drones being used in supply chain?

"...drones are on the verge of blowing a big hole in the supply-chain process. Big players are already skirmishing to get out in front" (Bamburly, 2015).

Just as Miller (2016) described in his article on the common uses of personal, commercial, and government drones, Bamburly (2015) also presents an example of product delivering drones this time with a real life example, the "TacoCopter." Bamburly found that a San Francisco startup company generated the idea of the "TacoCopter" as a means of fast-food product delivery initiated through an app ordering system off of a smartphone straight to any physical location. Miller (2016) also pointed out in his article that Domino's Pizza was seeking to create a drone to deliver pizza. Bamburly (2015) finds that a prototype has already been made that is equipped with claws that support the weight of a delivery bag that contains two pizza boxes (Bamburly, 2015). Currently, drones are not able to support much weight, which is why companies like Google, Inc. are testing with smaller objects before moving on to larger, heavier goods.

Bamburly (2015) has gathered the following information from Amazon.com, Inc., Google, Inc. and United Postal Service of America, Inc. (UPS) about their commercial drone projects that have already begun, but could be fully functional within the next five years. Amazon.com, Inc., previously mentioned by Miller (2016), is toying with the idea of "Amazon.com, Inc. Prime Air," which is an air product delivery system that has the ability to deliver packages in about 30 minutes. Amazon.com, Inc. CEO Jeff Bezos announced the company's Octocopter drone on a *60 Minutes* episode in 2013 (Rose, 2015). Bezos believes the technology will be fully functional in the next five years and will be a hit, since the vast majority of packages weigh less than five pounds. Google, Inc., in the summer of 2014, reported that they were also getting in the commercial drone games (Bamburly, 2015). By this time, Google, Inc. had already completed at least 30 test flights in Queensland, Australia, where they delivered anything from first-aid kits to dog treats. The program is called Project Wing and will be focused on delivering medical

supplies to those of immediate assistance (Bamburry, 2015). United Postal Service of America, Inc. (UPS) is investigating the use of a smaller commercialized version of a militaristic UAV (Bamburry, 2015). United Postal Service of America, Inc. (UPS) has decided that their drone program will focus on internal use within their warehouse to improve efficiency, reduce fuel costs, and on-the-job accidents (Bamburry, 2015). Caldwell of bizjournals.com reported that United Postal Service of America, Inc. (UPS) recently made an order of 18 electrically powered trucks that feature a compartment on top of the truck for an add-on drone (Caldwell, 2015). The compartment is designed for The Horsefly drone, which was created and developed by AMP Electric Vehicles (Bamburry, 2015). This special drone is used to load the truck through a roof opening. The drone is equipped with eight rotors (most commercial drones have four) that allow for rotor redundancy, so that it will remain in flight if one rotor fails. Ultimately, The Horsefly drone will be used for short trips in order to conserve battery life, while the docking station will also offer a recharging port. However, the FAA (Federal Aviation Administration) has not approved the drone for commercial flight, but once it does AMP Electric will have full rights to mount drones to trucks as they wish (Bamburry, 2015). Amazon.com, Inc., Google, Inc., and United Postal Service of America, Inc. (UPS) believe that commercial drones will help in congested traffic areas in big cities, where trucks and large vehicles barely fit and struggle to make good time when delivering packages (Bamburry, 2015).

Drones will have a major impact on the supply-chain within the city, but on farms drones will reign as the number one efficiency and cost reduction device. 3D Robotics has started to raise awareness among farmers on how drones can improve efficiency of day-to-day farming tasks (Bamburry 2015). Farmers are already spraying fields with chemicals using drones. Spraying was either done by small planes or by manually walking the fields. Drones also enable farmers to determine if the crops need to be sprayed, which will reduce the amount of pesticides that come in contact with the produce. Drones also lower the cost of delivering produce to the marketplace (Bamburry, 2015). The aircraft could take the produce from the field to the warehouse, which uses less fuel and manpower, which would in turn reduce the market price of the goods. Bamburry (2015) also mentions that UAVs could be used to assess weather-related damages and to collect data for crop growth patterns.

UAV's can also be used in the construction world. Hubbard et al. (2015) described the use of radio frequency identification (RFID) technology and UAV to track materials on construction sites in their study on Feasibility. Hubbard et al. (2015) equipped a UAV with an RFID reader. The researchers used this setup in order to provide accurate material information. Hubbard et al. (2015) placed special emphasis on a project managers ability to plan a construction site and maintain constant information flows on materials and workers.

Hubbard et al. (2015) study proved to be successful, since the UAV and RFID equipment did not interfere with each other and all tags were able to be read. Successful combination of UAV and RFID technologies could (one day) help provide project management software with even more accurate information.

Overall, drones in the supply chain are focused around product delivery. They will allow for a definite cost reduction and increased efficiency among all companies that choose to use the technological advancement. As United Postal Service of America, Inc. (UPS) has noticed drones could enable their company to maneuver around their warehouse with increased efficiency by having groups of packages moved via air, rather than a forklift. This will not only move the product quicker, but will also generate less fuel cost and less accidents, since manpower will be dialed down. Drones will also act as a surveillance device for warehouses and delivery vehicles through the attached high-definition cameras (Bamburry, 2015).

Tavana et al. (2017), describes drones as a powerful contributor to the last mile delivery system. Essentially, the last mile delivery system is ground shipping. The transportation between business to customer can lack efficiency, be very expensive, and pollute the environment; therefore, it is a huge burden on the logistics chain. Deliveries via ground shipping are heavily dependent on traffic/travel times. Drones reduce travel time since they fly above all traffic, which creates a service that is quicker and more reliable (Tavana et al., 2017). Therefore, air travel is the most accurate, reliable, cost effective, and efficient way to deliver products.

Drones will simultaneously create jobs and take away jobs. Vlahovic et al. (2016), presents a perfect scenario of time effectiveness of drones, as well as job loss/gain through the pharmaceutical supply chain (comparing van delivery versus drone delivery). Vlahovic et al. (2016), models a supply chain that begins with the arrival of pharmaceutical supplies to the main warehouse. Orders are then received and processed by administrative staff, who then direct the orders to the warehouse worker. The warehouse worker packs the van (driver/delivery person required for each van). Like most delivery schedules, the van is dependent on the ferry. The complete process including the ferry ride and unloading of goods takes approximately 200 minutes (Vlahovic et al., 2016).

On the other hand, the delivery drone eliminates the additional worker of driver/delivery person (per each van). Also, the drone delivery system does not require additional time for reception because it is configured with the correct landing and docking zone (Vlahovic et al., 2016). Vlahovic et al. (2016), estimates the travel time to reduce to 27 minutes, with an additional 25 minutes for drop-off and recharge time. Thus, the complete process will take approximately 80 minutes. Although the example is relatively simple, Vlahovic et al. (2016), reveals that jobs like truck drivers, airplane pilots, and forklift drivers will be at risk, but new jobs that are centered around drones will replace these positions.

What is the overall effect of drones on the Supply Chain process? Detriment or Benefit?

One growing concern for the supply chain process, is that of the obsolescence curve, Fawcett and Waller (2014) conclude in their study that supply chain companies must stay ahead of the curve, by continually adapting and using proactive preemption to forecast future trends. Proactive preemption is the company's ability to be able to forecast (see into the future) future trends, by using brainstorming and visualizing techniques. The obsolescence curve for supply chain is measured by the growing number of new technologies that are taking over what used to be the most efficient and effective way to do a task. Fawcett and Waller's (2014) proactive preemption game plan can be achieved in four simple steps and can provide an outline for success in adaptation. The four steps include: scan, define new rules, adapt the strategy, and build the infrastructure. All steps seek to determine value-added principles and eliminate non-value-added processes. Drones are a sure way to stay ahead of the obsolescence curve (Fawcett & Waller, 2014).

In order for drones to stay ahead of the obsolescence curve, they must not be a fad for a certain generation. Fidget spinners and Slime are the newest fads. Although they are not technology, it is almost a sure thing that they will not stick around after a year or two. However, drones should stay in the market for quite a long period of time, since they are continually improving. Fawcett and Waller (2014) claim that a company must promote proactive renewal in addition to proactive preemption. Meaning, drone companies like DJI should constantly upgrade hardware and software for their products. Companies like Circuit City and Pan-Am met their demise and vanished due to not actively using both proactive renewal and proactive preemption (Fawcett & Waller, 2014).

Bamburly (2015) alluded to the resilience and sustainable features of drones in his paper on product delivery, but Fiskel (2003) examines those specific topics in his paper. Fiskel (2003) claims that a sustainable enterprise has the following factors:

- “(i) sensitivity and adaptability to the business environment
- (ii) cohesion and sense of identity
- (iii) tolerance of diversity (decentralization)
- (iv) conservative use of capital” (Fiskel, 2003)

Therefore, just as Fawcett and Waller (2014) mentioned companies like Amazon.com, Inc. and United Postal Service of America, Inc. (UPS) must continually adapt and match current market trends in the way they run their logistics task force. They also claim that a sustainable society must establish a system design that flows with the changing environment. Fiskel (2014) describes a sustainable society as one that:

- (i) Continually satisfies current needs of the population and forecasts in order to accurately provide for future generations
- (ii) Continually grows and adapts to the needs of both shareholders and stakeholders
- (iii) Continually improves the product or services design through modifications (Fiskel, 2003)

Therefore, the supply chain must continue to function in the most efficient way based off of the technology available. Drones are the new 18-wheelers. They provide an outlet of transportation internally and externally through operations via remote control and computer-generated maps and programs. Drones ultimately bring the supply chain closer to resilience and sustainability, by remaining above the obsolescence curve. Companies will benefit from the added surveillance that drones offer, as well as the continued value-added operations that will only get better over the years to come. Drones will make day-to-day tasks run more smoothly, by operating in the sky and taking forklifts out of the picture among warehouses. Ultimately, drones bring our society to pure sustainability by reducing the cost of the products it delivers, since there is a reduction in fuel cost.

The maker movement as described by Waller and Fawcett has minimized the supply chain tremendously. The maker movement is comprised of entrepreneurs who decide to start a company to sell handmade objects, IKEA projects, and the rise of assembly required products. This reduces the supply chain by taking out known producers and placing a local consumer in their place (Waller & Fawcett, 2013).

Drones aid in this movement because they can be acquired by the average consumer, who can then use them in their business operations or as entertainment. As mentioned before a drone can be purchased completed, by buying a kit, or by buy various parts and creating a new design. The last option creates a gap in the product chain. When a customer chooses to build their own they are now a part of product design and no longer a company’s endpoint (Waller and Fawcett, 2013).

The maker movement will affect supply chain design by having an impact on transportation, design and location of warehouses, forecasting, and the selection process of suppliers (Waller and Fawcett, 2013).

However, there are a few issues with drones that will affect the supply chain in a very negative way. Bamburly highlights these issues at the very end of his paper through a “food for thought” aspect. Bamburly asks the following questions, “What if they are hacked for consumer data? What if they are turned into weapons? Could they carry drugs or other contraband? ... If a bird can bring down a 737, what might a drone do?” The simplest answer to Bamburly’s questions is, yes (Bamburly, 2015).

In this day and age, improper uses of technologies happen every day. There is no debate that drones could and would be used in a malicious way once commercialized. Computers get hacked daily;

therefore, drones will be attacked for information. Drones will be under great speculation until the Federal Aviation Administration determines that they are being used in the correct fashion, with little to no privacy invasion. There is still work to be done about the range of drones and where they will be able to drop off a package (safety of product). Although, many questions still need to be answered drones are the replacement for all logistical transportation needs (internally and externally). Bamburly (2015) and the Association for Unmanned Vehicle Systems International (Sharma, 2013) believe that this disruptive technology could add \$8.2 billion a year over the next 10 years in economic activity. The Huffington Post reports that at least 70,000 jobs would be created in the first three years of functionality and gradually increase to 100,000 jobs by 2025 (Lowy, 2015). This growing industry will be one to watch not just for the future of supply chain, but also for the future of the entire service oriented industry and the jobs created by the new technological introduction (Bamburly, 2015).

“Key priorities for a firm’s supply chain management organization was to deliver the perfect order—companies were intently focused on delivering valued output with consistent quality and high efficiency every single time” (Stank et al., 2015). Drones will offer consistency and efficiency for supply chain companies like Amazon.com, Inc. and United Postal Service of America, Inc. (UPS). For all companies, the overall supply chain must be perfect and drones will bring them closer to perfection (Stank et al., 2015).

SWOT Analysis of Drones: Amended from (Vlahovic et al., 2016)

<p>Strengths</p> <ul style="list-style-type: none"> • Reduces fuel cost • Eliminates middle man • Reliable transport • Reduces travel time • Increased efficiency 	<p>Weaknesses</p> <ul style="list-style-type: none"> • Not much testing completed • FAA regulations • Too few companies interested • Customers are weary with the idea of drone usage
<p>Opportunities</p> <ul style="list-style-type: none"> • New jobs created • New fields of study • Air highways • Deliveries wherever and whenever 	<p>Threats</p> <ul style="list-style-type: none"> • Target practice • Customers not accepting drone deliveries • Security issues (with products left too far away from homes or businesses) • Possible inadequacies

Conclusion

Drones offer both benefits and detriments to the supply chain process. There will continue to be questions and debates about the topic for years to come, but ultimately drones will not be stopped. They will continue to expand and revolutionize life as our society knows it. The supply chain will never be the same, once drones have a definite foothold in the market. All companies should be preparing for their next highest paid employee and their new drone operator, the time to hire may be closer than any of us expect.

The results offer an even ground among professionals in the field. Meaning, that professionals are either all in with research and development for drones, or all out. Currently, there is not enough information on drones and their uses for professionals to decide to (or not to) invest their time, money, and energy into a possible bust innovation.

There are no true benefits or detriments of drones in the supply chain. However, drones will reduce middle man, create a lessor need for human interaction, and create a smoother operation between business to business and home to home interactions. Drones will reduce the middle man, by allowing the company to use in house employees to transport materials rather than subcontract out work. Drones will likely take jobs away from the general public, but will ultimately replace them with a different type of job. New jobs will include drone operators, engineers, and equipment technicians. Drones create a smoother flow among companies and costumers, by being able to skip traffic via air travel. Therefore, reducing the supply chain and creating an efficient process.

Further research is recommended to be done on the following topics in relation to drones in the supply chain:

- Science behind the equipment;
- Overall management;
- Regulations and Government Warnings;
- Past experiences creating current worries among general population; and,
- Market research on packages being delivered via drone.

At the conclusion of this paper, drones are continually being studied by the average 20-year-old college student and the CEO of Amazon.com, Inc. it will come to no surprise when the next taco, pizza, or package is ordered and a UAV takes flight. Keep watching the sky and see what happens next.

Limitations

Lack of viable current research created a less ideal scenario for this research paper. Drones in the supply chain are a relevant topic, but one that has not been researched as much as other technologies within the manufacturing sector. Lack of current research made my paper inconclusive; therefore, it did not provide a definite answer towards the primary question, are drones a detriment or a benefit? The scope of the paper could have also been narrower. It should have provided a decision and either fought against the decision or proved it; therefore, creating a conclusive output.

References

- Bamburly, D. (2015). DRONES: Designed for Product Delivery. *Design Management Review*, 26(1), 40-48. doi:10.1111/drev.10313
- Betterton, C. (2017). Drones for Healthcare and Disaster Relief. Retrieved September 20, 2017, from <http://cscmpscrt.org/drones-for-healthcare-and-disaster-relief/>
- Caldwell, C. (2015, February 9). New UPS trucks designed to add drone on top. Retrieved May 31, 2017, from <http://www.bizjournals.com/jacksonville/blog/morning-edition/2015/02/new-ups-trucks-designed-to-add-drone-on-top.html>
- CNET (Ed.). (2016, February 26). Best Drones of 2017. Retrieved May 31, 2017, from <https://www.cnet.com/topics/drones/best-drones/>
- Fawcett, S. E., & Waller, M. A. (2014). Can We Stay Ahead of the Obsolescence Curve? On Inflection Points, Proactive Preemption, and the Future of Supply Chain Management. *Journal of Business Logistics*, 35(1), 17-22. doi:10.1111/jbl.12041
- Fiksel, J. (2003). Designing Resilient, Sustainable Systems. *American Chemical Society: Environmental Science & Technology*, 37(23), 5330-5339. Retrieved May 30, 2017.
- Hubbard, B., Wang, H., Leasure, M., Ropp, T., Lofton, T., Hubbard, S., & Lin, S. (2015). Feasibility Study of UAV use for RFID Material Tracking on Construction Sites. Retrieved September 20, 2017, from <http://ascpro0.ascweb.org/archives/cd/2015/paper/CPRT367002015.pdf>
- Husten, L. (2014, October 30). Grad Student Invents Flying Ambulance Drone To Deliver Emergency Shocks. Retrieved September 20, 2017, from <https://www.forbes.com/sites/larryhusten/2014/10/29/grad-student-invents-flying-ambulance-drone-to-deliver-emergency-shocks/#52fa3e861bfc>
- Lowy, J. (2015, February 14). FAA seeking drone rules favorable to commercial operators. Retrieved May 31, 2017, from <http://www.huffingtonpost.com/huff-wires/20150214/us--faa-drones/>
- Miller, M. (2016, January 20). Drones: What Are They, Exactly, and How Will They Affect Your Future? Retrieved May 30, 2017, from <http://www.informit.com/articles/article.aspx?p=2433612>
- Rose, C. (2015, September 29). Amazon's Jeff Bezos looks to the future. Retrieved May 31, 2017, from <http://www.cbsnews.com/news/amazons-jeff-bezos-looks-to-the-future/>
- S., A., D., & C. (2015). Reimagining the 10 Megatrends That Will Revolutionize Supply Chain Logistics. *Transportation Journal*, 54(1), 7. doi:10.5325/transportationj.54.1.0007
- Sharma, R. (2013, November 26). Growing The Use Of Drones In Agriculture. Retrieved May 31, 2017, from <https://www.forbes.com/sites/rakeshsharma/2013/11/26/growing-the-use-of-drones-in-agriculture/#267b9723ea72>
- Tavana, M., Khalili-Damghani, K., Santos-Arteaga, F. J., & Zandi, M. (2017). Drone shipping versus truck delivery in a cross-docking system with multiple fleets and products. *Expert Systems with Applications*, 72, 93-107. doi:10.1016/j.eswa.2016.12.014

- Vlahovic, N. , Knezevic, B. , Batalic, P. (2016). 'Implementing Delivery Drones in Logistics Business Process: Case of Pharmaceutical Industry'. *World Academy of Science, Engineering and Technology, International Science Index, Economics and Management Engineering*, 3(12), 3095.
- Walcutt, L. (2016, October 03). This 'Edible' Drone Can Deliver Food To Help Survivors Of Humanitarian Crises. Retrieved September 20, 2017, from <https://www.forbes.com/sites/levelup/2016/10/03/this-edible-drone-can-deliver-food-to-help-survivors-of-humanitarian-crises/#390d94eb4245>
- Walcutt, L. (2017, May 31). Blood Delivery Drones Are Revolutionizing Healthcare In Rwanda. Retrieved September 20, 2017, from <https://www.forbes.com/sites/levelup/2017/05/31/blood-delivery-drones-are-revolutionizing-healthcare-in-rwanda/#76ffe780917d>
- Waller, M. A., & Fawcett, S. E. (2013). Click Here for a Data Scientist: Big Data, Predictive Analytics, and Theory Development in the Era of a Maker Movement Supply Chain. *Journal of Business Logistics*, 34(4), 249-252. doi:10.1111/jbl.12024

MULTI-OBJECTIVE MATHEMATICAL MODELS TO DESIGN BIOMASS TO BIOFUEL SUPPLY CHAIN SYSTEM IN SOUTH CAROLINA

Shadae S. Taylor, Mathematical Education, South Carolina State University
Orangeburg, SC 29117, 803-707-1247, Staylor@scsu.edu

Jae-Dong Hong, Industrial Engineering, South Carolina State University
Orangeburg, SC 29117-7722, 803-536-8861, jhong@scsu.edu

ABSTRACT

In this paper, we use two multi-objective mathematical programming (MOMP) models to design biomass to biofuel supply chain (*BBSC*) system. In the MOMP models, we consider two objectives of minimizing the input, total logistics cost, and of maximizing the total output of biofuels. We propose the procedure of finding efficient supply chain network schemes by solving MOMP models. Through a case study using the data for South Carolina, we evaluate the proposed procedure and demonstrate that the proposed procedure performs well and can help the practitioners and decision-makers design efficient *BBSC* system.

INTRODUCTION

Bioenergy—energy produced from biomass—has the great potential to reduce the dependence on unstable oil supply and mitigate the global environmental crisis of using fossil fuel. In fact, bioenergy is the fastest-growing source of energy generation, according to the IEO2013 Reference case (U.S. Energy Information Agency 2013). A significant amount of research over the world has been devoted to methods of producing bioenergy. Not many attention has been given to the production efficiency of biomass to bioenergy supply chain system. Balaman and Selim [2] emphasize the importance of biomass to bioenergy supply chain by claiming that that design, operation, and management issues in renewable energy supply chains are increasingly gaining importance in recent years in parallel with the rising interest in renewable energy sources. They claim that biomass-based bioenergy production has been proposed as a part of the solution to the worldwide increasing energy consumption, limited fossil fuel resources, climate change and environmental pollution caused by the use of fossil fuel resources.

Indeed, biomass is one of new sources of bioenergy, which is a form of renewable energy. Recently, biomass has played an important role in the global demand for energy. Many countries are now seeking the opportunity to use biomass feedstocks for producing bioenergy. Biofuels refer to liquid and gas fuels used for transportation and industrial processes. In fact, much of the gasoline in the United States has been blended with ethanol, which is a typical example of biofuels. Today, ethanol is known as the cleanest and most affordable fuel additive on the market. The United States Environmental Protection Agency (EPA) in collaboration with refiners, renewable fuel producers and various stakeholders developed a Renewable Fuel Standard program (RFS), which intended to set production targets based upon these growing energy needs to ensure that gasoline in the U.S. contains a minimum percentage of renewable fuel. The RFS has helped generate jobs, revive rural economies, reduce oil imports, lower gasoline prices, reduce air pollution, and cut greenhouse gas emissions. Low oil prices caused record gasoline utilization, leading to rare ethanol use in E10 blends (10% ethanol, 90% gasoline). Since higher blends of ethanol also experienced growth, hundreds of retail stations offered lower-cost, cleaner-burning fuels such as E15 and E85. As 2017 began, ethanol producers faced a number of important challenges. Unnecessary regulatory obstacles continue to constrain ethanol's use in the marketplace. Industries whose market share is threatened by ethanol continue attempts to undermine biofuels and the RFS. As shown in Figure 1, even when faced with daunting challenges, U.S. ethanol producers continued building partnerships and growing markets just as they have

done for nearly four decades. The RFS requires oil companies to blend increasing volumes of renewable fuels with gasoline and diesel, reaching 36 billion gallons in 2022. Each renewable fuel category in the RFS program must emit lower levels of greenhouse gases relative to the petroleum fuel it replaces.

In recent years, several biomass-to-bioenergy logistics studies have been conducted. Most of these existing studies focus either on the optimization of biorefinery locations (Celli et al. [3]; Graham et al. [7]; Panichelli & Gnansounou [11]; Perpina et al. [12]; Steen et al. [16]) or on the optimization and simulation of the biomass collection, storage, and transport operations (Frombo et al. [6]; Kumar & Sokhansanj, [10]; Rentizelas et al. [14]; Sokhansanj et al. [15]). Some of the deterministic models take an integrated view of plant location, production, and transportation decisions of biomass supply chains (Eksioglu et al. [4], Zamboni et al. [19], Huang et al. [9], An et al. [1]).

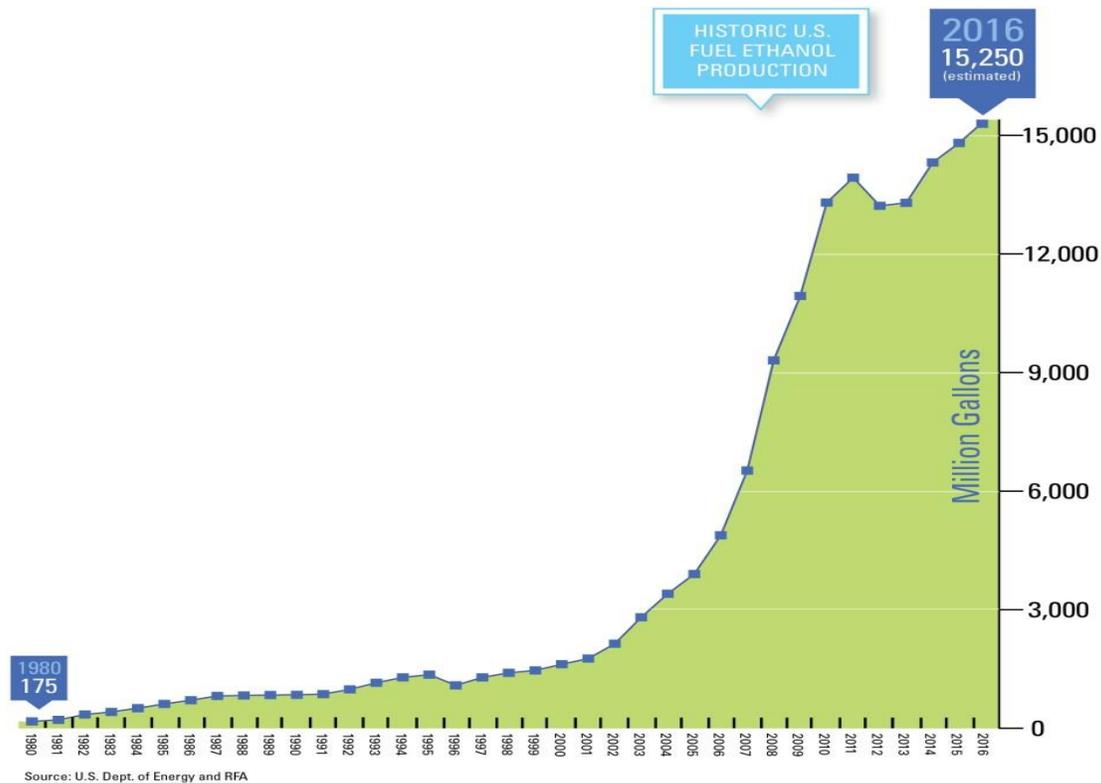
In this study, we consider an integrated biomass to biofuel supply chain (*BBSC*) network system design problem studied by Eksioglu et al. [4] and Hong et al. [8]. Eksioglu et al. [4] propose a mathematical model that can be used to design the supply chain and manage the logistics of a biorefinery. Eksioglu et al. [4] use the State of Mississippi as the testing ground of their model. Hong et al. [8] propose the productivity-driven approach to finding robust biofuel facility location, using data from the State of South Carolina for their study. We use the basic structure of their network system. The supply chain network consists of four different types of facilities: a supply point - farm or harvest site (HS), a storage point - collection facility (CF), and a production point - biorefinery (BRF), and a demand point – blending station (BS). We assume that the locations of HS and BS are fixed, and the demand of each BS is constant throughout the planning period. The logistics network structure is depicted in Figure 2. We do not consider gas stations in this supply chain. The inbound flows (solid arrows) in Figure 2 represent the collection, storage, and transportation of biomass, which can be of many types. The biomass collected at each HS is brought by trucks into a local CF. Smaller loads of biomass collected from the HS are temporarily stocked at the CF before they are consolidated and transported to a BRF by large-capacity trucks for processing into biofuel.

After aggregation, densification, pelletization of biomass feedstocks at the HS, a CF is a potential site for to store and preprocess (e.g., compress) biomass to a more valuable density and/or to pre-treat biomass to make a better quality biomass feedstock so that it can be transported in a more cost-effective way. In addition, a direct transportation of biomass from an HS to a BRF is allowed and the resulting transportation cost is usually higher than going through the CF, since the direct shipping of biomass from an HS to the BRF requires more space (due to the low biomass density) and more operations and preparation to be processed into biofuel. Thus, conversion rates to biofuel of biomass feedstock shipped from CF to BRF are usually higher than those for biomass feedstock shipped from HS to BRF. The outbound flows (dashed arrows) in Figure 2 show that biofuels transported from BRFs to BSs are to be blended with fossil fuels before being distributed to gas stations. Given the locations of BSs and their demands, the transportation costs mainly depend on the proximity of BRFs to BSs. In this supply chain network, determining the locations of BRFs and CFs will be the most critical decision, since a BRF usually requires several million dollars as the annualized construction and operation costs. Also, the use of CFs would affect the quality of biofuel that primarily depends on the moisture content in the biomass (van Dyken et al., [18]), letting alone the total transportation cost between HSs and BSs.

Contrary to the traditional total cost minimization approach by Eksioglu et al. [4], we consider the production efficiency, which is defined as the ratio of production amount of biofuel to the total logistics costs. Thus, we consider two goals as the major performance measures. The first goal is to minimize the total logistics cost (*TLC*), as Eksioglu et al. [4] consider. The second goal is to maximize the biofuel production output (*BPO*). To accommodate these two goals in one objective function, we use two multi-objective mathematical programming (MOMP) approaches as a tool for designing an efficient *BBSC*. The typical MOMP model allows the decision maker to assign weights to the deviational variables in the objective function to better reflect the importance and desirability of deviations from the various goals. The

aim of this paper is to apply a production efficiency-driven approach (PEDA) to evaluate each optimal solution for given weights, generated by the MOMP models formulated for the *BBSC* design problem, and to identify the most efficient option from all options, where a commonly used measure of efficiency is the ratio of output to input. As far as we know, applying a PEDA to *BBSC* design problem has not been tried in any literature. This process would help practitioners as well as researchers to produce a finer evaluation of efficiency/productivity and to provide a design and benchmarking framework for designing *BBSC* system to improve overall supply chain productivity.

FIGURE 1. HISTORIC U.S. FUEL ETHANOL PRODUCTION



The rest of this paper is organized as follows. After the development of two MOMP models in the next section, a PEDA to *BBSC* is introduced. In the following section, as a case study, we consider the *BBSC* network design problem in South Carolina (SC), USA and present the resulting analysis. The last section summarizes the developed MOLP models and research findings. It also provides recommendations for future research directions.

MULTI-OBJECTIVE PROGRAMMING MODELS

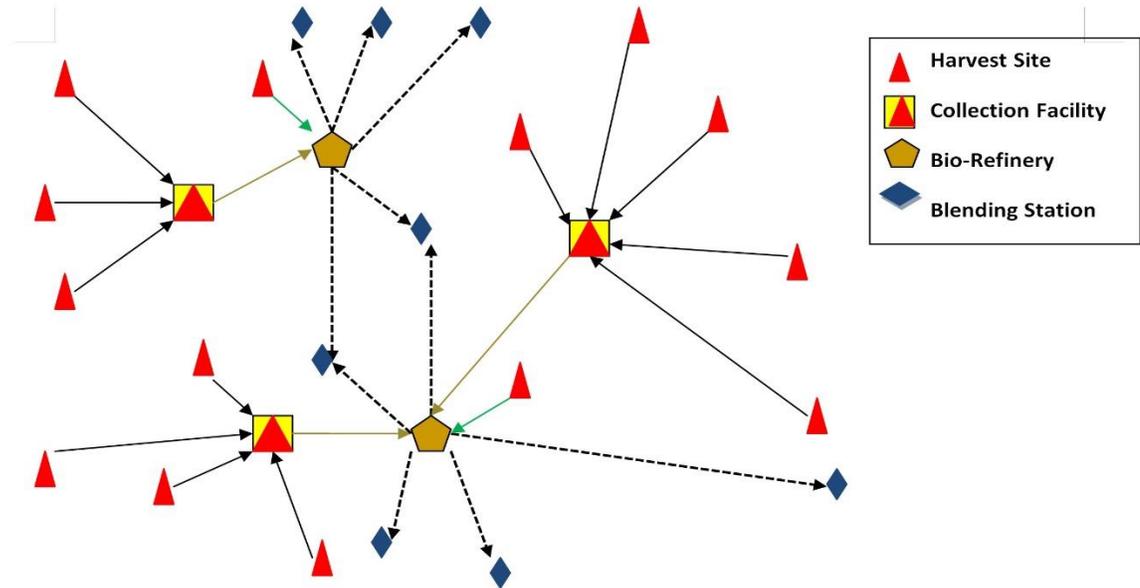
As Hong et al. [8] assume, CFs can be located at any HS and a biorefinery (BRF) can only be built at a candidate BRF location since BRF locations must satisfy some realistic requirements. This is a reasonable assumption at the planning stage for the *BBSC* model. It may be difficult to decide potential CF locations which are not HSs since the assignment of HSs to a CF is not known.

Let F be the set of all harvesting sites (HSs) and potential collection facility (CF) locations, indexed by f . Now, let J , I , and K respectively be the set of CFs, BRFs, and BSs, indexed by j , i , and k . Also, let L and G respectively be the set of capacities of BRF and CF, indexed by l and g . The parameters used in this

formulation are the following: ψ_{il}^b is amortized annual cost of constructing and operating a BRF_i with the l^{th} size; ψ_{jg}^c is amortized annual cost of constructing and operating a CF_j with the g^{th} size; C_l^b and C_g^c denote the actual capacity of l^{th} and g^{th} size of BRF and CF, respectively; β_f and γ_f are conversion rates to bio-energy of biomass feedstock shipped from CF to BRF and from HS to BRF, respectively; S_f denotes the yield of biomass feedstock from HS_f ; D_k is the demand of biofuel for BS_k ; δ_i is the maximum number of HSs that ship biomass directly to BRF_i ; d_{ji}^1 , d_{ji}^2 , d_{ji}^3 , and d_{ik}^4 are unit transportation cost (UTC) from HS_f to CF_j , from HS_f to BRF_i , from CF_j to BRF_i , and from BRF_i to BS_k , respectively. In this study, we set $d_{ji}^2 \geq d_{ji}^1$, to denote a higher unit transportation cost for shipping biomass from HS_f directly to BRF_i .

The decision variables are the following: x_{il}^b is a binary variable that equals 1 if a biorefinery of size l is located in site i , and 0 otherwise; x_{jg}^c is a binary variable that equals 1 if a collection facility of size g is located in site j , and 0 otherwise; y_{jf}^1 is a binary variable that equals 1 if HS_f 's yielded biomass shipped to CF_j and 0 otherwise; y_{fi}^2 is a binary variable that equals 1 if HS_f ships biomass directly to BRF_i , and 0 otherwise; y_{ji}^3 is a binary variable that equals 1 if CF_j is assigned to BRF_i , and 0 otherwise; y_{ik}^4 is the fraction of BRF_i ' produced biofuel shipped to BS_k .

FIGURE 2. SCHEMATIC OF BIOMASS-BIOFUEL SUPPLY CHAIN



Letting N_b and N_c denote the maximum number of BRFs and CFs to be built, we formulate the following MIQP model that minimizes the total logistics cost (TLC), which is the sum of the annualized construction and operation cost for CFs and BRFs and the transportation costs from HSs to CFs, HSs to BRFs, CFs to BRFs, and BRFs to BSs:

$$TLC = \left[\sum_{i \in I} \sum_{l \in L} \psi_{il}^b x_{il}^b + \sum_{j \in J} \sum_{g \in G} \psi_{jg}^c x_{jg}^c \right] + \left[\sum_{j \in J} \sum_{f \in F} S_f d_{jf}^1 y_{jf}^1 + \sum_{i \in I} \sum_{f \in F} S_f d_{fi}^2 y_{fi}^2 \right]$$

$$+ \left[\sum_{i \in I} \sum_{j \in J} \left(\sum_{f \in F} S_f y_{fj}^1 \right) d_{ji}^3 y_{ji}^3 \right] + \left[\sum_{i \in I} \sum_{k \in K} D_k d_{ik}^4 y_{ik}^4 \right] \quad (1)$$

To find the biofuel production output (BPO), let β_f denote the conversion rate to biofuel of biomass feedstock shipped from CF to BRF and γ_f the conversion rate to biofuel for biomass feedstock shipped from HS to BRF. Now, BPO is given by

$$BPO = \sum_{i \in I} \sum_{j \in J} \left[\sum_{f \in F} S_f y_{fj}^1 y_{ji}^3 \right] \beta_f + \left[\sum_{i \in I} \sum_{f \in F} S_f y_{fi}^2 \right] \gamma_f. \quad (2)$$

Let the nonnegative deviation variables, δ_{TLC}^+ and δ_{BPO}^- , denote the amounts by which each value of TLC and BPO deviates from the minimum value of TLC , TLC_{min} , and maximum values of BPO , BPO_{max} , respectively. Then, the deviation variables are given by

$$\delta_{TLC}^+ = TLC \text{ in (1)} - TLC_{min}, \quad (3)$$

$$\delta_{BPO}^- = BPO_{max} - BPO \text{ in (2)}. \quad (4)$$

Now, the first model's objective is to minimize the weighted sum of the percentage deviations (WSPD) as follows (see Ragsdale [13]):

$$G(\alpha) = \alpha_1 \frac{\delta_{TLC}^+}{TLC_{min}} + \alpha_2 \frac{\delta_{BPO}^-}{BPO_{max}}, \quad (5)$$

where α_g , $g = 1$ and 2 , is a weight factor ranging from 0 and 1 and $\sum_g \alpha_g = 1$. With an objective function given in (5) and constraints (3)-(4), we call it a **G-Model**.

The second model's objective is to minimize the maximum weighted percentage deviation (WPD), subject to each WPD is less than or equal to the objected value itself. Let Q represent the maximum WPD such as

$$Q(\alpha) = \text{Max} \left\{ \alpha_1 \frac{\delta_{TLC}^+}{TLC_{min}}, \alpha_2 \frac{\delta_{BPO}^-}{BPO_{max}} \right\}, \quad (6)$$

subject to

$$\alpha_1 \frac{\delta_{TLC}^+}{TLC_{min}} \leq Q, \quad (7)$$

$$\alpha_2 \frac{\delta_{BPO}^-}{BPO_{max}} \leq Q. \quad (8)$$

With an objective function given in (6) and the constraints (3)-(4) and (7)-(8), we call it a **Q-Model**. Now, for the $BBSC$ design problem, we formulate as a mixed integer linear programming (MILP) model as follows:

$$\text{Minimize } G(\alpha) \text{ in (5) or } Q(\alpha) \text{ in (6)}$$

subject to

Equations (3)-(4) and/or (7)-(8)

See Hong et al. [8] for other constraints. Now, we define the production efficiency score, PE_ω to be the ratio of BPO to TLC, as is given by

$$PE_\omega = \frac{BPO_\omega}{TLC_\omega}. \quad (9)$$

CASE STUDY USING EPA TRACKED SITES IN SOUTH CAROLINA

As Hong et al. [8] use, we follow the same scenario illustrated in Figure 3 (EPA Tracked Sites in South Carolina (SC) with Biorefinery Facility Siting Potential [5]). Sixteen (16) counties, whose biomass resources are classified ‘good’ or better as shown in Figure 3, are selected as the harvesting sites (HSs). Then, one city from each county using a centroid approach was chosen as the candidate location for collection facility (CF) location. Five (5) locations {Branchville, Cayce, Lake City, Prosperity, Ridgeland} and ten locations (10) throughout SC are selected as candidate sites for BRFs and blending stations (BSs). The potential locations for BRFs are selected based upon low population density, easy access to interstate highways, etc. We use the actual distances between cities representing HSs, CFs, BRFs, and BFs. Table 1.A shows the demands (in thousand gallons) for all BSs, whose demands are hypothetical values and would be readily replaced by true demand data for real-world applications. We summarize the values of the input parameters in Table 1.B. Note that we assume that the conversion rates, β_i and γ_i , are 70% and 30%, respectively. As shown in Figure 3, the minimum, maximum, and average amounts of biomass yield at each HS are summarized in Table 1.C. Based upon these input data, an Excel spreadsheet model for MILP problem is developed and solved using Analytic Solve Platform with VBA (Visual Basic for Applications).

TABLE 1.A. DEMAND FOR BLENDING STATION

No.	Blending Station	Demand(in 1000 gallons)
1	Aiken	200
2	Bishopville	200
3	Clinton	300
4	Dillon	200
5	Greenville	200
6	Lancaster	200
7	Manning	250
8	Santee	150
9	Spartanburg	200
10	Summerville	150

TABLE 1.B. INPUT DATA USED FOR CASE STUDY

Symbol	Meaning	Value
ψ_{il}^b	Amortized annual cost of constructing and operating a BRF_i with the l^{th} size	\$0.7M, \$0.8M, and \$1M for $l=1, 2, 3$.

ψ_{jg}^c	Amortized annual cost of constructing and operating a CF_j with the g^{th} size	\$120K, \$150K, and \$200K for $g=1, 2, 3$.
C_l^b	Actual capacity of l^{th} size of BRF	500K, 800K, 1M gallons for $l=1, 2, 3$.
C_g^c	Actual capacity of g^{th} size of CF	400K, 800K, 1M tons for $g=1,2,3$.
β_f	Conversion rates to bio-energy of biomass feedstock shipped from CF to BRF	70%
γ_f	Conversion rates to bio-energy of biomass feedstock shipped directly from HS to BRF	30%
δ_i	Maximum number of HSs that ship biomass directly to BRF_i	16
N_b	Maximum number of BRFs to be built	2
N_c	Maximum number of CFs to be built	4
d_{fj}^1	Unit transportation cost (UTC) from HS_f to CF_j	\$0.005/mile/K metric tons
d_{fi}^2	Unit transportation cost (UTC) from HS_f to BRF_i	\$0.01/mile/K metric tons
d_{ji}^3	Unit transportation cost (UTC) from CF_j to BRF_i	\$0.007/mile/K metric tons
d_{ik}^4	Unit transportation cost (UTC) from BRF_i to BS_k	\$0.01/mile/K gallons

Before solving the two MILP models, G- and Q-Model, it is necessary to determine the target values for each goal parameter. Those are TLC_{min} and BPO_{max} . These values can be found by solving the MILP problem with the objective function of the corresponding equations of TLC in (1) and BPO in (2). In fact, each of these target values could be obtained by setting the corresponding weight equal to 1 and solving the MILP problem. For example, setting $\alpha = (1, 0)$ and solving either G-Model or Q-Model yields the target value of TLC , TLC_{min} . Similarly, setting $\alpha = (0, 1)$ and solving either G- or Q-Model yields the target value of BPO , BPO_{max} . Now, we solve and summarize the target values, TLC_{min} and BPO_{max} , in Table 2. Using the values in Table 2, the two models are solved for various values of the weight, α_g , where each weight changes between 0 and 1 with an increment of 0.1. There are eleven configurations for each model.

TABLE 1.C BIOMASS YIELD

No	Harvest Site	Minimum Yield (Thousand Metric Tons)	Average (Thousand Metric Tons)	Maximum Yield (Thousand Metric Tons)
1	Allendale	100	150	200
2	Berkeley	150	200	250
3	Chester	150	225	300
4	Colleton	100	200	300
5	Darlington	150	225	300
6	Dorchester	150	225	300
7	Florence	150	225	300
8	Georgetown	250	400	550
9	Greenwood	150	225	300

10	Hampton	150	225	300
11	Horry	100	175	250
12	Lexington	100	175	250
13	Newberry	250	400	550
14	Orangeburg	150	225	300
15	Richland	250	400	550
16	York	150	225	300

TABLE 2. THE TARGET VALUES OF TWO GOALS.

Target Value	$\alpha=(\alpha_1, \alpha_2)$	<i>TLC</i> (K\$) (pd)	<i>BPO</i> (Kgallon) (pd)
<i>TLC</i> _{min}	(1, 0)	4,021.97 (0.0)	2160 (20.8)
<i>BPO</i> _{max}	(0, 1)	7,586.76 (88.6)	2730 (0.0)

pd: percentage deviation from the target value, pd= (x-Target Value)/Target Value*100(%)

After solving each model, G- and Q-Model, we present values of the two performance metrics, *TLC* and *BPO*, along with the configurations of weights, production efficiency score, PE_ω in (22), and rankings of PE_ω , $\omega = 1, 2, \dots, 11$. As shown in Table 3, if we focus on minimizing *TLC* only, as the scheme #11, it may not yield the most efficient supply chain design scheme due to the reduced amount of biofuel production. In a similar vein, the scheme with the maximum *BPO* with the maximum *TLC*, as shown in the scheme #1, would not be the most efficient one either. In fact, both the schemes #1 and #11 turn out to be the two most inefficient schemes, which rank the very last two. Note that the schemes #2 and #3 for G- and Q-Model, #4 and #5 for G-Model yield the same *TLC* and *BPO* and rank 1st with the highest production efficiency score of 0.6195, whereas the scheme #5 for Q-Model ranks 2nd with the production efficiency score of 0.6159.

In Figure 4 and 5, we depict the optimal locations and allocations of CFs and BRFs and assignments of BRFs to BSs, which are also obtained by solving G- and Q-Model. For example, the scheme # 5Q in Figure 4 with number two ranking selects {Florence, Georgetown, Newberry, Richland} and {Prosperity, Lake City} as the optimal locations of CFs and BRFs, respectively. And the allocation scheme is as follows: For biomass feedstocks, the harvest sites (HSs) {Colleton, Darlington, Florence, Horry, Lexington} ship to CF {Florence}, HSs {Berkeley, Dorchester, Georgetown,} ship to CF {Georgetown}, HSs {Allendale, Chester, Newberry, York} to CF {Newberry}, HSs {Hampton, Orangeburg, Richland} to CF {Richland}. Now CFs {Florence, Georgetown} ship to BRF {Lake City} while CFs {Newberry, Richland} ship to BRF {Prosperity}. Only HS {Greenwood} directly ships their biomass feedstocks to BRF {Prosperity}. For the produced biofuels, BRF {Prosperity} ships to BSs {Aiken, Clinton, Greenville, Lancaster, Spartanburg}, whereas BRF {Lake City} to BSs {Bishopville, Dillon, Manning, Santee, Summerville}.

Let us call the most efficient scheme group, {2GQ, 3GQ, 4G, 5G, 6G}, as Group1. We notice that there is no direct shipment from HS to BRF in Group 1, whereas there is one case of direct shipment from HS to BRF in the next efficient scheme, 5Q. Thus, the schemes in Group1 generate a higher *TLC* as well as a higher *BPO* than the scheme 5Q, since a direct shipment suggested by 5Q may lower the shipping cost due to the shorter distance, but the conversion rate of the direct shipment is lower than that of indirect shipment from CF to BRF.

Note that regarding performance measures, scheme #1 is dominated by schemes #2 through #3 for both G- and Q-Model and 4G, 5G, and 6G. The two most efficient supply chain schemes, Group 1 and 5Q, are depicted in Figure 4, whereas the two most inefficient schemes, 1GQ and 11GQ in Figure 5. We observe that all schemes select {Prosperity, Lake City} as BRFs and allocation from BRFs to BSs are same for all schemes. Thus, these two BRF locations and their allocations seem to be robust for all supply chain schemes. In fact, as we put more weights on *TLC*, the direct shipments from HSs to BRFs increase to reduce *TLC*. As shown in Figure 6, the scheme #11, which generates the minimums of *TLC*, shows that seven HSs directly ship their biomass feedstocks to BRFs. As a result, this scheme yields the lowest *BPO*. Note that, in the efficient schemes to generate more *BPO*, the transportation route does not look as efficient as the scheme #11, such as the long shipping distances from HS {Colleton} to CF{Newberry} and from HSs {York, Hampton} to CF {Florence}.

From the case study, we observe that the higher *TLC* a supply scheme requires, the higher *BPO* it generates. From this observation, we can claim that the traditional single-objective models of minimizing the total cost or maximizing the biofuel production may not generate efficient supply chain schemes. Thus, our multi-objective approach proposed in this paper would help decision-makers design efficient biomass to bioenergy supply chain schemes and find the robust bioenergy facility location-allocation decisions.

SUMMARY AND CONCLUSIONS

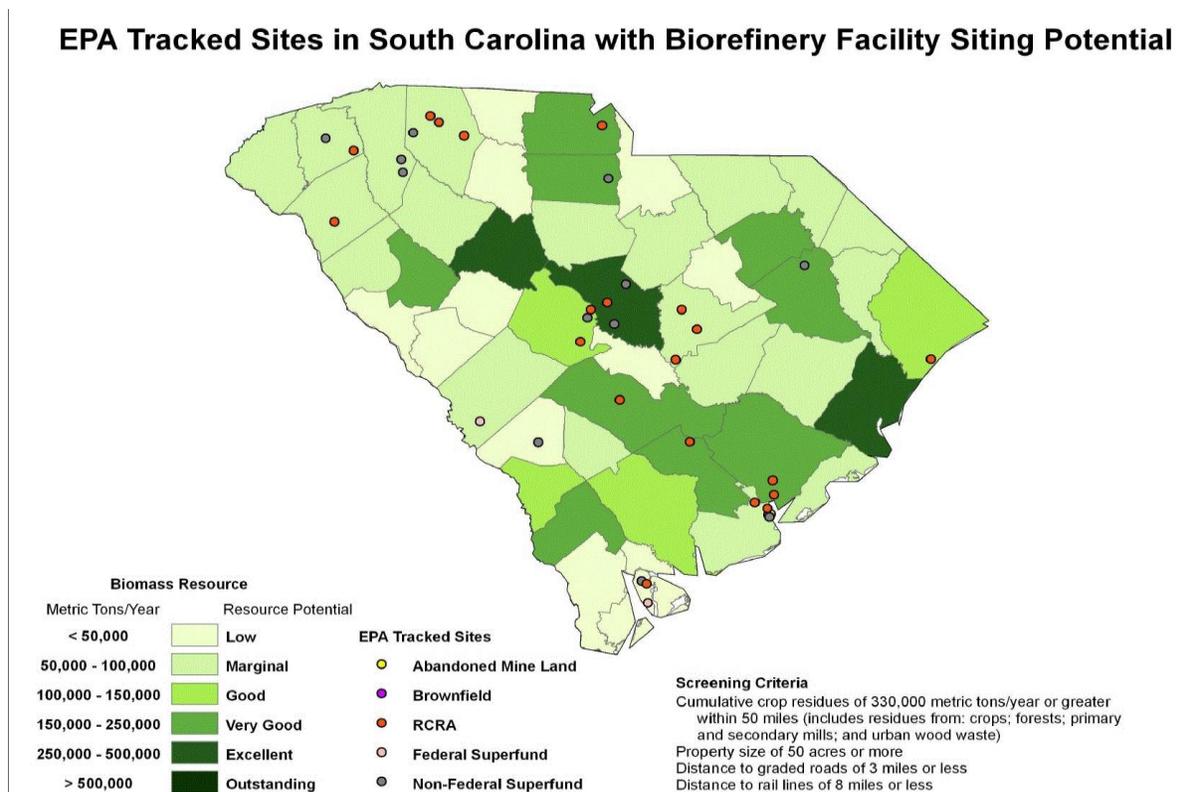
To design a more balanced biomass-to-bioenergy supply chain (*BBSC*) design scheme, we apply two multi-objective mathematical programming models, G- and Q-Model. We use a production efficiency-driven approach (PEDA), where the efficiency is defined as the ratio of the biofuel production output (*BPO*) to the total logistics cost (*TLC*). The two models provide various supply chain schemes to the decision maker. Through a case study for South Carolina, we evaluate those schemes using PEDA and rank them regarding the generated efficiency score of each alternative. As expected, the scheme with either the highest *BPO* or the lowest *TLC* will not be the most efficient one, as shown in Table 3. In other words, the scheme with the highest *BPO* requires the highest *TLC*, whereas the scheme with the lowest *TLC* results in the lowest *BPO*. Contrary to the conventional cost-driven approach (CDA) used by various researchers, the *BBSC* scheme generating the minimum *TLC* is not necessarily the best or the most efficient one from an integration perspective. This paper demonstrates that our framework would generate a balanced biomass-to-biofuel supply chain scheme, find the robust facility location and allocation decisions, and shows that the applicability of our innovative approach to this type of supply chain design problem.

TABLE 3. NUMERICAL EXAMPLE

No.	G or Q (α_1, α_2)	<i>TLC</i>	<i>BPO</i>	PE_ω	Rank
1	G, Q(0.0, 1.0)	\$7,768.92	2730	0.3514	11
2	G, Q(0.1, 0.9)	\$4,406.66	2730	0.6195	1
3	G, Q(0.2, 0.8)	\$4,406.66	2730	0.6195	1
4	G(0.3, 0.7)	\$4,406.66	2730	0.6195	1
	Q(0.3, 0.7)	\$4,331.35	2640	0.6095	3
5	G(0.4, 0.6)	\$4,406.66	2730	0.6195	1
	Q(0.4, 0.6)	\$4,286.33	2640	0.6159	2

6	G(0.5, 0.5)	\$4,406.66	2730	0.6195	1
	Q(0.5, 0.5)	\$4,260.88	2570	0.6032	5
7	G(0.6, 0.4)	\$4,108.06	2480	0.6037	4
	Q(0.6, 0.4)	\$4,249.27	2490	0.5860	8
8	G(0.7, 0.3)	\$4,108.06	2480	0.6037	4
	Q(0.7, 0.3)	\$4,179.82	2480	0.5933	6
9	G(0.8, 0.2)	\$4,108.06	2390	0.5872	7
	Q(0.8, 0.2)	\$4,108.06	2480	0.6037	4
10	G(0.9, 0.1)	\$4,022.17	2180	0.5420	9
	Q(0.9, 0.1)	\$4,070.19	2390	0.5872	7
11	G, Q(1.0, 0.0)	\$4,021.97	2160	0.5371	10

FIGURE 3. EPA TRACED SITES IN SOUTH CAROLINA WITH BIOREFINERY FACILITY SITING POTENTIAL



REFERENCES

- [1] An, H., Wilhelm, W. E., & Searcy, S. W. “A Mathematical Model to Design a Lignocellulosic Biofuel Supply Chain System with a Case Study Based on a Region in Central Texas.” *Bioresource Technology*, 2001,102, 7860-7870.
- [2] Balaman, S. Y. & Selim, H. “Biomass to Energy Supply Chain Network Design: An Overview of Models, Solution Approaches and Applications,” In: S. D. Eksioglu et al. (Eds), *Handbook of Bioenergy: Bioenergy Supply Chain – Models and Applications* (pp.1- 35), New York: Springer, 2015.
- [3] Celli, G., Ghiani, E., Loddo, M., Pilo, F., & Pani, S. “Optimal Location of Biogas and Biomass Generation Plants.” *In Proceedings of the 43rd International Universities Power Engineering Conference*, 2008, Padova, Italy, 1-6.
- [4] Eksioglu, S. D., Acharya, A., Leightley, L. E., & Arora, S. “Analyzing the Design and Management of Biomass-to-Biorefinery Supply Chain.” *Computers & Industrial Engineering*, 2009, 57(4), 1342-1352.
- [5] EPA Tracked Sites in South Carolina with Biorefinery Facility Siting Potential. Retrieved June 15, 2013, from www.epa.gov/renewableenergyland/maps/pdfs/biorefinery_sc.pdf.
- [6] Frombo, F., Minciardi, R., Robba, M., Rosso, F., & Sacile, R. “Planning Woody Biomass Logistics for Energy Production: A Strategic Decision Model.” *Biomass and Bioenergy*, 2009, 33(3), 372-383.
- [7] Graham, R.L., English, B.C., & Noon, C.E. “A Geographic Information System-based Modeling System for Evaluating the Cost of Delivered Energy Crop Feedstock.” *Biomass and Bioenergy*, 2000, 18(5), 309-329.
- [8] Hong, J.D., Feng, K., & Xie, Y. “A Simulation-Based Robust Biofuel Facility Location Model for an Integrated Bio-Energy Logistics Network.” *Journal of Industrial Engineering and Management*, 2014, 7(5), 1415-1432.
- [9] Huang, Y., Chen, C.W. & Fan, Y. “Multistage Optimization of the Supply Chains of Biofuels.” *Transportation Research Part E*, 2010, 46(6), 820-830.
- [10] Kumar, A., & Sokhansanj, S. “Switchgrass (*Panicum virgatum*, L.) Delivery to a Biorefinery Using Integrated Biomass Supply Analysis and Logistics (IBSAL) Model.” *Bioresource Technology*, 2007, 98(5), 1033-1044.
- [11] Panichelli, L., & Gnansounou, E. “GIS-Based Approach for Defining Bioenergy Facilities Location: A Case Study in Northern Spain Based on Marginal Delivery Costs and Resources Competition between Facilities.” *Biomass and Bioenergy*, 2008, 32(4), 289-300.
- [12] Perpina, C., Alfonso, D., Perez-Navarro, A, Penalvo, E., Vargas, C., & Cardenas, R. “Methodology Based on Geographic Information Systems for Biomass Logistics and Transport Optimization.” *Renewable Energy*, 2009, 34(3), 555-565.
- [13] Ragsdale, C. T., *Spreadsheet Modeling & Decision Analysis: A Practical Introduction to Business Analytics*. 7th Edition, Stamford, CT: Cengage Learning, 2015.

- [14] Rentizelas, A. A., Tolis, A. J., & Tatsiopoulos, L. P. “Logistics Issues of Biomass: The Storage Problem and the Multi-Biomass Supply Chain.” *Renewable and Sustainable Energy Reviews*, 2009, 13(4), 887-894.
- [15] Sokhansanj, S., Kumar, A., & Turhollow, A.F. “Development and Implementation of Integrated Biomass Supply Analysis and Logistics Model (IBSAL).” *Biomass and Bioenergy*, 2006, 30(10), 838-847.
- [16] Steen, E. J., Kang, Y., Bokinsky, G., Hu, Z., Schirmer, A., McClure, A., del Cardayre, S. B., & Keasling, J. D. “Microbial Production of Fatty-Acid-Derived Fuels and Chemicals From Plant Biomass. *Nature*, 2010, 43, 559-562.
- [17] United States Environmental Protection Agency, Renewable Fuel Standard Program. Retrieved, July 23, 2011, from <http://www.epa.gov/otaq/fuels/renewablefuels/index.htm>.
- [18] van Dyken, S., Bakken, B. H., & Skjelbred, H. I. “Linear Mixed Integer Models for Biomass Supply Chains with Transport, Storage and Processing.” *Energy*, 2010, 35 (3), 1338–1350.
- [19] Zamboni, A., Shah, N., & Bezzo, F. “Spatially Explicit Static Model for the Strategic Design of Future Bioethanol Production Systems. 1. Cost Minimization.” *Energy & Fuels*, 2009, 23(10), 5121-5133.

FIGURE 4. EFFICIENT SUPPLY CHAIN NETWORKS.

(Schemes #2GQ, 3GQ, 4G, 5G, 6G)

(Scheme #5Q)

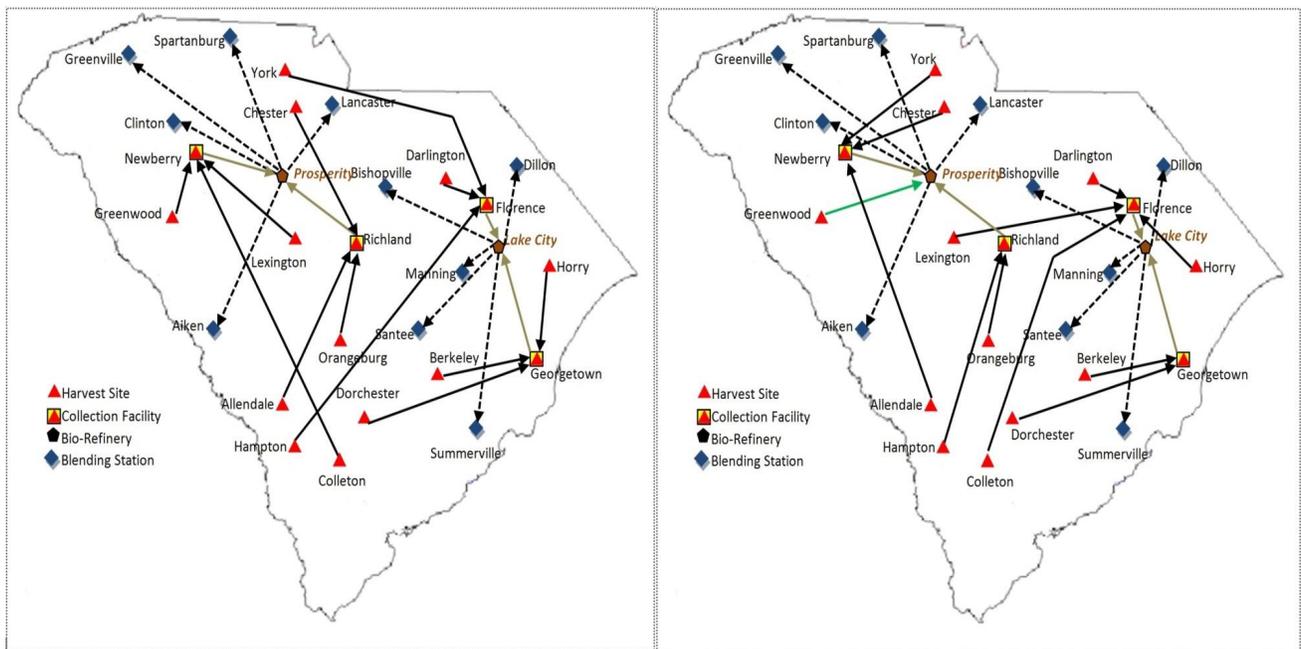
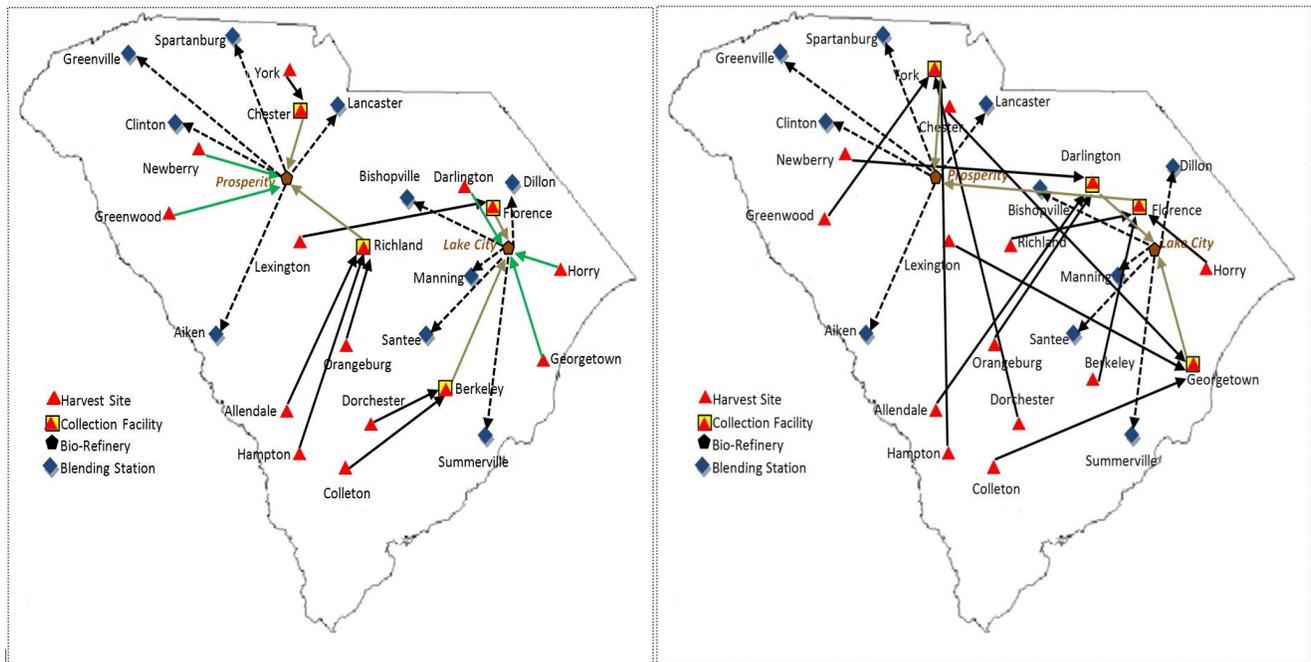


FIGURE 5. INEFFICIENT SUPPLY CHAIN NETWORKS.

(Scheme #11GQ)

Scheme (#1 GQ)



BUILDING ENGAGING ONLINE COMMUNITIES

Belinda Shipps, North Carolina A&T State University

As the Internet continues grow and connect people globally, there are more opportunities to share knowledge and information through online communities. These online communities exist in many different environments where others network, share and mentor others. In one survey of learning professionals, online community was selected as one of the top three concerns for e-learning (Kaplan, 2017). Many people learn from online sources. Communities of learning create an opportunity for learners to expand, gain and share knowledge that may be difficult to understand. In order for these communities to be useful and successful, trust and engagement are important considerations. This research addresses factors associated with building engaging online learning communities. A model is provided for building engaging online communities.

Statistics and Analytics Students Success in the Work Place: Role of Analytical/Statistics/Computer Based Academics

Annie M. Stith-Willis,
Virginia Commonwealth University,
Department of Supply Chain Management and Analytics,
Richmond, VA. 23284-4000, 804-828-7111, amstithw@vcu.edu

Wilma Andrews,
Virginia Commonwealth University,
Department of Information Systems,
Richmond, VA. 23284-4000, 804-827-0956, wandrews@vcu.edu

Robert L. Andrews,
Virginia Commonwealth University,
Department of Supply Chain Management and Analytics,
Richmond, VA. 23284-4000, 804-355-4645, randrews@vcu.edu

ABSTRACT

In this session presenters, along with the audience will explore the relationship between how we assess student's overall academic performance with post graduate employment skills identified by employers as insufficient or lacking. Every year thousands of Business graduates are employed for their first professional job. Most graduates believe that because of their earned diploma they have the necessary combination of technical, analytical, and interpersonal skills to succeed in the work place. In an article written by Jonathan Berr and published in MoneyWatch (5/7/2016) a survey released by PayScale (76,000 participants) stated the following:

- ❖ Approximately 90% of all graduates considered themselves well prepared
- ❖ One-half of hiring managers considered graduates prepared
- ❖ Sixty percent of all companies said new graduates lacked the following skills; critical thinking (56%), attention to detail (56%), writing proficiency (44%), and public speaking (39%).¹

Many of the classes we teach in our curriculum require the same set of skills that students think they have mastered and employers are clearly saying 40% to 50% are lacking. What are we doing in our classes to reinforce and assess these skills accurately? Are we teaching and assessing student achievement accurately with the way we award proficiency and exceptional academic success? Does faculty mislead students with a false sense of accomplishment the way

we grade, accommodate excuses, behavior, and give multiple opportunities outside of an agreed upon deadline?

INTRODUCTION

Thousands of college and university graduates start jobs with a false sense of their accomplishments and the set of skills they are offering their new employers. What role do their college professors and how they were assessed in the classroom play in the false interpretation of their actual skills. This session will focus on students enrolled in analytical courses i.e., statistics, analytics, computer based applications, business calculus, regression analysis, and etc.

The session leaders will use the presentation to conduct a conversation about differences and commonalities in current views and practices when it comes to student post graduate success and their role. We will share as practitioners and interactively explore some of the issues discussed above including:

- ❖ Student skills perception vs reality
- ❖ Faculty role in student perception
- ❖ True faculty assessment of student readiness and preparedness for employment
- ❖ Cost to students
- ❖ Cost of intellectual deficiency
- ❖ Compromise and role of ethics

All faculties, but especially new/junior faculty may use this session to question senior/seasoned faculty to garner advice. Faculty charged with working on assessment criteria may use this as an opportunity to make comparisons or garner ideas that they can apply to their individual programs.

REFERENCES

[1] Berr. Jonathan, “Employers: New College grads aren’t ready for workplace”, CBS MoneyWatch, May 17, 2016

GETTING MORE FROM ONLINE VIDEOS: USING EDPUZZLE IN THE CLASSROOM

Leann Mischel, Coastal Carolina University

New pedagogies are regularly being adopted in education. One such pedagogy is the flipped classroom which moves the preparation outside of the classroom and allows for a variety of activities then to occur inside the classroom. Such activities range from discussion to team work. The use of video lessons watched outside the classroom is often incorporated so that students can watch lectures at their convenience and can review topics repeatedly if necessary. Students using online videos to enhance teaching and learning have earned higher cumulative test scores than those who attended a “traditional” undergraduate course (Caviglia-Harris, 2016).

Video usage is also the predominant educational tool used in Massive Online Open Courses (MOOCs). As MOOCs become more and more popular, there is a need to learn more about how to effectively share videos with students to maximize their learning.

Finally, the use of videos for just general online learning has been steadily increasing. Sites similar to Lynda.com or Khan Academy allow individuals to learn about topics of interest at their own pace without seeking a degree.

As the use of videos for online learning increases, so does the need to ensure that learning is occurring. Studies that have investigated the most effective way to implement multimedia instructional design, focusing on videos, in particular. EDpuzzle offers a method to distribute those lectures as well as other videos to students while also giving a variety of feedback tools to the educator.

The purpose of this paper is to review some of those findings and apply them to the use of EDpuzzle, a free online source for video sharing that allows educators to enhance the learning process by incorporating quizzes, voiceovers and notes. Each of these attributes, as well as others offered by

EDpuzzle will be discussed. A description of the program will be provided followed by a discussion of ways it can be used in the classroom. Finally, advantages and disadvantages of the program will be outlined.

Description

EDpuzzle is an online resource that provides an opportunity to use video clips to enhance classroom learning experiences. The program is provided for free of charge online and can be accessed easily by both students and teachers.

Educators can choose video clips from a variety of sources including YouTube, Khan Academy, National Geographic, TED Talks, Veritasium, Numberphile, Crash course and Vimeo. A library can also be created and shared with others in your school so if you have several people teaching the same class, you can share video lessons. Each of these sites can be searched for topics related to what is being taught in the class or a known video by title.

Once a video has been chosen, it can be cropped to make it shorter. Research has shown that videos lasting 7 minutes or shorter are able to retain a student's attention better. EDpuzzle provides the ability to crop a video from the beginning or end.

The educator can do a voiceover throughout the entire video or freeze the video at any time and provide an audio note – alerting students to watch for something or to focus students' attention.

Quizzes can also be incorporated at any time during the video. You can insert open ended questions for students to answer, True/False or Multiple Choice questions, or just comments to help guide them. The input boxes allow for easy text editing, mathematical equations and also the ability to insert other video links.

Finally, data can be collected to tell which students listened to the video, how many times they watched each section of the video, and how well they performed on the quiz questions provided.

Classroom Applications

This is a valuable resource for any class taught online. It ensures that students actually watch a video and understand it rather than just having it run in the background on their computer. By inserting questions along the way, educators can be sure that the content of the video has been absorbed by students.

Teachers can also make the videos more personal by adding their own voice to help students focus on important concepts.

Extra practice on a subject and ability to gauge learning. Because the educator can see how many times the student watched each section of the video and the students' scores on the incorporated questions, modifications can be made to cover topics that may not have been absorbed completely by the students.

Many online videos already have captions provided for hearing impaired. Closed captioning is important to include in videos since more and more students are learning online. It is important that the schools provide resources so that learning can be accessed by hearing impaired students.

Quizzes can be multiple choice, True/False, or open ended and can be used repeatedly and shared. If there are multiple sections of a course, EdPuzzle provides the ability to share the same quiz across sections so the educator can ensure consistency across sections.

Student progress can be monitored. If students are struggling with concepts, new resources can be provided to enhance learning.

It is sometimes a struggle to incorporate presentations in an online class. Students often glaze over presentations and video lectures, run them in the background, or just don't watch them at all. EdPuzzle allow students to post their presentations and create their own questions for other students to watch and get feedback. It also provides educators with the ability to post lectures with questions throughout to get student feedback and gauge learning. Students can listen to any part of the lecture multiple times if a concept is more difficult to grasp.

The application also allows the educator to use voiceover to enhance learning. For instance, an instructor can find a video that demonstrates a “how to” or particular concept of interest. Rather than using the audio that is incorporated in the original video, the instructor can record their own voice to talk through the video for students. This way, important concepts can be pointed out and the video can be more easily tied to any text the students need reinforced.

Advantages and Disadvantages

Aside from the fact that EDpuzzle is a free program to use, there are several other advantages to using it. The first advantage is that it can enhance distance learning experiences. Students can now break up videos to shorter lengths and easily see where they need to repeat information. When questions are distributed throughout the video, it helps the viewer absorb smaller pieces at a time. Studies have indicated that longer videos are less likely to be watched to completion (Kim, et al., 2014).

EDpuzzle also ensures learning. Since students can take quizzes throughout the video, instructors are able to gauge learning. After analyzing the student scores on any particular video, the educator can easily see which topics need more reinforcement and which topics were easily understood. The instructor can then modify future lessons to ensure retention and understanding.

The ability to add audio notes is an important feature to consider when using the program. When adding an audio note, the video is frozen for a short period of time while the instructor inserts some audio to help focus the lesson. This technique is called signaling. In several experiments involving both computer-based lessons and paper-based lessons, learners who engaged in lessons incorporating signals performed better on transfer tests than students who were engaged in lessons without signals (Harp and Mayer, 1998; Mautone & Mayer, 2001; Stull and Mayer, 2007).

Last, EDpuzzle has created the ability to share videos with others. If you are teaching a course that has several sections, one person can find appropriate videos, write the incorporated quizzes and create a

library to share them with the other instructors. The ability to share videos and the content allows instructors to reduce their prep time when putting the course together and also allows the instructors to pool their quiz results to look at student learning across several classes.

There are also disadvantages to the program that need to be considered. First, in many schools there are still students who do not have reliable internet connection. In areas where students do not have easy access to computers and internet, usage of EDpuzzle would be less effective.

There is also a slight learning curve to using the program. While it is very menu driven with easy to follow instructions throughout, it does take a little time to learn how to use it. While instructors will probably use trial and error, students may have questions that will require extra time from the instructor.

The program does not allow interaction between the student and instructor. While this is true of many online classes and video programs, it is still considered a disadvantage. There are some video programs that exist which allow students to ask questions at certain points during a video. This is not as conversational as one-on-one interaction, but still allows the instructor to have a better idea of where questions are coming up.

Two way communication is important for online classes. Many learning management systems (LMS) incorporate the ability to have chat sessions or even online video interaction. EDpuzzle does not have the function to allow for student interaction or interaction between student and instructor. So, there is no way for other students to comment and/or interact with each other on posted videos. Any interaction must be done through the LMS.

If the instructor wants only parts of a video, there currently is no way to cut and paste the video together to include only those parts the instructor wants to keep. Cropping can be done at the beginning of the video and at the end, but cannot be done in the middle. Instead of cutting and pasting, the instructor either has to use their own video processing tool, or they must separate the pieces they want into different videos.

Finally, EDpuzzle does not allow voiceover for just part of the video. If the instructor wants to do voiceover, they must do so for the entire video. However, the audio notes can be inserted throughout. With audio notes, rather than having the video run continuously through the inserted audio, it is stopped so a short audio clip can be inserted.

Conclusion

Given that teaching is increasingly incorporating the use of videos, it is important to have a better understanding of how learning can be further enhanced through those videos. EDpuzzle offers the ability to address some of the issues that other video providers have not yet addressed. By allowing students to interact more with the online learning process and providing important feedback to instructors, EDpuzzle can be a valuable tool to use in flipped classrooms, MOOCs, hybrid courses and online learning in general.

References

- Caviglia-Harris, J. (2016). Flipping the undergraduate economics classroom: Using online videos to enhance teaching and learning. *Southern Economic Journal*, 83(1), pp. 321-331. DOI: 10.1002/soej.12128
- Guo, P. J. , Kim, J. & Rubin, R. (2014). How **video** production affects student engagement: An empirical study of MOOC **videos**. *Proceedings of the first ACM Conference on Learning Scale Conference*, 41–50. doi: 10.1145/2556325.2566239
- Harp, S. F. & Mayer, R. E. (1998). How seductive details do their damage: A theory of cognitive interest in science learning. *Journal of Educational Psychology*, 90, 414-434.
- Kim, J., Guo, P. J., Seaton, D. T., Mitros, P., Gajos, K. Z., & Miller, R. C . (2014). Understanding in-video dropouts and interaction peaks in online lecture videos. In *Proceedings of the First ACM Conference on Learning @ Scale Conference (L @ S '14)*. ACM, New York, NY, USA, 31-40.
- Mautone, P. D. & Mayer, R. E. (2001). Signaling as a cognitive guide in multimedia learning. *Journal of Educational Psychology*, 93, 377-389.
- Mayer, R. E. (2008). Applying the science of learning: Evidence-based principles for the design of multimedia instruction. *American Psychologist*, 63(8), 760–769. doi: 10.1037/0003-066x.63.8.760
- Stull, A., & Mayer, R. E. (2007). Learning by doing versus learning by viewing: Three experimental comparisons of learner-generated versus author-provided graphic organizers. *Journal of Educational Psychology*, 99, 808-820.
- Van der Sluis, F., Ginn, J. & Van der Zee, T. (2016). Explaining Student Behavior at Scale: The influence of **video** complexity on student dwelling time. In *Proceedings of the Third (2016) ACM Conference on Learning@ Scale* (pp. 51–60). ACM. doi: 10.1145/2876034.2876051

AN ANALYSIS OF RISK-ADJUSTED RETURNS FOR TRADING MOVING AVERAGE CROSSOVERS VERSUS A STRAIGHT BUY AND HOLD STRATEGY

**C. Michael Smith, CFP®, Ph.D., Roanoke College, Salem, VA
cmsmith@roanoke.edu**

ABSTRACT

This study analyzes the returns of an S&P 500 exchange-traded fund from 1997-2016 to determine the impact to a portfolio's risk (standard deviation) and return of a straight buy-and-hold investing strategy versus trading moving average crossovers. Four moving average pairs (20/100, 20/200, 50/200, and 100/200) are analyzed. Results indicate that trading moving averages reduces the risk to an investment portfolio over a straight buy-and-hold strategy. In addition, the long-term returns associated with trading moving averages are generally comparable to that of a buy-and-hold strategy.

INTRODUCTION

Technical analysis is a field in finance that attempts to predict the future pricing behavior of securities by analyzing past price movements. While the investment advisory profession is full of technical analysts (also known as chartists) who attempt to use patterns and charts to “beat the market”, much of the academic world typically looks at technical analysis with mild derision. It is true that there is a wealth of data to suggest that many technical analysis methods fail to be economically helpful. This data may be best summed up by Burton Malkiel, who states in his classic tome on investing “*A Random Walk Down Wall Street*” that the academic world is able “to pick on technical analysis” because “the method does no better than a buy-and-hold strategy” and because it is “easy to pick on” (Malkiel, 2016).

Greater numbers of academics in finance typically embrace theories such as modern portfolio theory (MPT) and the efficient market hypothesis (EMH) which state that all investors are best served by investing in a well-diversified “market portfolio”. Investors can then adjust the volatility of their portfolios by simply dedicating a portion of the total investment into a risk-free asset like U.S. Treasury securities. Further, the efficient market hypothesis states that it is impossible to “beat the market” because all relevant information about a stock is already worked into the stock's price – making the stock's price a “fair value” no matter when a trade for it is placed. With EMH, undervalued or overvalued stocks simply don't exist (Markowitz, 1952; Sharpe, 1966).

However, while elegant mathematical formula can prove both MPT and EMH, almost everyone is capable of proving an extremely popular technical trading theory, known as momentum, with their own eyes and life experience. In fact, no one would describe “momentum” as a theory. Momentum is a scientific fact. Whether someone is observing runners, vehicles, boulders or investments, almost everyone has experienced the physics of momentum in some way. Objects

that are moving in some direction will tend to keep moving in that direction. When some force exerts itself against the object, it will come to a stop and begin to experience the same momentum in the opposite direction. Momentum is real and observable.

While no one is likely to argue the merits of momentum, many investors may argue whether or not momentum can be identified and utilized to make investing decisions that earn risk-adjusted returns in excess of that of the market. This study analyzes the ability of a popular momentum indicator, moving average crossovers, to provide investors with insight that could potentially earn them improved risk-adjusted returns over time.

In investments, a moving average using closing prices is simply the average of the closing prices of some security or index over time. For instance, a 50-day simple moving average on a stock's closing price will sum the closing prices over a 50-day period and divide by fifty. By developing moving averages, investors can smooth the price action in a security by filtering out much of the noise from price movements. Investors generally break down moving averages as either short term (perhaps 50 days or less) or long term (perhaps 100 days or more). Short-term moving average shifts indicate a change in the short-term momentum of a security while long-term moving averages tend to be more stable. A shift in the long-term moving average of a security signals a long-term change in the security's trend.

Since short-term moving averages demonstrate the momentum over the short term, and long-term moving averages demonstrate momentum over the long-term, some technical analysts suggest that a change in the long-term trend is imminent when a short-term moving average crosses a long-term moving average. This relationship is most easily viewed when the two moving averages are charted together. See Figure A for a chart of the shorter-term 50-day moving average plotted alongside a longer-term 200-day moving average for Pfizer stock (Ticker PFE).

Figure A

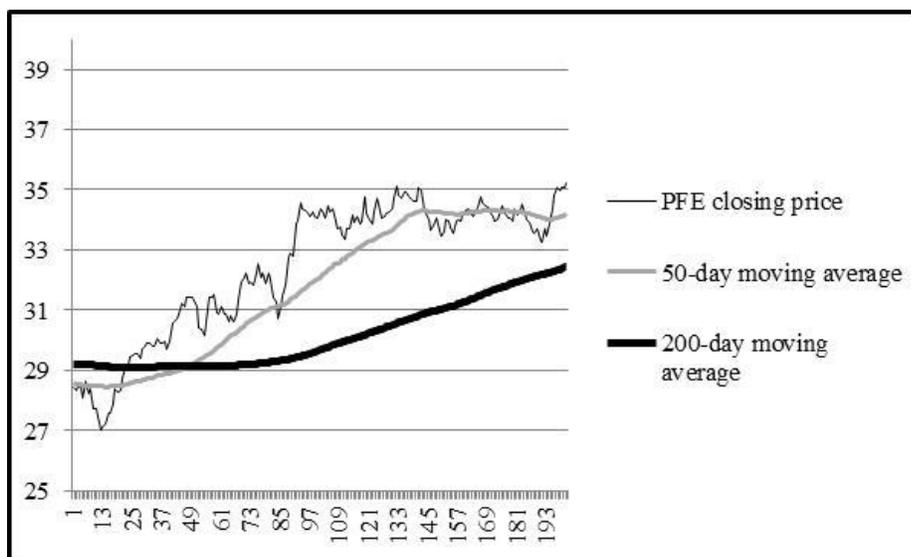


Figure from Smith, C. M. (2017). *Investments: Fundamental Theory and Practice*

As can be viewed in Figure A, the chart begins with the shorter-term, 50-day moving average below the longer-term, 200-day moving average. Moving average technicians interpret this price action as negative (bearish), as the long-term trend is down. However, note that on day 49, the short-term moving average crosses the long-term moving average from below. This positive (bullish) crossover is called a “Golden Cross” and is a “buy” signal for traders of moving average crossovers. This bullish crossover suggests that the stock’s momentum has changed to the upside. However, if the short-term moving average were to cross the long-term moving average from above (a Death Cross), the strategy would be to sell the asset as downward momentum has once again taken over.

To summarize the strategy of trading crossovers, technical analysts who believe in trading moving averages typically buy the security or index on a “Golden Cross” and sell on a “Death Cross”. Is it possible that this simple strategy results in higher risk-adjusted returns than a traditional buy-and-hold strategy? And given that moving averages can be created for any timeframe – which moving average crossovers provide the best results?

Several studies have demonstrated the efficacy of trading moving averages (Dolvin, 2014; Jagadeesh & Titman, 1993; Kilgallen, 2012). The purpose of this study is to extend the analysis that trading moving averages has on the risk-adjusted return of an investment portfolio compared to the traditional buy-and-hold strategy.

METHODOLOGY

The underlying investment

Moving averages can be calculated for many different types of investments. The underlying investment utilized for all the data points of this study is an S&P 500 exchange-traded fund (Ticker SPDR) known informally as a “Spider”. The Spider is actually the first exchange-traded fund ever created which is beneficial for analysis as there is a long investment time-frame of available data. For this study, the daily closing prices of the Spider ETF were obtained from 1997 through 2016 (20 years).

The expected return and standard deviation of a buy-and-hold strategy

In order to test the performance of the risk-adjusted returns of trading moving averages to a benchmark of a buy-and-hold strategy, the first step is to determine the expected return and standard deviation of a buy-and-hold strategy. Using the daily closing prices of the Spider, the annual returns are calculated from 1997 through 2016 and an expected return and standard deviation are calculated from the annual return data. The analysis reveals that the expected return of the Spider is 8.64% and the risk (as measured by the investment’s standard deviation) is 17.16%.

Calculation of the Sharpe ratio to aid comparisons

In addition, the Sharpe ratio is utilized to aid in the comparison of the risk-adjusted returns of the buy-and-hold strategy to that of a strategy that involves trading moving average crossovers. The higher the Sharpe ratio, the more the investor is being rewarded for the level of risk that has been assumed. For the purposes of this study, the Sharpe ratio for the buy-and-hold strategy is first computed using a risk-free rate of return of 2.5% (which is the approximate current rate on 10-year U.S. Treasuries). Utilizing these values, the Sharpe ratio for the buy-and-hold strategy is $(8.14\% - 2.5\%) \div 17.16\% = .3578$.

Summary of buy-and-hold calculations

- **SPDR Buy-and-hold expected return = 8.64%**
- **SPDR Buy-and-hold standard deviation = 17.16%**
- **SPDR Buy-and-hold Sharpe ratio = .3578**

Therefore, if trading moving averages provides higher risk-adjusted returns than a traditional buy-and-hold strategy, the Sharpe ratios of the moving averages will be greater than .3578.

Choosing the moving average pairs

The next step is selecting and analyzing the moving averages. While there are numerous moving average pairs, this study limits the moving average combinations to the following four pairs:

- 100 Day/200 Day
- 50 Day/200 Day
- 20 Day/200 Day
- 20 Day/100 Day

Methodology for calculations associated with trading moving average crossovers

For each pair (listed above), the short-term and the long-term moving averages are calculated for the Spider. Whenever a short-term moving average crosses a long-term moving average from below, that day's closing price is labeled as a "buy" price. On the other hand, whenever a short-term moving average crosses a long-term moving average from above, the closing price is labeled as a "sell" price.

Example of moving average return calculation

For each moving average pair, the holding period returns are calculated using the Spider's closing prices at each bullish and bearish crossover. For instance, when analyzing the 100/200 Day crossover trading strategy, the first year (1997) begins with a 100-day moving average of 49.30 and a 200-day moving average of 47.31. Since the short-term moving average is greater than the long-term moving average, the Spider is "bought" at the 1/2/1997 closing price of \$74.03. Further, on 11/16/98, the long-term moving average (77.46) experiences its first bearish crossover of the short-term moving average (77.42). Therefore, the Spider is sold on 11/16/98 at that day's closing price (81.84) and placed in cash until the next bullish crossover (which takes

place on 1/1/1999) and so on. The holding period returns are calculated for each sale price and annualized using the arithmetic average for comparisons.

Assumption one – No taxes or trading fees

For the purposes of this study, taxes and fees are not considered. It is true that taxes and fees are likely to have a stronger impact on trading moving averages than a buy-and-hold strategy. More trades equate to more trading fees and more taxable events. However, for the purposes of comparison, the actual dollar impacts were considered too variable to be relevant. For instance, a trader may have a \$6.95 trading fee on a \$1,000,000 portfolio (with very little impact) or a \$35 trading fee on a \$1,000 account (with a very large impact). In addition, a trader may be in a 36% tax bracket while another trader may be utilizing the trading strategy within a tax-qualified plan (like a Roth IRA) making the tax rate zero. These differences simply cannot be analyzed in any helpful way for the purposes of this informational study.

However, it may also be worth noting that shorter-term moving averages experienced more trading than longer-term moving averages. While this study did not consider the impact of taxes and trading fees, this observation may have merit in taxable accounts, especially with lower dollar amounts. See Table A.

Table A

Strategy	Total trades over 20-year period
Buy-and-hold	2
100/200 day	18
50/200 day	22
20/200 day	32
20/100 day	68

Assumption two – Cash has no return

When “sell” signals take place due to a bearish crossover, the account is assumed to be converted into cash until a bullish “buy” signal takes place. It is possible that the investment will remain in cash for extended periods of time before being re-invested into the Spider ETF. During these periods, no return is assumed on the “cash” account. The reasoning behind this assumption is partially due to the fact that the rates of return associated with current “cash” or money market accounts is historically low (and close to zero). In addition, the purpose of this study is to lend analysis to the efficacy of trading moving averages only. The inclusion of “cash” rates of returns arguably damages the power of the study’s true purpose.

RESULTS

Moving average returns are calculated for each holding period and annualized for comparative purposes. In addition, using the 20-year expected return, the standard deviation and Sharpe ratio are calculated (using a risk-free rate assumption of 2.5%). The results are summarized in Table B.

Table B

SPDR Strategies			
Expected Return, Standard Deviation, & Sharpe Ratio			
	Expected Return	Standard Deviation	Sharpe Ratio
Buy and Hold	8.64%	17.16%	0.3580652
Trading 20-100 MA Crossovers	4.46%	13.17%	0.1489114
Trading 20-200 MA Crossovers	7.44%	11.64%	0.4244925
Trading 50-200 MA Crossovers	8.86%	10.80%	0.5885395
Trading 100-200 MA Crossovers	7.58%	11.91%	0.4267065

In analyzing the 20 years' of data, the results suggest that three of the four moving average pairs studied provide superior risk-adjusted results over a straight buy-and-hold strategy. The shortest moving average trading strategy (20/100) is the only example to return a Sharpe ratio below the buy-and-hold strategy. This is likely due to the significantly lower return associated with the 20/100 strategy as the standard deviation (risk) of this strategy is also lower compared to the buy-and-hold strategy. In only one case was the expected return higher than the buy-and-hold strategy (50/200), but in all cases, trading the moving averages resulted in a more stable portfolio (as demonstrated by the lower standard deviations).

CONCLUSION

Based on the findings of this 20-year analysis, an investment strategy that trades moving average crossovers is less volatile than a traditional buy-and-hold strategy. This lower volatility is largely due to the fact that trading crossovers provides investors with the ability to avoid being invested in severe market downturns. Note in Appendix B that all four moving average strategies have significantly improved returns over a buy-and-hold strategy during the dot.com bubble of 2002 and the Great Recession of 2008.

In addition, in three of the moving average strategies analyzed, the risk-adjusted return was higher than a traditional buy-and-hold strategy. Only the shortest term moving average pair (20/100) had a lower risk-adjusted return than a buy-and-hold investment. However, even the 20/100 pair had a lower total standard deviation (13.17%) than the buy-and-hold strategy (17.16%). Therefore, it would appear that trading moving averages may be a more risk-averse strategy than buy-and-hold.

From a certain perspective, trading moving averages is no different from the advice of modern portfolio theorists. Recall that MPT calls for investors who desire to decrease their portfolio's risk to allocate a percentage of their investment portfolio to the risk-free asset. In essence, this is exactly what trading moving averages accomplishes. The only difference is that by trading the moving averages, the potential for higher risk-adjusted return remains possible. The allocation to the risk-free rate becomes "strategic".

Interestingly, the implication that trading moving averages involves lower risk to the investor than a buy-and-hold strategy is somewhat of a paradigm shift for many investors. Typically, investors associate frequent "trading" with "risk". While some trading strategies may involve more risk to the investor than simply buying and holding an investment, it does not appear that trading moderate to long-term moving averages falls under this label. In fact, risk averse investors may find that trading moving averages helps them sleep much better at night.

REFERENCES

- Dolvin, S. D. (2014). *The efficacy of trading based on moving average indicators: An extension*. The Journal of Wealth Management, Vol 17, No. 1, pp 52-57.
- Jegadeesh, N. & Titman, S. (1993). *Returns to buying winners and selling losers: Implications for stock market efficiency*. Journal of Finance, Vol 48, No. 1, pp 82-99.
- Kilgallen, T. (2012). *Testing the simple moving average across commodities, global stock indices, and currencies*. The Journal of Wealth Management, Vol 15, No. 1, pp 82-99.
- Malkiel, B. (2016). *A Random Walk Down Wall Street* (11ed). W. W. Norton.
- Markowitz, H. (1952). *Portfolio selection*. Journal of Finance, Vol 7, No. 1, pp 77-91.
- Sharpe, W. F. (1966). *Mutual fund performance*. Journal of Business, Vol 39, No. 1, pp 119-138.

APPENDIX A - DEFINITIONS

Annualized return - any investment's return over a given period that is re-scaled to a period of one-year

Arithmetic average – sum of a series of numbers divided by the count of the series of numbers, an investment's return in an average year over a particular period

Exchange-traded funds (ETFs for short) - marketable securities that track an index

Expected return – an asset's return that investors anticipate on receiving in the future based from its prior performance

Holding period return – return calculation over any period of time (*i.e.* three months)

Percentage return – the investment's "rate of return" or the amount earned on each dollar invested

Return – profit on an investment over a period of time

S&P 500 – a stock index that represents the largest publicly-traded companies in the U.S.

Sharpe ratio – measures a portfolio's risk premium divided by the portfolio's standard deviation

Spider – popular nickname for an S&P 500 exchange-traded fund (Ticker SPDR)

Standard deviation – a measure of risk that considers the dispersion of an asset's returns from its mean (or expected return)

APPENDIX B – RETURN COMPARISON TABLES

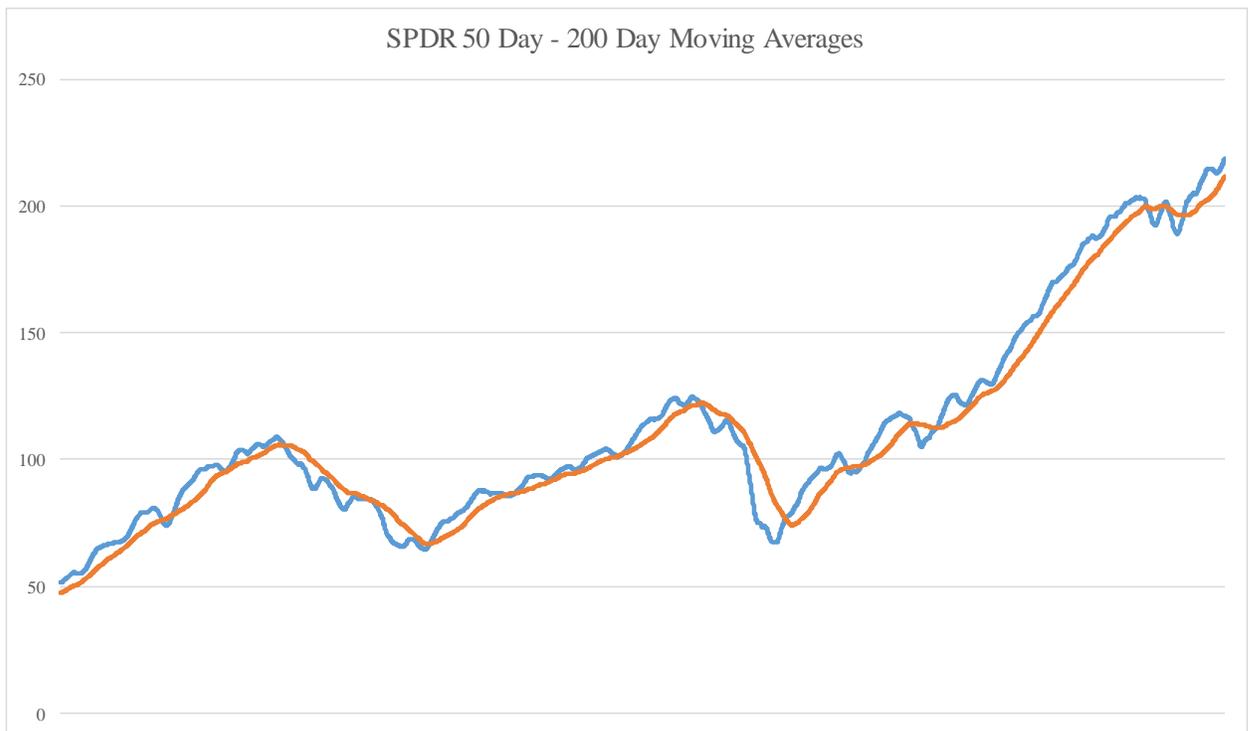
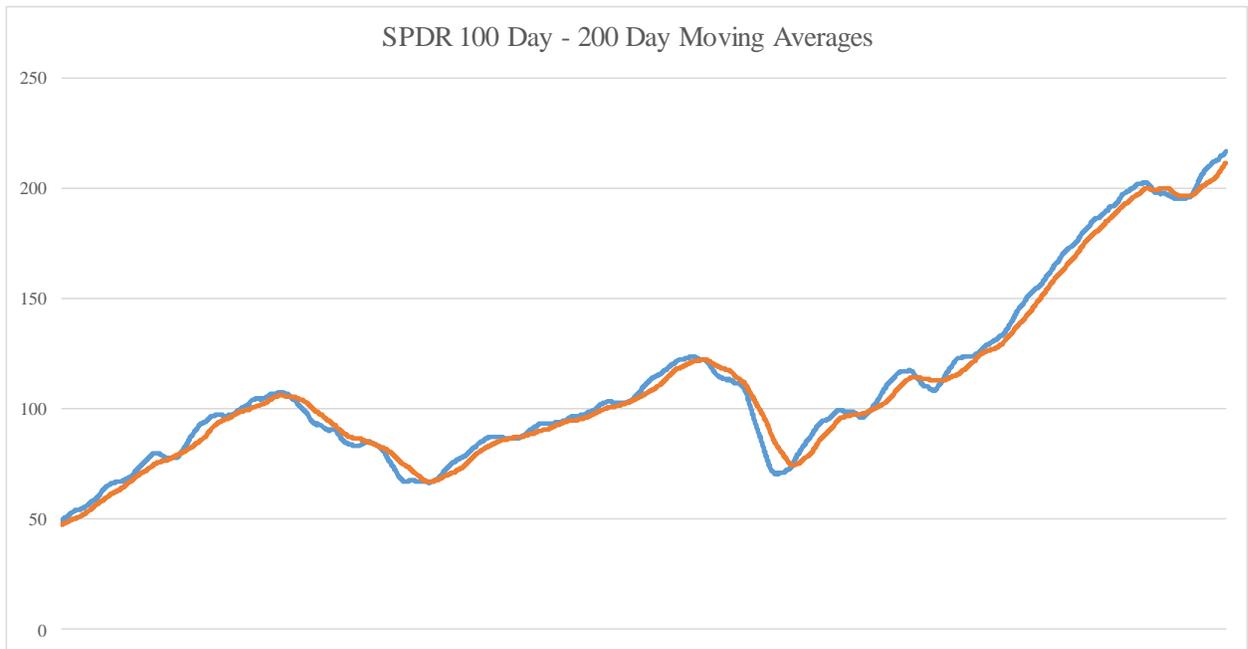
SPDR Returns				
Buy & Hold Versus Trading 100/200 Day Moving Average Crossovers				
Timeframe	Year(s)	Buy & Hold Return	Moving Average Return	Moving Average Improvement
20-year	1997-2016	331.43%	297.93%	-33.50%
10-year (1)	1997-2006	121.99%	125.32%	3.33%
10-year (2)	2007-2016	94.70%	76.92%	-17.78%
5-year (1)	1997-2001	64.29%	69.88%	5.59%
5-year (2)	2002-2006	33.68%	32.63%	-1.05%
5-year (3)	2007-2011	-1.38%	8.12%	9.50%
5-year (4)	2012-2016	94.33%	63.64%	-30.69%
1-year (1)	1997	33.14%	33.14%	0.00%
1-year (2)	1998	28.03%	18.04%	-10.00%
1-year (3)	1999	20.66%	18.59%	-2.08%
1-year (4)	2000	-8.85%	-8.41%	0.44%
1-year (5)	2001	-10.13%	0.00%	10.13%
1-year (6)	2002	-22.42%	-7.93%	14.49%
1-year (7)	2003	24.18%	13.04%	-11.15%
1-year (8)	2004	10.75%	4.99%	-5.76%
1-year (9)	2005	5.32%	5.32%	0.00%
1-year (10)	2006	13.84%	13.84%	0.00%
1-year (11)	2007	5.33%	5.33%	0.00%
1-year (12)	2008	-36.24%	-7.93%	28.30%
1-year (13)	2009	22.65%	17.82%	-4.84%
1-year (14)	2010	13.14%	0.25%	-12.89%
1-year (15)	2011	0.85%	-7.31%	-8.17%
1-year (16)	2012	14.17%	6.71%	-7.46%
1-year (17)	2013	29.00%	29.00%	0.00%
1-year (18)	2014	14.56%	14.56%	0.00%
1-year (19)	2015	1.29%	-5.11%	-6.40%
1-year (20)	2016	13.59%	7.70%	-5.88%

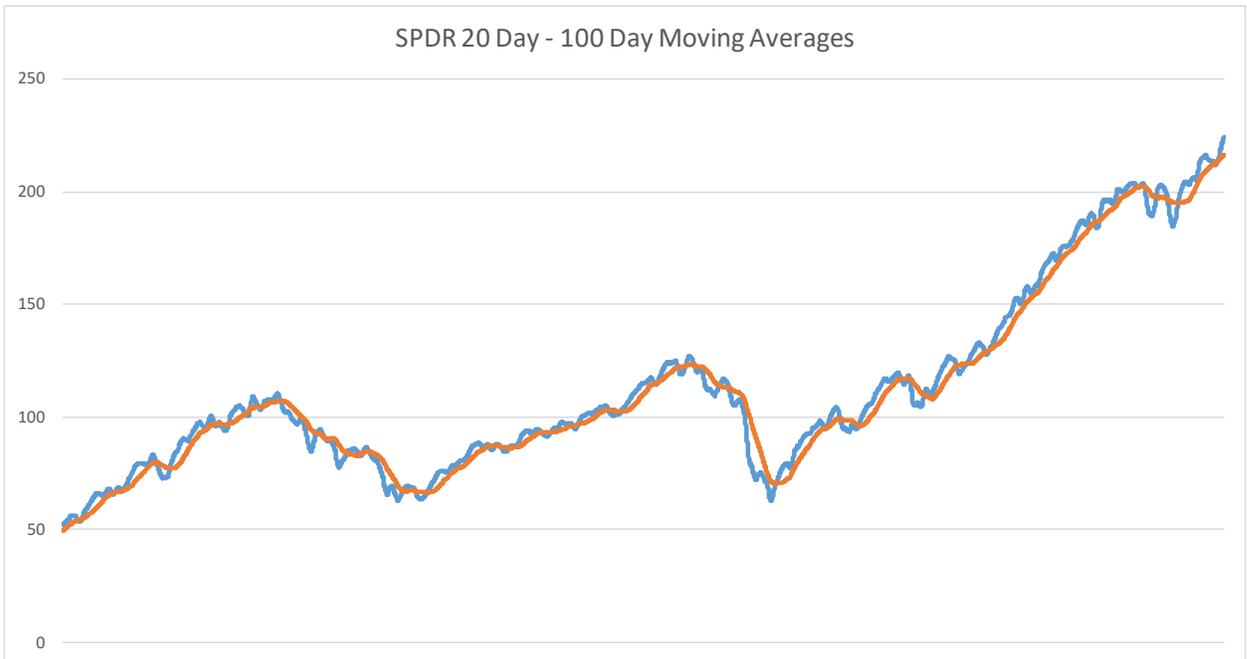
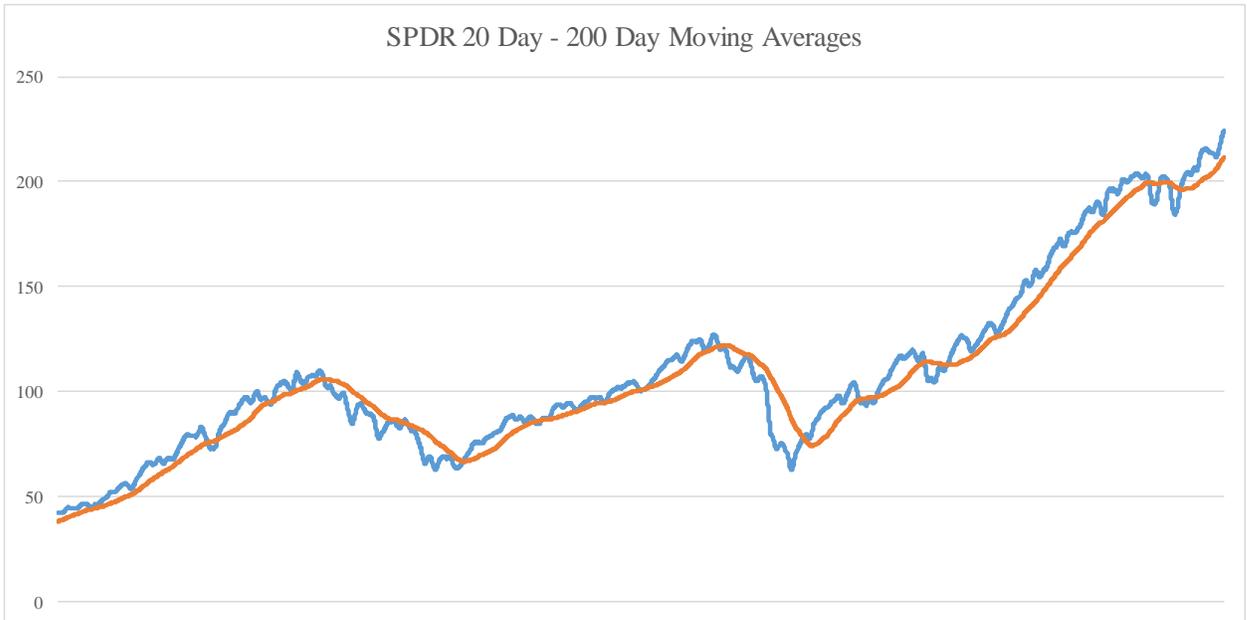
SPDR Returns				
Buy & Hold Versus Trading 50/200 Day Moving Average Crossovers				
Timeframe	Year(s)	Buy & Hold Return	Moving Average Return	Moving Average Improvement
20-year	1997-2016	331.43%	412.59%	81.15%
10-year (1)	1997-2006	121.99%	151.23%	29.25%
10-year (2)	2007-2016	94.70%	104.39%	9.69%
5-year (1)	1997-2001	64.29%	68.54%	4.25%
5-year (2)	2002-2006	33.68%	49.07%	15.39%
5-year (3)	2007-2011	-1.38%	28.86%	30.24%
5-year (4)	2012-2016	94.33%	58.62%	-35.71%
1-year (1)	1997	33.14%	33.14%	0.00%
1-year (2)	1998	28.03%	6.87%	-21.16%
1-year (3)	1999	20.66%	20.66%	0.00%
1-year (4)	2000	-8.85%	-1.15%	7.70%
1-year (5)	2001	-10.13%	0.00%	10.13%
1-year (6)	2002	-22.42%	-1.75%	20.67%
1-year (7)	2003	24.18%	18.72%	-5.47%
1-year (8)	2004	10.75%	8.55%	-2.20%
1-year (9)	2005	5.32%	5.32%	0.00%
1-year (10)	2006	13.84%	10.43%	-3.42%
1-year (11)	2007	5.33%	6.12%	0.79%
1-year (12)	2008	-36.24%	0.00%	36.24%
1-year (13)	2009	22.65%	22.76%	0.11%
1-year (14)	2010	13.14%	1.26%	-11.87%
1-year (15)	2011	0.85%	-4.93%	-5.78%
1-year (16)	2012	14.17%	10.61%	-3.57%
1-year (17)	2013	29.00%	29.00%	0.00%
1-year (18)	2014	14.56%	14.56%	0.00%
1-year (19)	2015	1.29%	-4.04%	-5.33%
1-year (20)	2016	13.59%	1.01%	-12.57%

SPDR Returns				
Buy & Hold Versus Trading 20/200 Day Moving Average Crossovers				
Timeframe	Year(s)	Buy & Hold Return	Moving Average Return	Moving Average Improvement
20-year	1997-2016	331.43%	349.54%	18.10%
10-year (1)	1997-2006	121.99%	123.03%	1.05%
10-year (2)	2007-2016	94.70%	101.92%	7.22%
5-year (1)	1997-2001	64.29%	54.58%	-9.70%
5-year (2)	2002-2006	33.68%	44.28%	10.60%
5-year (3)	2007-2011	-1.38%	16.55%	17.93%
5-year (4)	2012-2016	94.33%	73.25%	-21.08%
1-year (1)	1997	33.14%	33.14%	0.00%
1-year (2)	1998	28.03%	9.28%	-18.76%
1-year (3)	1999	20.66%	12.19%	-8.48%
1-year (4)	2000	-8.85%	-4.63%	4.22%
1-year (5)	2001	-10.13%	0.00%	10.13%
1-year (6)	2002	-22.42%	-3.68%	18.74%
1-year (7)	2003	24.18%	23.32%	-0.86%
1-year (8)	2004	10.75%	6.43%	-4.32%
1-year (9)	2005	5.32%	3.23%	-2.09%
1-year (10)	2006	13.84%	9.21%	-4.63%
1-year (11)	2007	5.33%	2.17%	-3.16%
1-year (12)	2008	-36.24%	0.00%	36.24%
1-year (13)	2009	22.65%	19.74%	-2.92%
1-year (14)	2010	13.14%	3.95%	-9.19%
1-year (15)	2011	0.85%	-10.79%	-11.65%
1-year (16)	2012	14.17%	-1.97%	-16.14%
1-year (17)	2013	29.00%	29.00%	0.00%
1-year (18)	2014	14.56%	14.56%	0.00%
1-year (19)	2015	1.29%	-6.85%	-8.14%
1-year (20)	2016	13.59%	10.56%	-3.02%

SPDR Returns				
Buy & Hold Versus Trading 20/100 Day Moving Average Crossovers				
Timeframe	Year(s)	Buy & Hold Return	Moving Average Return	Moving Average Improvement
20-year	1997-2016	331.43%	128.63%	-202.80%
10-year (1)	1997-2006	121.99%	45.91%	-76.08%
10-year (2)	2007-2016	94.70%	56.97%	-37.72%
5-year (1)	1997-2001	64.29%	15.27%	-49.02%
5-year (2)	2002-2006	33.68%	25.24%	-8.45%
5-year (3)	2007-2011	-1.38%	8.49%	9.87%
5-year (4)	2012-2016	94.33%	42.42%	-51.91%
1-year (1)	1997	33.14%	14.42%	-18.72%
1-year (2)	1998	28.03%	19.49%	-8.54%
1-year (3)	1999	20.66%	11.67%	-8.99%
1-year (4)	2000	-8.85%	-17.70%	-8.85%
1-year (5)	2001	-10.13%	-7.62%	2.51%
1-year (6)	2002	-22.42%	-6.78%	15.64%
1-year (7)	2003	24.18%	14.92%	-9.26%
1-year (8)	2004	10.75%	2.56%	-8.19%
1-year (9)	2005	5.32%	-2.99%	-8.32%
1-year (10)	2006	13.84%	12.44%	-1.40%
1-year (11)	2007	5.33%	-4.36%	-9.69%
1-year (12)	2008	-36.24%	-8.68%	27.56%
1-year (13)	2009	22.65%	30.01%	7.35%
1-year (14)	2010	13.14%	1.63%	-11.50%
1-year (15)	2011	0.85%	-8.50%	-9.35%
1-year (16)	2012	14.17%	6.52%	-7.65%
1-year (17)	2013	29.00%	29.00%	0.00%
1-year (18)	2014	14.56%	4.71%	-9.86%
1-year (19)	2015	1.29%	-2.23%	-3.52%
1-year (20)	2016	13.59%	0.71%	-12.88%

APPENDIX C – MOVING AVERAGE CHARTS





Quantitative Easing and Asset Prices

James Winder, Rutgers Business School, Piscataway NJ, 848-445-2996

Anthony Somma, Rutgers Business School, Piscataway NJ

ABSTRACT

This paper studies the effects of the Federal Reserve's Quantitative Easing programs on a sample of developed and developing countries. The analysis covers three time periods, each beginning in December 2008, when the first QE program was announced. The three interval ending dates are the taper announcement of December 2013, the end of the taper in October 2014, and a more recent, post-crisis date, December 2016. The results suggest a significant, but not ubiquitous, QE effect on currency, equity, and sovereign bond markets.

I.) INTRODUCTION

Commentators wrote throughout the financial crisis that the liquidity created by quantitative easing drove stock and bond prices so high in the US that money managers were forced to "chase return" in emerging market countries. Essentially, risk-adjusted rates of return were too low. Investors did not receive adequate compensation for the risks they were taking because of the need to show return to clients.

Our project will determine the extent to which the Fed's three QE programs caused interest rates to be lower, and equity markets and exchange rates to be stronger than they would have been in the absence of the extraordinary US monetary policy.

The main question we will address is: how did the Fed's three QE Programs affect emerging market currencies, interest rates, and stock markets?

We use monthly average data from the IMF's International Financial Statistics database and from Bloomberg. As a secondary area of research, I will assess the effects of QE on countries with different types of currency regime, as determined by the IMF's Annual Report on Exchange Arrangements. The estimation was done using Eviews.

II.) GENERAL MODEL FORMULATION

Currency researchers at investment banks often use expected interest rate, inflation, and real growth differentials to forecast the major currencies. We will try the same methodology here for both developed and emerging financial markets.

There are three equations we will estimate for a group of selected countries.

$$a.) \ln(\text{FCUR}_A) = \beta_0 + \beta_1 \ln(\text{FED}) + \beta_2 (\ln i_A - \ln i_S) + \beta_3 (\ln y_A - \ln y_S) + \beta_4 (\ln \Pi_A - \ln \Pi_S) + u_t$$

$FCUR_A$ = foreign exchange value of a currency A.

\$ subscript = US.

FED = the size of the Fed's balance sheet, measured as "Reserve Bank Credit" from the Fed's weekly H.4.1 release. Reserve Bank Credit contains holdings of Treasury, Federal Agency, and mortgage-backed securities. These securities "held outright" account for about 95% of Reserve Bank Credit. The remainder includes several items, such as float and loans.

i = short-term or long-term interest rate

y = real economic activity, which we will approximate by industrial production.

Π = rate of inflation, as measured by a country's consumer price index.

$$b.) \ln(FEQU_A) = \beta_0 + \beta_1 \ln(FED) + \beta_2 (\ln i_A - \ln i_S) + \beta_3 (\ln y_A - \ln y_S) + \beta_4 (\ln \Pi_A - \ln \Pi_S) + u_t$$

$FEQU_A$ = Country A's main equity market index.

$$c.) \ln(FI_A) = \beta_0 + \beta_1 \ln(FED) + \beta_2 (\ln i_S) + \beta_3 (\ln y_A - \ln y_S) + \beta_4 (\ln \Pi_A - \ln \Pi_S) + u_t$$

FI_A = Country A's interest rate.

III.) COUNTRIES TO BE ANALYZED

Australia, Brazil, Bulgaria, Canada, Chile, China, Czech Republic, Egypt, Estonia, Greece, India, Indonesia, Israel, Japan, Korea, Lithuania, Malaysia, Mexico, Philippines, Poland, Romania, Singapore, Slovakia, Thailand, Turkey, UK, and US.

IV.) ESTIMATION PERIODS

There are three estimation periods tested in the paper:

- a.) December 2008 to October 2014. This period corresponds to the announcement of the first Quantitative easing program through the end of the tapered purchases in late 2014.
- b.) December 2008 to December 2013. It was in December 2013 that the Fed announced a "tapering" its monthly Treasury and MBS would begin. Did investor behavior change after the Fed signaled that its debt purchases would be scaled back?
- c.) December 2008 to December 2016. This period was chosen simply to test relationships during and after the Great Recession and the European debt crisis.

V.) EVOLUTION OF THE ESTIMATION METHODOLOGY

The three proposed models were estimated for the 27 countries listed above for which data were available. Not every country has a sovereign 10-year yield in the IMF database.

Many of the series were not stationary in log form, using the Augmented Dickey Fuller test as the criterion to judge stationarity. They were stationary in most cases in first difference form. We also analyzed the time series properties of the log series. Many, if not most signaled an AR(1) process, and many series also indicated an MA(1) process.

The results for the three estimated models often had statistically significant regressors with the proper signs, but with low DW statistics, signaling a systematic process in the residuals. To achieve stationarity and to account for the systematic processes in the residuals, AR(1) and MA(1) terms were added to each estimated equation.

An example using the Korea won is helpful to explain the evolution of the final form of the estimated models. These results appear in Tables 1 and 2.

The regressors for Tables 1 and 2 are defined as follows.

$$IP = (\ln IP_A - \ln IP_\$)$$

$$CPI = (\ln CPI_A - \ln CPI_\$)$$

$$CBR = (\ln i_A - \ln i_\$), \text{ where "i" is the central bank policy rate.}$$

$$FED = \ln(\text{Reserve Bank Credit}).$$

A.) Expected Signs for Regressors.

	<u>FCUR/\$</u>	<u>\$/FCUR</u>	<u>Foreign Equity</u>	<u>Foreign IEM Sovereign Bond Yield</u>
IP	minus	plus	plus	minus
CPI	plus	minus	plus	plus
CBR	minus	plus	minus	?
FED	minus	plus	plus	minus

B.) Comments on Signs.

IP: If economic activity in the foreign economy picks up relative to US growth, then the foreign currency will appreciate versus the dollar. In IEM generally, stock and bond markets move together, that is, stock and bond prices tend to move in the same direction because of the importance of the IEM country's credit story when it comes to attracting foreign investors.

CPI: Here, we are invoking PPP to determine the currency sign. We are also assuming that some inflation during this extraordinary time of deflationary threat is treated as a desirable feature of an IEM economy.

CBR: The expected sign of the coefficient on IEM bond yields is unclear because of the potential for longer bond maturities to appreciate in price when the central bank is raising short-term interest rates. Inverted yield curves can occur. Greece/Russia is an example of this result.

FED: These signs are the central hypotheses of the paper. Fed QE leads to greater capital flows into foreign markets, so these currencies appreciate versus, and their equity markets and bond markets appreciate in price.

Table 1
Illustrative Example of Regression Progression: Korean Won

Korean Won: Structural Model

	C	IP	CPI	CBR	FED	AR(1)	MA(1)	Adj R2	DW
Dec/2008-Oct/2014	8.36 (43.4)	-0.40 (-7.51)	-1.18 (-1.64)	0.05 (1.53)	-0.19 (-9.40)			0.80	0.72
Dec/2008-Dec/2013	8.07 (28.9)	-0.41 (-7.26)	-1.78 (-2.13)	0.05 (1.36)	-0.15 (-4.27)			0.77	0.74
Dec/2008-Dec/2016	8.39 (50.3)	-0.38 (-7.03)	0.10 (0.17)	-0.06 (-7.34)	-0.15 (-7.79)			0.68	0.59

Korean Won: Blended Model

Dec/2008-Oct/2014	8.77 (19.2)	-0.05 (-1.50)	-0.63 (-0.92)	0.02 (1.22)	-0.22 (-3.84)	0.81 (11.08)	0.45 (3.51)	0.94	1.93
Dec/2008-Dec/2013	9.26 (14.5)	-0.05 (-1.29)	-0.55 (-0.73)	0.03 (1.65)	-0.29 (-3.50)	0.83 (10.84)	0.46 (3.24)	0.92	1.97
Dec/2008-Dec/2016	8.16 (15.9)	-0.06 (-2.17)	-0.11 (-0.19)	-0.00 (-0.12)	-0.14 (-2.19)	0.87 (16.4)	0.50 (5.06)	0.92	1.99

Table 2
Illustrative Example of Regression Progression: Korean Equities

Korean Equity: Structural Model

	C	IP	CPI	CBR	FED	AR(1)	MA(1)	Adj R2	DW
Dec/2008-Oct/2014	6.01 (15.7)	0.87 (8.27)	6.11 (4.29)	-0.04 (-0.58)	0.20 (5.17)			0.82	0.94
Dec/2008-Dec/2013	6.27 (11.5)	0.91 (8.23)	6.68 (4.26)	-0.04 (-0.55)	0.17 (2.50)			0.83	1.05
Dec/2008-Dec/2016	5.84 (20.9)	0.83 (9.11)	4.78 (4.76)	0.02 (1.89)	0.20 (6.23)			0.80	0.92

Korean Equity: Blended Model

Dec/2008-Oct/2014	6.04 (5.74)	0.08 (1.06)	-0.04 (-0.03)	-0.02 (-0.81)	0.20 (1.47)	0.87 (20.2)	0.20 (1.48)	0.94	2.05
Dec/2008-Dec/2013	5.30 (3.86)	0.07 (0.92)	-0.26 (-0.17)	-0.04 (-1.11)	0.29 (1.67)	0.86 (17.7)	0.22 (1.55)	0.94	2.10
Dec/2008-Dec/2016	6.28 (15.9)	0.06 (-2.17)	-0.43 (-0.19)	-0.01 (-0.12)	0.16 (2.19)	0.87 (16.4)	0.24 (5.06)	0.94	2.11

In the structural equations for both the exchange rate and the equity market, IP and FED enter with the expected signs and are significant at the 5% level. CPI results are mixed for the currency equation, but inflation has the expected sign and is significant in the equity market estimations. The central bank rate has the expected sign and is significant in just one of the three equations.

While the structural equation results are encouraging, the DW statistics reveal a systematic property in the residuals. The dependent variables in log terms are also not stationary, raising the possibility that the regressions are spurious. To estimate equations that satisfy stationarity and remove the systematic disturbances from the estimated residuals, time series terms AR(1) and MA(1) are applied to the residuals. Correlation analysis using partial autocorrelation indicates the presence of both of these processes.

The explanatory power of the structural variables generally deteriorates when the models include the time series terms. The only variable that maintains the expected sign and its statistical significance is FED.

C.) Time Series Models.

The time series models we used are:

$$\text{a.) } \ln(\text{FCUR}_A) = \beta_0 + \beta_1 \ln(\text{FED}) + u_t$$

where u_t includes AR(1) and MA(1) processes.

AR(1) process:

$$y_t = x_t \beta + u_t.$$

$$u_t = \rho u_{t-1} + \varepsilon_t.$$

$$y_t = \rho y_{t-1} + (x_t - \rho x_{t-1}) \beta + \varepsilon_t.$$

MA(1) process:

$$u_t = \varepsilon_t + \theta \varepsilon_{t-1}.$$

AR(1) MA(1) process:

$$u_t = \rho u_{t-1} + \varepsilon_t + \theta \varepsilon_{t-1}.$$

$$\text{b.) } \ln(\text{FEQU}_A) = \beta_0 + \beta_1 \ln(\text{FED}) + u_t$$

$$\text{c.) } \ln(\text{FI}_A) = \beta_0 + \beta_1 \ln(\text{FED}) + u_t$$

VI.) SUMMARIZING ESTIMATION RESULTS USING FED AND TIME SERIES TERMS

Table 3

Dependent Variable: ln(Currency)

Countries With Correct Sign for FED and Significant at the 5% Level or Better

Using FED, AR(1), MA(1) Model

	Dec/2008- Oct/2014	Dec/2008- Dec/2013	Dec/2008- Dec/2016
	Indonesia	Indonesia	Bulgaria
	Israel	Israel	Czech
	Korea	Korea	Estonia
	Romania	Poland	Indonesia
	Russia	Romania	Mexico
		Russia	Poland
		Singapore	Romania
			Russia
Total			
# of Countries	5	7	8

Table 4

Dependent Variable: ln(Foreign Equity)

Countries With Correct Sign for FED and Significant at the 5% Level or Better

Using FED, AR(1), MA(1) Model

	Dec/2008- Oct/2014	Dec/2008- Dec/2013	Dec/2008- Dec/2016
	Czech	Bulgaria	Australia
	Egypt	Japan	Czech
	India	Mexico	Egypt
	Japan	Poland	India
	Mexico	Romania	Japan
	Poland	Slovakia	Mexico
	Romania	UK	Poland
	Slovakia	US	Slovakia
	UK		UK
	US		US
Total			
# of Countries	10	8	10

Table 5

Dependent Variable: ln(Sovereign Bond Yield)

Countries With Correct Sign for FED and Significant at the 5% Level or Better

Using FED, AR(1), MA(1) Model

	Dec/2008- Oct/2014	Dec/2008- Dec/2013	Dec/2008- Dec/2016
	Bulgaria	Bulgaria	Australia
	Japan	Japan	Canada
	Korea	Korea	Czech
	Romania	Romania	Poland
		Slovakia	Thailand
			US
Total			
# of Countries	4	5	6

VII.) CONCLUSIONS

The results are mixed, at best, about the impact of the tapering announcement in December 2013. More currencies and sovereign bond yields had significant FED coefficients, with the proper sign, during the December 2008 to December 2013 period than during the December 2008 to October 2014 period, but the differences are small. For currencies, the numbers are seven significant relationships for period ended December 2013 and five significant relationships for the period ended October 2014. For bond yields the numbers are five and four significant relationships, respectively, for the two intervals. Moreover, equity markets had more significant relationships (10) during the full QE period than in the period ending with the tapering announcement (8).

It is also important to note that for all three markets, currency, equity, and sovereign bond, there were at least as many significant relationships in the period that ended in December 2016, than in either of the two periods that were part of the QE programs. This result suggests that a longer historical study is needed of the role of US monetary policy in global asset markets, during both “extraordinary” and “normal” times.

Finally, the results suggest that equity markets benefited more from the Fed’s QE programs than did currency markets. There were more significant relationships in equity markets than in currency markets for every regression period. This makes some sense because central banks might intervene to keep their currencies from appreciating due to capital inflows that resulted from QE. This intervention, by itself, could create liquidity that could be invested in domestic equity markets. Paying more attention to the currency regimes of the countries in our sample, as well as testing capital flows for the effects of QE are important ways to expand this research.

One final question for future research is whether US monetary policy can destabilize another country’s financial system. Many leaders of Emerging Market countries, particularly some from South America, were especially outspoken about the negative effects of US QE on their economies and currencies.

VIII.) REFERENCES

Evans, Michael, *Practical Business Forecasting*, Wiley-Blackwell, 2002.

Thompson, Max, "Applied Econometric Time Series Analysis on Inflation," Rutgers University undergraduate honors thesis, 2016.

The Beveridge Curve in the Recovery from the Great Recession: Estimates for Five Geographic Regions

C. Barry Pfitzner, bpfitzne@rmc.edu
Steven D. Lang, slang@rmc.edu
Department of Economics, Business, and Accounting
Randolph-Macon College

Abstract

This exercise documents the shift in the Beveridge Curve (the relationship between job vacancies and the unemployment rate) in the post-Great Recession time period for the United States and the four census regions. Utilizing JOLTS (Job Openings and Labor Turnover Survey) data from the Bureau of Labor Statistics, we present statistical and graphical evidence of the outward shift in the curve by region. We calculate the magnitude of the shift in terms of the unemployment rate for each region. The largest shifts were observed for the Mid-West and West census regions. In general, the evidence does not yet support a second shift in the curves back to the pre-recovery curves, with the possible exception of the West census region.

1. Introduction

In this paper we estimate Beveridge Curves (the relationship between job vacancies and unemployment) for the most recent data at six geographic levels: the United States as a whole, the four major census regions, and the Commonwealth of Virginia. We show the well-

documented shifts in the curve following the *Great Recession* (December 2007-June 2009).

Some evidence is presented on the magnitude of the shifts for the various geographic levels, and we attempt to compare evidence by region on the possible return to the more normal labor market conditions that were evident prior to the *Great Recession*. That is, have labor markets stabilized in the recovery? Did some regions recover faster than others?

The remainder of the paper is organized as follows: section 2 describes the *Beveridge Curve* and presents methodology for the empirical estimations; section 3 provides a brief literature review; section 4 describes the data, presents the empirical estimates and visual evidence of the curve shifts for each of the geographic regions; in section 5 we present preliminary conclusions.

2. The Beveridge Curve

The Beveridge Curve, the relationship between unemployment and job vacancies, has become a centerpiece among economists as they consider aggregate labor market dynamics. In the words of Blanchard and Diamond, "... the Beveridge Curve contains essential information about the functioning of the labor market and the shocks that affect it."¹

The starting point for the Beveridge Curve is a matching function. Potential workers seeking jobs match with employers seeking workers. The workers seeking jobs in the model are the unemployed (U) and the employers have vacancies (V). That model can be written simply as:

$$M = m(U, V) \tag{1}$$

The usual assumptions are:

¹ Blanchard and Diamond (1989), p. 1.

$$m_u > 0, m_v > 0, m(0, V) = m(U, 0) = 0$$

Increases in either the number of vacancies and/or the number of unemployed will result in more matches and, therefore, more “new” hires (H). Some researchers write the above with H as the left side of (1). Once a match is made, the employer and employee engage in a bilateral negotiation that determines the wage. Much of the research specifies the matching function as a Cobb-Douglas form with constant returns to scale.² In that case (1) can be written as:

$$M = AU^\alpha V^{1-\alpha} \quad (2)$$

Dividing by the size of the labor force (L) and noting that in equilibrium, the number of separations (S) equal the number of matches (M), we can write³:

$$\frac{S}{L} = A \left(\frac{U}{L} \right)^\alpha \left(\frac{V}{L} \right)^{1-\alpha} \quad (3)$$

Now define ⁴ s^* = separation rate (S/L), u = the unemployment rate (U/L), and v = the vacancy rate (V/L). With a fixed separation rate (and fixed A), (3) defines an implicit negative relationship between the unemployment rate and the vacancy rate. That relationship is the Beveridge curve. The u - v relationship is, of course, the equivalent of an iso-quant. As a production function, it is useful to consider the left-hand side of (3) to be the hire rate (as stated above), and the inputs in the matching function the unemployment rate and the vacancy rate.

In log form and given our definitions above we have:

$$\ln(s^*) = \ln A + \alpha \ln(u) + (1 - \alpha) \ln(v) \quad (4)$$

² Petrongolo and Pissarades argue that the matching function is well-represented by this form.

³ This transformation holds because equation 2 exhibits constant returns to scale (is linearly homogeneous).

⁴ We designate this separation rate s^* to distinguish it from s in the following section. Here the separation rate is calculated relative to the labor force; in the following section it is measured relative to the employed component.

Consistent with the production function analogy, empirical estimation of (4) also generally specifies some measure of hires as the dependent variable.⁵

Section 4 of this paper contains a number of graphical representations of the *Beveridge Curve*. The negative relationship along a given curve can be explained with reference to tightness in the labor market and the business cycle as follows: during a period of high unemployment, with relatively low demand for labor, firms post few vacancies; when unemployment is low (the demand for labor is high), firms will have more difficulty in finding workers so vacancy posting are high.

2.1 Estimating the Beveridge Curve

The Beveridge Curve, implicit in (3) is often estimated directly—that is, a simple regression of the log of the vacancy rate (v) on the log of the unemployment rate (u):⁶

$$\ln(v_t) = \beta_0 + \beta_1 \ln(u_t) + \varepsilon_t \quad (5)$$

Still another relatively simple method of estimating the Beveridge Curve is given by Ghayad (2013). To develop the method he uses note that, in steady-state, given the equivalence of separations⁷ and matches, the relationship representing flows into unemployment (the left-side of 6) and out of unemployment (the right-side of 6), can be written as:

$$(1-u)s = Au^\alpha v^{1-\alpha} \quad (6)$$

⁵ Note that (4) is a regression on rates; some empirical work of this type is done in levels.

⁶ See Krueger, Cramer, and Cho (2014) or Figura and Ratner (2015).

⁷ Here the separation rate is defined as the “instantaneous probability” that a job becomes unproductive and thus is closed. That rate applies only to the employed or $(1-u)$ with the labor force normalized to be one. (See, for example, Blanchard (1998) or Barlevy (2011), p. 85.)

Dividing both sides by u and re-arranging we have:

$$\left(\frac{1-u}{u}\right)^s = A\left(\frac{v}{u}\right)^{1-\alpha}$$

With a constant s , we have $\left(\frac{1-u}{u}\right) = f\left(\frac{v}{u}\right)$. The regression that Ghayad runs (in his notation)

is:

$$\ln\left(\frac{1-u}{u}\right) = a + b\ln\left(\frac{v}{u}\right) + \varepsilon \quad (7)$$

Next write (7) as

$$e^{\ln\left(\frac{1-u}{u}\right)} = e^a * e^{b\ln\left(\frac{v}{u}\right)}$$

Simplify to

$$\left(\frac{1-u}{u}\right) = e^a * \left(\frac{v}{u}\right)^b$$

$$(\text{since } e^{\ln(x)} = x)$$

And re-arrange

$$u^{b-1} - u^b - e^a * v^b = 0$$

Finally solving for v :

$$v = \left(\frac{u^{b-1} - u^b}{e^a} \right)^{1/b} \quad (8)$$

Once a and b are estimated, the relationship in (8) is then used to plot the Beveridge Curve.⁸

3. A Brief Review of the Literature

3.1 History of the Beveridge Curve

Lord William Henry Beveridge (1879-1963), Oxford graduate, lawyer, economist, Member of Parliament, director of the London School of Economics, and considered a founding father of the modern British welfare state—never drew the curve that bears his name. Though he did study unemployment and job vacancies and the negative relationship between the two, the actual curve was developed by J.C.R. Dow and L.A. Dicks-Mireaux in 1958. Later researchers began to call the representation the Beveridge Curve in the 1980s.⁹

3.2 The Nobel Prize

More formal models that included the Beveridge Curve were developed later by Peter Diamond, Dale Mortensen, and Christopher Pissarides. The resulting model has come to be known as the D-M-P model and has become a centerpiece of labor market and macroeconomic analysis.

Diamond, Mortensen, and Pissarides shared the 2010 Nobel Prize in economics based in part on their contributions related to search theory and the Beveridge Curve. In the press release for the

⁸ Ghayad, p. 16, Appendix 1.

⁹ Lubik and Rhodes, p 1.

prize, the Committee commented that the prize was awarded “for their analysis of markets with search frictions.” The press release continues: “Why are so many people unemployed at the same time that there are a large number of job openings? How can economic policy affect unemployment? This year's Laureates have developed a theory which can be used to answer these questions. This theory is also applicable to markets other than the labor market.”¹⁰

3.2 Some Recent Contributions

The literature on the Beveridge Curve is very extensive. Here we reference a few papers that are relevant to our current project. Many papers and notes have documented an outward shift in the Beveridge Curve that coincides with the *Great Recession* and the subsequent recovery.¹¹ That the curve did, in fact, shift does not seem in dispute. However, we choose to emphasize three points of contention in the more recent literature: (1) What factors caused the shift and its duration; (2) can (did) stabilization policy have a role to play in reducing the unemployment rate; and (3) has the Beveridge Curve shifted (or begun to shift) back to its pre-*Great Recession* position?

On the first of the three points Benati and Lubik (2013) argue that technological change has caused the outward shift of the Beveridge Curve, and thus much of the unemployment was structural in nature. These authors suggest (with respect to point 2 of the preceding paragraph) that the extraordinary monetary policy that followed the *Great Recession* did (and could do) little to ameliorate the higher unemployment rate. Daly, Hobijn, Şahin, and Valletta (2012) suggest the outward shift of the curve could be explained by three factors: skill mismatches (structural

¹⁰ See, http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2010/press.html

¹¹ See Diamond and Şahin (2014), Ghayad (2013), and Daly, Hobijn, Şahin and Valletta (2012) as examples.

unemployment); disincentives related to job search on the part of the unemployed due to extended unemployment benefits; and uncertainty with regard to economic policy and the future course of economic conditions. Hobjin and Şahin (2012) also argue in a cross-country study that increased availability and duration of unemployment insurance compensation cause less intensive search and less incentive for job seekers to accept employment.

Ghayad (2013) considers the effects of unemployment compensation by segregating the unemployed into those who are not eligible for unemployment compensation (job leavers, new-entrants, and re-entrants) and those who are eligible to receive benefits. He finds that up to half of the rightward shift is explained by those groups *ineligible* to receive unemployment benefits, and thus at most the other half of the shift is due to those who *are* eligible for benefits, and therefore the portion of that one-half that is related to the level and duration of unemployment benefits is likely to be considerably less. Ghayad concludes that the increase in the unemployment rate relative to job openings will persist beyond the expiration of unemployment benefits.¹²

Barlevy (2011) presents evidence on the question of the efficacy of monetary policy to affect the unemployment rate. Assuming that employers are reluctant to hire, he argues that the reluctance is due to one of two factors. First, the employer may not be able to find suitable workers to fill the open positions, and second, the firm may not hire a suitable worker if the firm owner feels that employee would be less profitable under current conditions. Either way, the result would indicate a less efficient matching function, which Barlevy estimates in this paper. He calculates that less than one-half of the rise in unemployment during the *Great Recession* is due to the

¹² Ghayad (2013), p. 14.

inability to hire and part of that rise is due to profitability prospects¹³ (Barlevy further indicates that this is an upper bound on the effect on unemployment caused by a deterioration in the efficiency of the matching function for reasons intrinsic to his model, and cites other researchers who find such an effect to be considerably smaller.) He further concludes that if workers are less profitable due to worker characteristics, there is little monetary policy can do to lower the unemployment rate. However, if the hiring is less profitable because of insufficient aggregate demand, a role for monetary policy to attempt to stimulate demand may be justified.¹⁴

In a 2014 note, Diamond and Şahin consider shifts in the *Beveridge Curve*. Given the shift in the curve after October 2009, with unemployment considerably higher for any vacancy rate, they point out that such a shift is often ascribed to a *structural* (emphasis is the original) change in the matching and hiring process, and as such is "... orthogonal to changes in aggregate demand."¹⁵ This interpretation suggests that even if stabilization policies could restore aggregate demand to pre-recession periods, the unemployment rate would not return to the pre-recession low because the labor market would structurally be *structurally* less efficient in providing employment matches. These authors then employ a longer series on vacancies provided by Barnichon (2010) that allows *Beveridge Curve* plots for the period 1951-2014. These plots show that the curve shifted outward in seven of eight identified cycles since 1951. This finding clearly suggests a relationship between recessions and subsequent shifts of the curve. Diamond and Şahin also show that the unemployment rate did in fact return to pre-recession levels in three of the seven cycles in which a curve shift was observed. This finding indicates that a shift in the *Beveridge Curve* is not a predictor of the unemployment rate that is attained in the following expansion.¹⁶

¹³ Barlevy (2011), p. 93

¹⁴ *Ibid.*

¹⁵ Diamond and Şahin (2014) p 2.

¹⁶ *Ibid.*, p. 4.

The authors of this note also find a strong relationship between the duration of the expansion and a return to pre-recession unemployment rate lows. Finally, Diamond and Şahin, quoting Bernanke (and others), in addition to their own evidence, emphasize that outward shifts in the *Beveridge Curve* are not unusual in a recession, nor is the shift likely to be persistent.¹⁷ In simple terms, the outward shift following a recession is likely to be reversed.

One additional short paper is of interest to our investigation. Writing in 2015, Figura and Ratner examine the shift in the Beveridge Curve following the *Great Recession*. They link the increased ratio of the vacancy rate to the unemployment rate (the v-u ratio) to a recent decline in labor's income share. The authors suggest that if the decline in labor's share is caused by decreased bargaining power on the part of workers, then hiring workers becomes more profitable for firms, and as firms hire additional workers, the v-u ratio rises. These factors may cause the job creation curve¹⁸ to shift leftward. If the JC curve has shifted to the left *and* the Beveridge Curve should return to pre-recession levels, this analysis suggests the natural rate of unemployment might eventually be *lower* than the rate that pertained prior to the *Great Recession*.¹⁹

Our reading of the literature suggests three prominent explanations for the outward shift in the *Beveridge Curve* in the aftermath of the *Great Recession*. First, and likely foremost, uncertainty with respect to the recovery and economic policy made firms less likely to hire even as job postings recovered. Second, skill mis-matches (see again Daly, Hobjin, Şahin, and Valletta, 2012), likely exacerbated by the length of the recession as human capital deteriorated for the longer-term unemployed. Third, there may be some role for unemployment benefits making

¹⁷ Ibid., p. 4 (footnote).

¹⁸ The job creation (JC) curve slopes upward and to the right, reflecting firms' willingness to post vacancies for any unemployment rate. The intersection of the JC curve and the *Beveridge Curve* determines the equilibrium point in the v-u space.

¹⁹ See Figura and Ratner., pp. 3-6.

potential employees less likely to accept offered employment—though Ghayad’s work (2013) suggests a more minimal effect for this factor. All three of these factors are likely to dissipate with time, suggesting at least some reversal of the curve shift.

4. *Data and Estimations*

In this section, we present the data sources, estimations, and visual evidence of the current position of the *Beveridge Curve*.

4.1 Data

We collected data at five geographical divisions: United States as a whole and the four major census regions. The four major census areas are the Northeast, the South, the Mid-West and the West.²⁰ The data on the U.S. and the major census areas were collected from FRED, the economic database maintained by the Federal Reserve Bank of St. Louis. The vacancy rate is from the Bureau of Labor Statistics JOLTS (Job Openings and Labor Turnover Survey). That set of series began in 2000. The particular series we employ is total non-farm openings divided by the labor force. The unemployment rate is the civilian unemployment rate, also from the U.S. Bureau of Labor Statistics. We follow Figura and Ratner (and others) in utilizing quarterly averages of these measures throughout our calculations.

²⁰ The states (including the District of Columbia) that comprise the regions are: Northeast: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; South: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia; Midwest: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; West: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. (USD-17-0590, News Release, Bureau of Labor Statistics, US Department of Commerce, May 9, 2017)

4.2 Estimations: the US and the Census Regions

For each geographical division, we estimate the *Beveridge Curve* before the beginning of the recovery from the *great recession* and during the (current) recovery. We employ both the method described in equation 5 from above, and Ghayad's method (equation 6). The resulting curves are almost identical (as they should be). Herein we report only the estimations based on Ghayad's method.²¹ We utilize the National Bureau of Economic Research (NBER) dating for the beginning of the recovery and thus the shift in the curve.

Here (Table I) we report the results of regressions at each geographic division for the period from the 2001 until the end of the Great Recession (second quarter 2009) and the shifted *Beveridge Curve* from 2009 Q3 through 2017 Q1. The estimates of "a" and "b" easily meet tests of statistical significance, with very small p-values, and the overall fit is excellent for every region in each of the time periods. The slope estimates are similar (at least in a practical sense) for the individual geographic divisions across the two time frames, perhaps with the exception of the West region. On the other hand, the estimate of the constant declines in the recovery time frame in every case. The decline in the estimate of "a" (from Ghayad's equation 6 above) shifts the *Beveridge Curve* to the right.²² We conclude that in each case, there was a significant shift of the curve to the right for each geographical division.²³ The visual evidence of the next section will confirm these rightward shifts.

²¹ The results from estimations based on equation 5 are available from the authors on request.

²² Note that in equation 7 above, e^a is in the denominator, thus a lower coefficient estimate of "a" produces more vacancies relative to unemployment, i.e., a shift of the curve to the northeast.

²³ We also tested for the shift by specifying a dummy variable equal to 1 starting in the 3rd quarter of 2009. In every case the dummy variable indicated a significant upward shift in the *Beveridge Curve*.

4.3 Graphical Results: the US and the Census Regions

Here we present the graphical evidence of the shifts in the curves. Consider figure 1, the curve for the United States. The orange diamonds represent the data on the vacancy and unemployment rate from 2001 until the end of the recession and the black dots are the post-recession data. The rightward shift of the curve is evident—the fitted regression lines (green for the earlier period and red for the recovery period) are clearly on different planes. This is, of course, not news. What may be of interest is the black dot farthest to the left and touching the regression line is the last (first quarter, 2017) observed unemployment/vacancy combination. This individual observation is not indicative of any shift of the curve back to the pre-recovery green line. At this point, though the unemployment rate has fallen to levels some would judge as fill-employment, vacancies are still high relative to the current unemployment rate.

Table I: Regression Results for Each Geographic Division, 2001:1 – 2009:2 and 2009:3 – 2017:1: Dependent Variable: $\ln[(1-u)/u]$

Estimates	US Pre-Recovery	N.E. Pre-Recovery	South Pre-Recovery	M.W. Pre-Recovery	West Pre-Recovery
<i>Constant</i>	3.2956 (0.00564)	3.3143 (0.01854)	3.2162 (0.00747)	3.3018 (0.01272)	3.1796 (0.01205)
$\ln(v/u)$	0.54726 (0.00675)	0.58517 (0.02496)	0.55333 (0.01141)	0.56192 (0.01421)	0.55858 (0.01553)
\bar{R}^2	0.9952	0.9433	0.9861	0.9790	0.9751
<i>n</i>	34	34	34	34	34
Estimates	US Post Recession	N.E Post Recession	South Post Recession	M.W. Post Recession	West Post Recession
<i>Constant</i>	3.1247 (0.13794)	3.1813 (0.01924)	3.0610 (0.01651)	3.1081 (0.01229)	3.0854 (0.02053)
$\ln(v/u)$	0.52771 (0.01189)	0.60331 (0.01883)	0.53090 (0.01672)	0.53219 (0.01170)	0.61702 (0.01854)
\bar{R}^2	0.9850	0.9716	0.9711	0.9857	0.9736
<i>n</i>	31	31	31	31	31

(standard errors in parentheses below the parameter estimates)

Next, consider figure 2, the curves for the Northeast region. Again, though the unemployment rate has fallen a great deal in the recovery phase, the curve has not seemed to begin to shift back toward the origin. Interestingly, again, the most recent observation of the v-u combination (the black dot farthest to the left is exactly on the fitted regression line for the recovery time frame. It is not, however, far from the two left-most observations from the previous period, meaning the unemployment rate is not far from the pre-recession low. Generalizing, we do yet not see evidence of a return of the *Beveridge Curve* to the pre-recovery position.

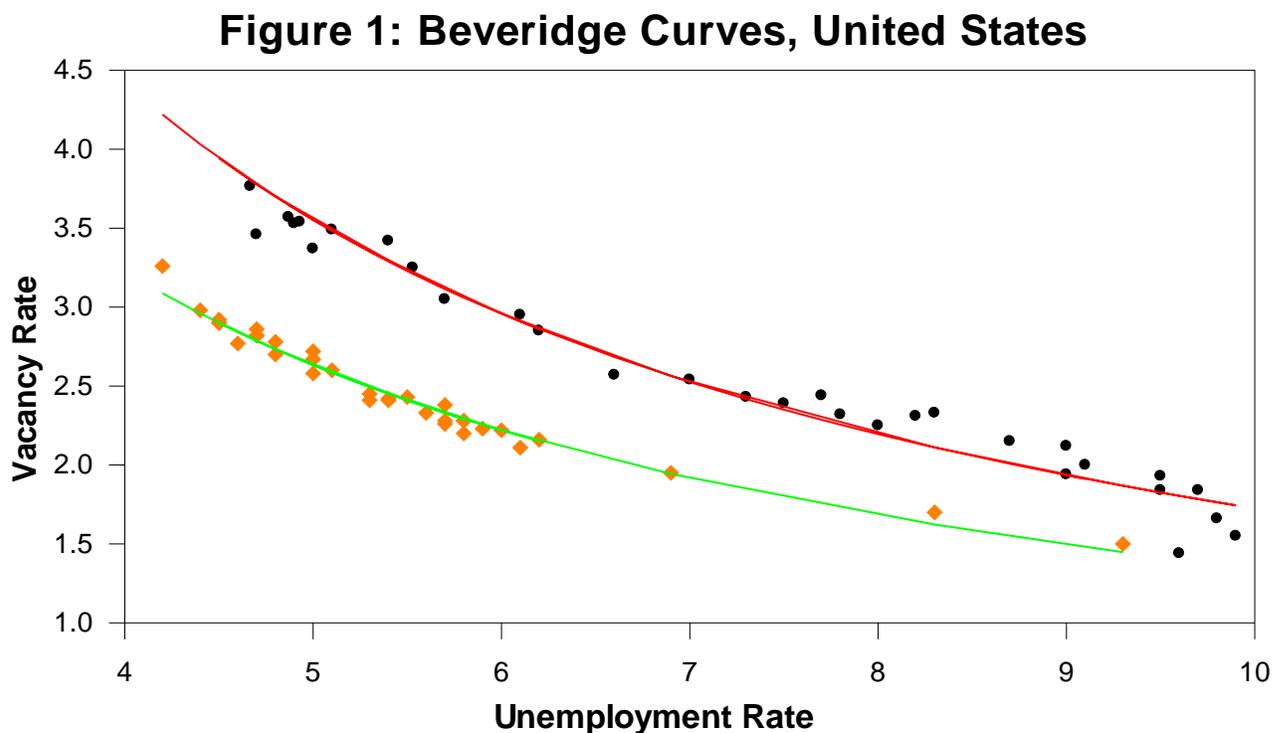


Figure 2: Beveridge Curves, Northeast Region

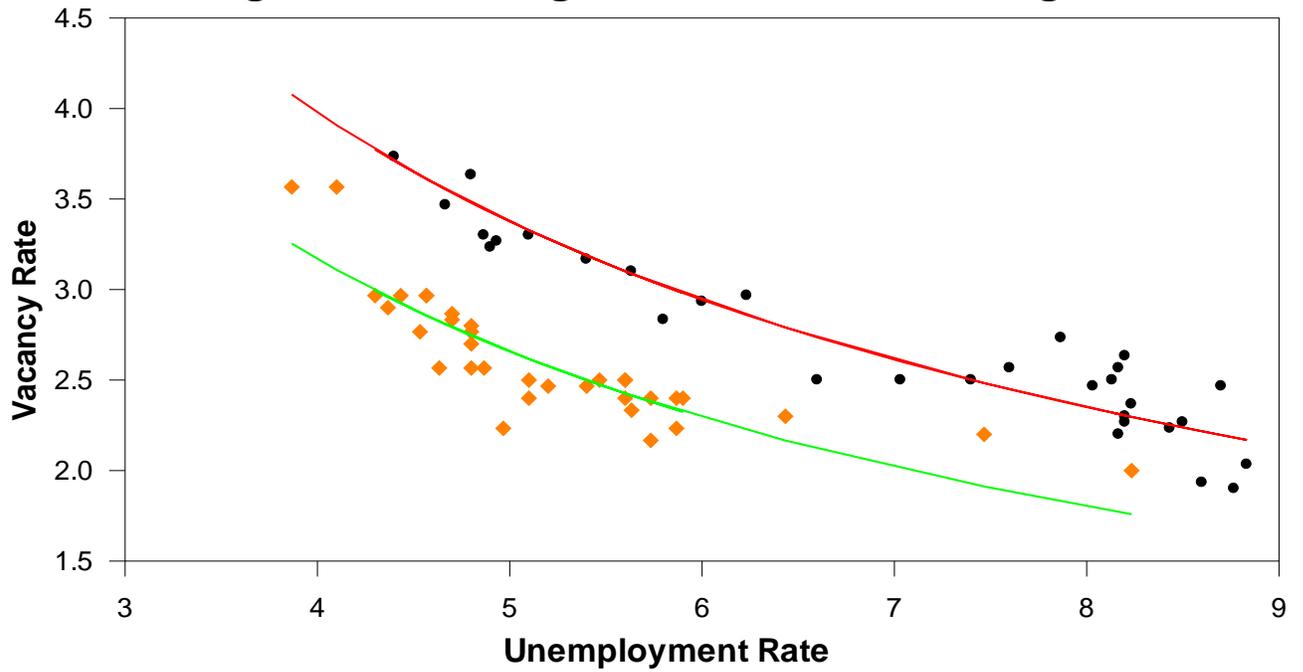


Figure 3: Beveridge Curves, South Region

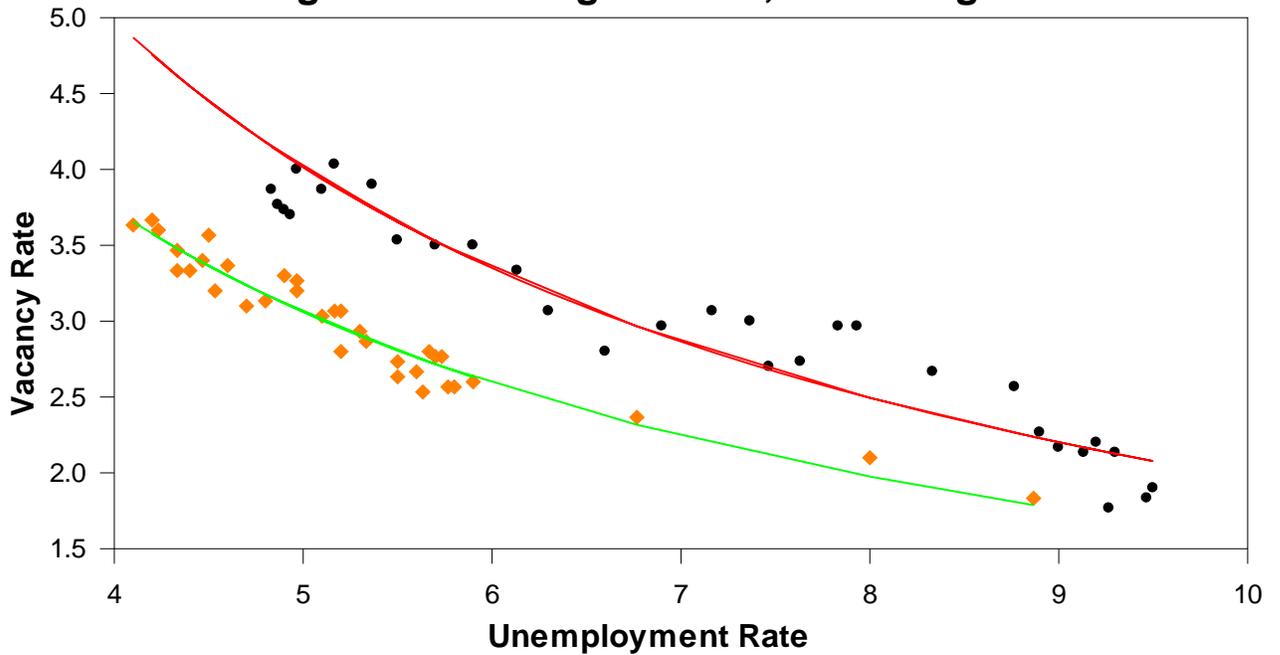
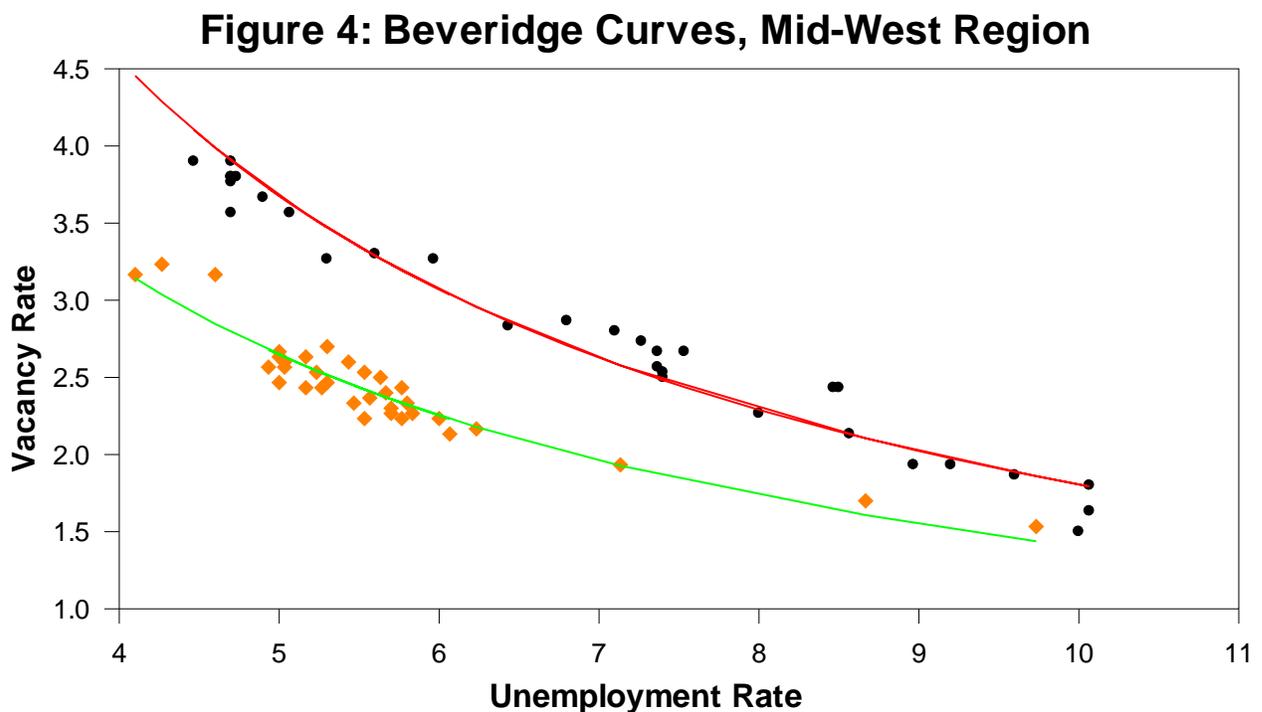


Figure 3 represents the *Beveridge Curves* for the South census region. As in the two prior graphs, the rightward shift of the curve is evident in the recovery period following the recession. The most recent cluster of five data points (black points farthest left in the diagram) are below the post-recession regression line, but closer to that line than the pre-recovery green line. Again, for the South region we conclude that the evidence does not (yet) support a shift of the *Beveridge Curve* back to that estimated for the 2001-2009 time frame.



In Figure 4, we see similar results for the Mid-West census region as compared to the previous three graphs. Here, as was the case for the U.S. and the Northeast region, the black dot farthest to the left in the diagram is the most recent observation (Q1, 2017). It is below the fitted red regression line, but considerably above the line fitted for the pre-recovery. As before, the most recent evidence does not yet show a return to the *Beveridge Curve* that pertained to the earlier period for the Mid-West census region.

Figure 5, for the West census region there is a somewhat different story—at least for the most recent observation. The post-recession fitted curve is, as was the case with all of other geographical divisions, considerably above the pre-recovery fit. Interestingly, the most recent data point from first quarter 2017, is an unemployment rate of 4.7% and a vacancy rate of 3.63%. That is the left-most black dot in the figure. In this case, that most recent observation is closer to the earlier estimated *Beveridge Curve* from the pre-recovery period. One might be tempted to argue that, in the case of the West region, the Beveridge Curve may be returning to its earlier position. Additional data, of course, will support or contradict such an assertion.



4.4 Comparing the Shifts across Regions

Suppose we wish to compare the shifts in the Beveridge Curves across regions—that is, how might the magnitude of the shifts be calculated. We propose the following: (1) select a full

employment unemployment rate for each region (and the US); (2) find the vacancy rate that corresponds to full employment prior to the recovery for each region; (3) in order to focus on the unemployment rate, compute the implied unemployment rate that corresponds to the vacancy rate found in (2) after the right-ward (upward) shift in the recovery phase.

We assume a full-employment unemployment rate for the US to be 5%, a common although arguable assumption. Next, we computed the mean unemployment rate over the sample period for the US and each region. The unemployment rate averaged 6.33% for the US over the sample period. Choosing the West census region as an example, the mean unemployment rate over the same period averaged 6.91%. Next assume that the ratio by which the mean rate in the West exceeds that of the US can be applied to the full-employment rate for the US yielding an estimated full-employment rate for the West region. That rate, is calculated to be 5.46% as follows:

$$\frac{6.91\%}{6.33\%} * 5.0\% = 5.46\%$$

The 5.46% unemployment rate for the West is associated with a vacancy rate of 3.04%. The estimated unemployment rate consistent with a 3.04 vacancy rate after the shift in the Beveridge Curve is 7.23%, so at this vacancy rate the implied unemployment rate is higher by 1.77%. We are not prepared to defend the precision of this estimate—consider it an approximation.

Applying the same method to each region, we estimate shifts for the US and the census regions. The results are summarized in Table II. The table reveals that the estimated shift, when measured horizontally suggests that the unemployment rate associated with the vacancy rate of 2.63 for the US would be 1.7 points higher, a 6.7% unemployment rate versus the 5%, assumed to be the full employment rate. The difference row computes the implied shift for each region.

The Northeast census region shift is comparable to that of the nation, whereas the shift for the South region is calculated to be a bit smaller than the nation as a whole and the Mid-West and West curves seem to have shifted by a larger magnitude, at least as measured by this method. The reader is cautioned that these calculations should be considered only as a rough guide, since they depend on both regression estimations and assumptions regarding full-employment for the nation and its census regions.

Table II: Computation of the right-ward Shift across Regions

<i>u, v, difference</i>	US	NE	South	Mid-West	West
<i>full emp. u</i>	5.0	4.8	4.85	4.95	5.46
<i>v at full emp.</i>	2.63	2.78	3.15	2.69	3.04
<i>u after shift</i>	6.7	6.5	6.4	6.8	7.23
<i>difference</i>	1.7	1.7	1.5	1.85	1.8

5. Conclusions

It is well-known that the *Beveridge Curve* shifted significantly upward (away from the origin) in the recovery time frame following the *Great Recession*. That shift is generally ascribed to a deterioration of the efficiency of the *matching function*, which is the underlying basis for the *Beveridge Curve*. We present evidence that the shift in the curve was consistent (though not the same) across each of the four census regions. Evidence suggests that the Mid-West and the West regions underwent the greatest shifts, when measured in terms of the unemployment rate. Even though the unemployment rate has fallen to near full-employment levels, thus far the preponderance of evidence does not support a shift back to the pre-recovery curve, which would indicate more normal labor market conditions.

References

- Barlevy, Gadi, "Evaluating the Role of Labor Market Mismatch in Rising Unemployment" *Economic Perspectives*, FRB Chicago, 35(3), 2011, pp. 81-95.
- Barnichon, Regis (2010). "Building a composite Help-Wanted Index," *Economics Letters*, 109(3), 175-178.
- Barnichon, Regis, and Andrew Figura, 2010, "What drives movements in the unemployment rate? A decomposition of the Beveridge curve," *Finance and Economics Discussion Series*, Board of Governors of the Federal Reserve System, working paper, No. 2010-48.
- Barnichon, Regis, Michael Elsby, Bart Hobijn, and Ayşegül Şahin, 2010, "Which industries are shifting the Beveridge curve?," *Federal Reserve Bank of San Francisco*, working paper, No. 2010-32, December.
- Benati, Luca and Thomas A. Lubik, "The Time-Varying Beveridge Curve," *Federal Reserve Bank of Richmond August 2013 Working Paper No. 13-12*
- Bernanke, Ben (March 2012). "Recent Developments in the Labor Market," (<http://www.federalreserve.gov/newsevents/speech/bernanke20120326a.htm>) .109(3), 175-178.
- Beveridge, William H. (1944). *Full Employment in a Free Society*. New York: W. W. Norton & Company.
- Blanchard, Olivier and Peter Diamond, "The Beveridge Curve," *Brookings Papers on Economic Activity*, 1989, No. 1
- Blanchard, Olivier, "Flows, Bargaining, and Unemployment," *Lecture Notes* (1998) <https://economics.mit.edu/files/780>
- Daly, Mary C., Bart Hobijn, and Robert G. Valletta (2011). "The Recent Evolution of the Natural Rate of Unemployment," *Working Paper Series 2011-05*, Federal Reserve Bank of San Francisco.
- Daly, Mary C., Bart Hobijn, Ayşegül Şahin, and Robert G. Valletta (2012). "A Search and Matching Approach to Labor Markets: Did the Natural Rate of Unemployment Rise?" *Journal of Economic Perspectives*, 26, Summer 2012, 3-26.
- Diamond, Peter A. and Ayşegül Şahin, "Shifts in the Beveridge Curve," *Staff Report No. 687*, Federal Reserve Bank of New York, August 2014.

- Diamond, Peter A., "Cyclical Unemployment, Structural Unemployment," NBER Working Paper No. 18761, February 2013. © 2013 by Peter A. Diamond
- Dow, J. Christopher R. and Louis A. Dicks-Mireaux (1958). "The Excess Demand for Labour: A Study of Conditions in Great Britain, 1946–56," *Oxford Economic Papers* 10(1): 1–33.
- Figura, Andrew and David Ratner, "The Labor Share of Income and Equilibrium Unemployment," FEDS Notes, Board of Governors, Federal Reserve System, June 8, 2015.
- Ghayad, R. (2013). A Decomposition of Shifts of the Beveridge Curve (Public Policy Brief No 13-1). Boston: Federal Reserve Bank of Boston.
- Kocherlakota, Narayana, 2011, "Notes on 'Labor markets and monetary policy,'" supplementary material for speech at St. Cloud State University, March 3, available at www.minneapolisfed.org/news_events/pres/kocherlakota_notes_March3_2011.pdf.
- Krueger, Alan B., Judd Cramer, and David Cho (2014) "Are the Long-Term Unemployed on the Margins of the Labor Market?" *Brookings Papers on Economic Activity*, Spring 2014.
- Lubik, Thomas A. and Karl Rhodes, "Putting the Beveridge Curve Back to Work," Economic Brief, Federal Reserve Bank of Richmond, September 2014, No. 14-09.
- Mortensen, Dale T., and Christopher A. Pissarides, 1994, "Job creation and job destruction in the theory of unemployment," *Review of Economic Studies*, Vol. 61, No. 3, July, pp. 397–415.
- Pereira, Rui, "The Long-Term Unemployed in Virginia," Virginia Employment Commission, August 2012. Available at: http://virginiarmi.com/content/pdfs/research_2012-08_longtermunemployed_rev.pdf
- Petrongolo, Barbara, and Christopher A. Pissarides, 2001, "Looking into the black box: A survey of the matching function," *Journal of Economic Literature*, Vol. 39, No. 2, June, pp. 390–431.
- Shimer, Robert (1998). "Why Is the U.S. Unemployment Rate so Much Lower?" NBER Macroeconomics Annual, 13, 11-16.

USING A BINOMIAL LOGIT MODEL TO ESTIMATE AND EXPLAIN THE HOME FIELD ADVANTAGE IN MAJOR LEAGUE BASEBALL

William Levernier, Georgia Southern University, PO Box 8152, Statesboro, GA 30460-8152

ABSTRACT

In a sporting event involving two teams, the home team generally has a higher likelihood of winning the event than the visiting team. This advantage is known as the home-field advantage (HFA). This paper develops a statistical model that estimates the magnitude of the home-field advantage and identifies some factors that affect the advantage in Major League Baseball. The model is estimated using all 24,297 regular-season games that were played during the ten seasons from 2006 through 2015 as observations. Post-season games (i.e., the League Division Series, League Championship Series, and the World Series) are excluded from the analysis. Among the important findings that emerge from the study are the HFA varies from season-to-season, with the advantage being twice as large in some years as in others; the HFA varies by team, with the advantage being more than five times as large for some teams than others; and the HFA is larger in games that don't go into extra innings than in games that do, with the advantage being about 1.6 times higher in games that don't go into extra innings. Perhaps the most important finding, however, is that the home-field advantage is more than seven times as large in games that are won by one run than in games that are won by two or more runs.

INTRODUCTION

The home-field advantage (HFA) in sports is the phenomenon in which the home team has a higher probability of winning a given game than the visiting team. Over the course of a season, then, a particular team is likely to win a higher percentage of its games when it's the home team than when it's the visiting team. While a home-field advantage exists in virtually all sports, this paper examines the extent to which the advantage exists in Major League Baseball and identifies some of the factors that affect the magnitude of the advantage. This issue is examined using the ten-year period from 2006 to 2015. Specifically, all regular-season Major League Baseball games played during the period are used as observations in a logit model that estimates the probability that the home team will win a particular game, given certain characteristics of the game.

In the next section, the literature pertaining to the home-field advantage is reviewed. While some of these studies examine the home-field advantage in baseball, most examine it in other sports, especially soccer. Following the literature review, some general patterns related to the home-field advantage that emerge from the data are discussed. In the next section the logit model is developed and estimated, followed by a discussion of the regression results and the estimated probabilities of a home team winning a game under different scenarios. The paper finishes with a summary and concluding remarks.

LITERATURE REVIEW

The home-field advantage is a topic that's been widely examined in the economics, social science, and sport science literature. Much of the literature on the topic has focused on European football, or soccer as it's called in the United States (Anders and Rotthoff, 2014; Beck and Meyer, 2012; Carmichael and Thomas, 2005; Forrest, et. al., 2005; Koyama and Reade, 2009; and Pollard and Gomez, 2009). Some studies have focused on college (NCAA) baseball (Bray, Obara, and Kwan, 2005) or hockey (Leard and Doyle, 2011). A few studies have compared the home-field advantage across multiple sports (Berdell, Ciecka, and Krautman, 2013; and Gomez, Pollard, and Luiz-Pascual, 2011; Pollard and Pollard, 2005).

Some have even looked at the effect of the home-field advantage on a team's success in the post-season playoffs (Rogerson, 2014).

Anders and Rothoff (2014) compared two different soccer leagues, the Bundesliga (Germany) and Major League Soccer (US) during the 2004 through 2009 seasons. In soccer, the decisions of the referee can have a huge impact on the outcome of the game. The Bundesliga is a league that's considered to have hostile fans, while the MLS is considered to be a league that has peaceful fans. Using a probit model, where the dependent variable predicts the home team's likelihood of winning a game, they find that attendance positively affects the outcome of the game in the Bundesliga, but that it has no effect on the outcome of games in the MLS. This arises mostly because a large number of fans at a Bundesliga game is relatively intimidating to a referee, but a large number of fans at an MLS game is not.

Two studies focused on European football for a single season. Carmichael and Thomas (2005) used the English Premier League (England's top league) for their analysis and found that, in general, home teams outperform visiting teams. Their measures of performance are shots taken by a team and goals scored by a team. Forrest, et. al. (2005) used the English Football League (a collection of leagues that are a level below the English Premier League) for their analysis. They focused on the extent to which a home advantage affects attendance at games, and found that attendance at a game falls as the home advantage becomes stronger (i.e., the game isn't expected to be close).

The *trend* in the home-field advantage over time is a topic that has also begun to receive attention in the literature. Koyama and Reade (2009) examine the English Football League and find that although a home-field advantage exists, it's been getting smaller over time. They apply a principle-agent explanation to this trend by noting the decline corresponds to increased television coverage of the games. With games more commonly televised that was previously the case, players have incentive not to shirk during away games, because their fans who are watching the games back home are now able to monitor their effort at away games. Pollard and Gomez (2009) determined the home field advantage for teams in four different European football leagues (in France, Italy, Spain, and Portugal). They found that since the late 1970s there's been a general decline in the home advantage. Pollard and Pollard (2005), using four American sports leagues (Major League Baseball, the National Hockey League, the National Football League, and the National Basketball Association) and four levels of football in England, found that while the home –field advantage has stayed fairly constant in Major League Baseball, it's generally declined over time in the other leagues.

Gomez, Pollard, and Luis-Pascual (2011) analyzed nine different professional sports leagues in Spain over the same time period, the 2005-06 through 2009-10 seasons. The team sports they include in their study are baseball, basketball, handball, indoor soccer, roller hockey, rugby, soccer, volleyball, and water polo. They find that there's a home-field advantage in all nine sports, but that it varies across sports. They find that the advantage is strongest in rugby, and lowest in volleyball, water polo, and roller hockey. Berdell, Ciecka, and Krautmann (2013) also examine multiple sports leagues, but confine their analysis to three U.S. sports leagues: the National Football League, the National Basketball Association, and Major League Baseball, using data from the 2001 – 2010 seasons. They, too, find that a home-field advantage exists in all sports and that it exists for all teams.

Leard and Doyle (2011) use game-level data from the National Hockey League from the 2007-08 season to determine to what extent winning a game is affected by a team being the home team. They utilize a binary probit model, where the dependent variable indicates whether or not the team won the game, and where one of the explanatory variables is a dummy variable that indicates whether or not the team was the home team. Their regression results indicate that a team's probability of winning a game is higher if it's the home team than if it's the visiting team.

GENERAL PATERNS RELATED TO THE HOME-FIELD ADVANTAGE

To examine the home-field advantage in Major League Baseball, data on all 24,297 regular-season games played during the ten seasons from 2006 through 2015 were used. Several factors pertaining to each game were gathered. These factors include the year the game was played, how many runs the home team scored, whether or not the game went into extra innings, whether the game involved two teams from the same league (either the National League or the American League) or two teams from different leagues (an Interleague game), the two teams playing the game, and whether the game was won by a single run or by two or more runs. The game-level data used in this study were obtained from the Baseball Reference web site, an on-line data source for all things related to professional baseball (www.baseballreference.com).

Table 1 reports the home-field advantage for each of the ten seasons examined in the study. The HFA is calculated as the difference between the proportion of games won by the home team and the proportion of games lost by the home team. This difference can be calculated as

$$\text{HFA} = (\text{HW} - \text{HL}) / (\text{HW} + \text{HL}) \quad (1)$$

Where HW is the number of games won by the home team
HL is the number of games lost by the home team

Table 1
Home-Field Advantage by Year

Year	HW	HL	HFA
2006	1,327	1,102	0.0926
2007	1,318	1,113	0.0843
2008	1,351	1,077	0.1129
2009	1,333	1,097	0.0971
2010	1,358	1,072	0.1177
2011	1,277	1,152	0.0515
2012	1,295	1,135	0.0658
2013	1,308	1,123	0.0761
2014	1,288	1,142	0.0601
2015	1,315	1,114	0.0828
Total	13,170	11,127	0.0841

During the 2006 – 2015 seasons, home teams won 13,170 of the 24,297 games, or 54.2 percent of the games. Conversely, they lost 11,127 of the games, or 45.8 percent of the games. The difference between the two percentages is 8.4 percent. In a randomly chosen game, then, the home team's likelihood of winning is 8.4 percentage points higher than that of the visiting team.

The HFA fluctuates substantially across the seasons. The HFA in 2010, the year with largest HFA, is more than twice as large as the HFA in 2011, the year with the smallest HFA. The HFA in 2008, the year with the second largest HFA, is approximately 1.9 times larger than the HFA in 2014, the year with the second smallest HFA. In only three of the ten years was the HFA within one percentage point of the total HFA (8.41%).

Table 2 reports how the HFA varies by whether or not a game goes into extra innings; by whether the game is won by one run or by two or more runs; and by whether the game is an American League game, a National League game, or an Interleague game.

Table 2
Home-Field Advantage by Various Factors, all years

ExtraInn	HW	HL	HFA
No	12,040	10,113	0.0870
Yes	1,130	1,014	0.0541
Total	13,170	11,127	0.0841

WinBy1	HW	HL	HFA
Yes	4,307	2,767	0.2177
No	8,863	8,360	0.0292
Total	13,170	11,127	0.0841

League	HW	HL	HFA
AL	5,539	4,728	0.0790
NL	6,103	5,132	0.0864
Inter. Lg.	1,528	1,267	0.0934
Total	13,170	11,127	0.0841

ExtraInn indicates whether the game went into extra innings.

WinBy1 indicates whether the game was won by one run.

League indicates if both teams in a game were American League teams, both teams in a game were National League teams, or the game was an Interleague game (i.e., a game with one team from the American League and one team from the National League).

The top panel of Table 2 indicates that the home-field advantage is smaller in games that go into extra innings than in games that don't. Of the 24,297 regular-season games played during the 2006 – 2015 period, 2,144 went into extra innings. The HFA in these games was 5.4 percent. In the games that didn't go into extra innings, the HFA was a much larger 8.7 percent.

The middle panel indicates that the size of the HFA varies substantially by the closeness of a game. Specifically, in games that are won by one run the HFA is 21.8 percent, while in games decided by two or more runs the HFA is only 2.9 percent. One possible explanation for this pattern is related to the fact that the home team bats last in an inning. Thus, if a game enters the last (i.e., 9th) inning with the score tied, when the visiting team comes to bat, it doesn't know how many runs it needs to score to win the game. If the game then moves to the bottom of the ninth with the score still tied, the home team knows that it only needs to score one run to win the game. As such, it can employ a strategy that's designed to score just one run.

The bottom panel indicates that the HFA is larger for interleague games than for either National League games or American League games. A possible explanation for this is that in interleague games, the rule regarding the designated hitter is applied according to the home team's league. When the home team is in the National League there is no designated hitter, but when the home team is in the American League there is a designated hitter. As such, during interleague games, the home team is playing under a set of

rules with which it is familiar but the visiting team is not. It's not surprising, then, that the home team will have a larger than usual advantage in these games.

Table 3 shows the HFA for each team during the 2006 – 2015 period. The magnitude of the advantage varies greatly, however. The Colorado Rockies had the largest advantage at 14.8 percent, while the New York Mets had the smallest advantage at 2.6 percent. Thus, the HFA for the Rockies is more than five times as large as the HFA for the Mets.

Table 3
Home Field Advantage 2006 - 2015, by Team (from largest to smallest)

Team	HW	HL	RW	RL	Win%	HFA
COL	440	371	320	490	0.4688	0.1475
PIT	434	376	318	491	0.4645	0.1427
TOR	458	352	362	448	0.5062	0.1185
STL	491	318	398	412	0.5491	0.1156
HOU	400	409	309	501	0.4379	0.1130
MIL	447	363	361	449	0.4988	0.1062
WSN	427	381	347	463	0.4784	0.1001
TBR	458	355	376	432	0.5145	0.0980
ATL	458	352	379	431	0.5167	0.0975
BAL	417	389	344	469	0.4700	0.0942
DET	468	342	396	414	0.5333	0.0889
OAK	446	364	374	435	0.5065	0.0883
CLE	432	376	363	448	0.4910	0.0871
SFG	448	363	379	429	0.5108	0.0833
BOS	466	344	400	410	0.5346	0.0815
NYY	496	314	430	380	0.5716	0.0815
CIN	432	377	369	442	0.4944	0.0790
SDP	421	389	358	453	0.4806	0.0783
LAD	469	341	406	403	0.5405	0.0772
ARI	422	388	360	450	0.4827	0.0765
MIN	427	384	365	446	0.4883	0.0764
CHW	427	384	367	443	0.4898	0.0734
CHC	414	395	360	449	0.4784	0.0667
SEA	403	411	346	460	0.4623	0.0658
TEX	449	362	397	413	0.5219	0.0635
LAA	472	338	424	386	0.5531	0.0593
MIA	395	412	356	456	0.4639	0.0510
PHI	442	368	406	404	0.5235	0.0444
KCR	392	418	359	451	0.4636	0.0407
NYM	419	391	398	412	0.5043	0.0259
Total	13,170	11,127	11,127	13,170	0.5000	0.0841

RW is the number of games won by the team as the road (i.e., visiting) team.

RL is the number of games lost by the team as the road (i.e., visiting) team.

Win% is the team's overall win percentage during the 2006 – 2015 seasons.

There were seven teams that had an HFA of at least 10.0 percent. They are the Colorado Rockies, the Pittsburgh Pirates, the Toronto Blue Jays, the St. Louis Cardinals, the Houston Astros, the Milwaukee Brewers, and the Washington Nationals. At the low end, three teams had a home-field advantage of less than 5.0 percent. They are the New York Mets, the Kansas City Royals, and the Philadelphia Phillies.

During a given season, the home-field advantage of a particular team is often much larger or much smaller than the numbers indicated in the above table. It's not uncommon for there to be a team with a home-field advantage that's larger than 20 percent during a particular season, or for there to be a team that doesn't have a home-field advantage. Table 4 and Table 5 reports such teams.

Table 4
Teams with a Home-Field Advantage of at Least 20 Percent during a Year

Team	Year	HW	HL	RW	RL	HFA
COL	2014	45	36	21	60	0.2963
DET	2010	52	29	29	52	0.2840
PIT	2010	40	41	17	64	0.2840
TBR	2006	41	40	20	61	0.2593
ATL	2010	56	25	35	46	0.2593
COL	2010	52	29	31	50	0.2593
MIL	2006	48	33	27	54	0.2593
HOU	2015	53	28	33	48	0.2469
TBR	2009	52	29	32	49	0.2469
MIL	2007	51	30	32	49	0.2346
PIT	2006	43	38	24	57	0.2346
TEX	2007	47	34	28	53	0.2346
SDP	2014	48	33	29	52	0.2346
MIN	2008	53	28	35	47	0.2275
CHW	2008	54	28	35	46	0.2264
LAD	2015	55	26	37	44	0.2222
MIL	2011	57	24	39	42	0.2222
STL	2010	52	29	34	47	0.2222
PIT	2009	40	41	22	58	0.2188
TBR	2008	57	24	40	41	0.2099
ATL	2015	42	39	25	56	0.2099
BOS	2008	56	25	39	42	0.2099
BOS	2009	56	25	39	42	0.2099
DET	2009	51	30	35	47	0.2028

Table 4 reports the twenty-four occurrences where a team's home-field advantage was at least 20 percent during a season. The largest HFA was 29.6 percent, which was accomplished by the Colorado Rockies in 2014. Close behind at 28.4 percent were the Detroit Tigers and Pittsburgh Pirates, both in 2010. Three teams, the Tampa Bay Rays, Pittsburgh Pirates, and Milwaukee Brewers, all had a HFA of at least 20 percent three times during the ten-year period.

Table 5 reports the thirty-one occurrences where a team had a home-field *dis*advantage (i.e., a negative home-field advantage). The New York Mets had the two largest disadvantages, in 2011 and 2013. Close behind were the Miami Marlins (then they were called the Florida Marlins) and the Chicago White Sox, both in 2011. Three teams, the New York Mets, Philadelphia Phillies, and Texas Rangers all had a negative HFA at least three times during the ten-year period.

Table 5
Teams with a Home-Field Disadvantage during a Year

Team	Year	HW	HL	RW	RL	Win%	HFA
NYM	2011	34	47	43	38	0.4753	-0.1111
NYM	2013	33	48	41	40	0.4568	-0.0988
MIA	2011	31	47	41	43	0.4444	-0.0907
CHW	2011	36	45	43	38	0.4877	-0.0864
ATL	2009	40	41	46	35	0.5309	-0.0741
NYM	2007	41	40	47	34	0.5432	-0.0741
KCR	2014	42	39	47	34	0.5494	-0.0617
TBR	2014	36	45	41	40	0.4753	-0.0617
CHC	2010	35	46	40	41	0.4630	-0.0617
SEA	2014	41	40	46	35	0.5370	-0.0617
CHC	2013	31	50	35	46	0.4074	-0.0494
LAD	2014	45	36	49	32	0.5802	-0.0494
MIN	2012	31	50	35	46	0.4074	-0.0494
SEA	2015	36	45	40	41	0.4691	-0.0494
DET	2006	46	35	49	32	0.5864	-0.0370
BOS	2014	34	47	37	44	0.4383	-0.0370
HOU	2013	24	57	27	54	0.3148	-0.0370
PHI	2006	41	40	44	37	0.5247	-0.0370
PHI	2009	45	36	48	33	0.5741	-0.0370
CLE	2015	39	41	42	39	0.5031	-0.0310
TEX	2006	39	42	41	40	0.4938	-0.0247
MIN	2013	32	49	34	47	0.4074	-0.0247
NYM	2012	36	45	38	43	0.4568	-0.0247
SDP	2006	43	38	45	36	0.5432	-0.0247
TEX	2015	43	38	45	36	0.5432	-0.0247
PHI	2012	40	41	41	40	0.5000	-0.0123
ARI	2015	39	42	40	41	0.4877	-0.0123
BOS	2012	34	47	35	46	0.4259	-0.0123
SDP	2011	35	46	36	45	0.4383	-0.0123
TEX	2014	33	48	34	47	0.4136	-0.0123
MIA	2009	43	38	44	37	0.5370	-0.0123

Since a team wins a game by scoring more runs than its opponent, it's expected that the home team wins a larger percentage of games in which it scores a large number of runs than when it scores a small number of runs. Table 6 reports the number of times a home team won a game and the number of times it lost a

game for different numbers of runs it scored. It also reports how often it scored each number of runs, along with the associated home-field advantage.

When a home team scores three runs or less, it loses more often than it wins. In other words, it has a *negative* HFA. When a home team scores two runs in a game, for example, its likelihood of losing the game is 43.7 percentage points higher than its likelihood of winning. When a home team scores four runs or more in a game, it's more likely to win the game than to lose the game. Not surprisingly, the likelihood of it winning increases as the number of runs it scores increases. Once a home team scores 11 runs in a game, its HFA exceeds 90 percent.

Table 6
Home-Field Advantage by Number of Runs Scored by the Home Team

H_Runs	Freq.	%	HW	HL	HFA
0	1,329	5.47	0	1,329	-1.0000
1	2,350	9.67	292	2,058	-0.7515
2	3,145	12.94	886	2,259	-0.4366
3	3,406	14.02	1467	1,939	-0.1386
4	3,357	13.82	1943	1,414	0.1576
5	2,930	12.06	1,993	937	0.3604
6	2,319	9.54	1,735	584	0.4963
7	1,705	7.02	1,412	293	0.6563
8	1,239	5.10	1,070	169	0.7272
9	861	3.54	780	81	0.8118
10	559	2.30	522	37	0.8676
11	411	1.69	395	16	0.9221
12	291	1.20	285	6	0.9588
13	140	0.58	137	3	0.9571
14	104	0.43	102	2	0.9615
15 or more	151	0.62	151	0	1.0000
Total	24,297	100.00	13,170	11,127	0.0841

H_Runs is the number of runs scored by the home team.

Freq. is the number of times the home team scored the stated number of runs.

% is percent of games in which the home team scored the stated number of runs.

THE LOGIT MODELS AND REGRESSION RESULTS

The home-field advantage is a situation where the likelihood of the home-team winning a given game is larger than the likelihood of the visiting team winning the game. The greater the difference in the probabilities, the larger the HFA. Essentially, then, the issue of the HFA is an issue of probability.

If we denote the probability that the home team wins a game as $p(\text{HW})$, the probability that the visiting team wins a game is $1 - p(\text{HW})$. We can then measure the HFA in a given game as

$$\text{HFA} = p(\text{HW}) - [1 - p(\text{HW})]$$

$$\text{HFA} = 2 p(\text{HW}) - 1 \tag{2}$$

The HFA in a particular game can therefore be calculated from the probability that the home team wins the game. The probability that the home team wins a game can be econometrically estimated with a binary logit model. In this paper, five different logit models, each with a different combination of explanatory variables, are estimated. The models are:

$$\text{Model 1} \quad Z = a + b_1 \text{Runs} \quad (3)$$

$$\text{Model 2} \quad Z = a + b_1 \text{Runs} + b_2 \text{RunsSqrd} \quad (4)$$

$$\text{Model 3} \quad Z = a + b_1 \text{Runs} + b_2 \text{RunsSqrd} + b_3 \text{OneRun} \quad (5)$$

$$\text{Model 4} \quad Z = a + b_1 \text{Runs} + b_2 \text{RunsSqrd} + b_3 \text{OneRun} + b_4 \text{Interact} \quad (6)$$

$$\text{Model 5} \quad Z = a + b_1 \text{Runs} + b_2 \text{RunsSqrd} + b_3 \text{OneRun} + b_4 \text{Interact} + b_4 \text{Extra} \quad (7)$$

The variables, along with their definitions, are as follows:

Z	a binary dependent variable that takes a value of 1 if the home team wins the game, a value of 0 if it loses the game.
Runs	the number of runs the home team scores in the game.
RunsSqrd	the number of runs squared the home team scores in the game.
OneRun	a binary categorical variable (i.e., dummy variable) that takes a value of 1 if the game is won by one run, 0 otherwise.
Interact	an interaction term between Runs and OneRun. It's computed as $\text{Runs} * \text{OneRun}$. In games that are won by one run, the value of this variable is the same as the value of Runs. In games that are won by two runs or more, its value is zero.
Extra	a dummy variable that takes a value of 1 if the game goes into extra innings, 0 otherwise.

Runs is included as an explanatory variable because, as was seen in Table 6, the likelihood that the home team wins a game increases as it scores more runs. This relationship is estimated in Model 1. Also, the increase in the likelihood appears to be non-linear (see Table 6), such that when a home team scores an additional run the increase in the likelihood it will win the game is larger when the initial number of runs scored is small than when the initial number of runs scored is large. This indicates that a non-linear relationship exists between the likelihood of winning and the number of runs scored. Including a squared term for runs scored is therefore appropriate, thus *RunsSqrd* is included as an explanatory variable beginning with Model 2.

OneRun is entered as an explanatory variable beginning with Model 3. The middle panel of Table 2 indicates that the likelihood that the home team will win a game is substantially higher in a game won by one run than in a game won by two or more runs.

It's possible that the likelihood of the home team winning a game that's won by one run is different if the game is a high scoring game than if it's a low scoring game. This brings about the need for an interaction term, *Interact*, between the *Runs* and the *OneRun* variables. The interaction term is entered as a variable beginning with Model 4.

The final explanatory included in the model is *Extra*, which is entered as an explanatory variable in Model 5. We saw in the top panel of Table 2 that the home-field advantage is smaller in extra-inning games than in games that don't go extra innings.

To compute the probability that the home team will win a particular game, $p(\text{HW})$, the estimated value for Z , is inserted into the following equation (Pindyck and Rubinfeld, 1991):

$$p(\text{HW}) = 1 / (1 + e^{-Z}) \quad (8)$$

If the estimated value for Z is .7500, for example, the computed probability that the home team will win the game is

$$p(\text{HW}) = 1 / (1 + e^{-.7500}) = 1 / 1.4724 = .6792$$

This yields a computed HFA (from equation 2) of $2*(.6792) - 1 = .3584$.

THE ECONOMETRIC RESULTS AND THE PREDICTED PROBABILITIES OF THE HOME TEAM WINNING A GAME

The regression results of the five logit models are reported in Table 7 (the absolute value of the t-statistics are in parenthesis). The associated estimated probability of a home team winning a game for a given number of runs scored for each of the five models is reported in Table 8.

Table 7
Regression Results for Models 1-5

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	-2.09754 (62.54)	-2.61077 (55.48)	-3.01692 (56.30)	-4.09796 (58.23)	-4.08729 (58.14)
Runs	0.54652 (70.88)	.82550 (45.78)	.84474 (43.31)	1.16899 (51.03)	1.17178 (51.26)
RunSqr		-.02962 (19.08)	-.02822 (16.51)	-.04321 (24.77)	-.04348 (25.04)
OneRun			.91178 (26.06)	3.04411 (41.00)	3.07890 (41.34)
Interact				-.55575 (34.37)	-.54572 (33.57)
Extra					-.39731 (7.51)
Pseudo R-Sqr	.250	.257	.278	.311	.313

All coefficients are statistically significant at the .01 level.

The results in Table 7 indicate that the home team's probability of winning a game increases as it scores more runs. The negative coefficient on *RunSqr* in Models 2 – 5 further indicates that the probability of winning increases at a decreasing rate as the team scores more runs. Thus, an additional run scored by the

home team will increase its likelihood of winning by a larger amount when it scores a relatively small number of runs than when it scores a relatively large number of runs.

In Models 3 – 5, *OneRun* is included as an explanatory variable. Recall, this is a dummy variable that indicates whether or not the game was won by one run as opposed to two or more runs. The large positive coefficient indicates that the home team's probability of winning a game is much larger in games won by one run. This is a fairly important result, since the middle panel of Table 2 reports that 7,074 of the 24,297 games played during the ten-year period were won by a single run. In other words, 29.1 percent of the games in Major League Baseball were won by one run. As such, this type of game is a common occurrence and is likely to substantially increase the number of games won by the home team over the course of a season (a season consists of 81 home teams and 81 road games for each team).

The negative coefficient on *Interact* in Models 4 – 5 makes the effective coefficient on *Runs* smaller in games that are won by one run than in games won by two or more runs. It also has the effect of making the constant in the equation smaller in games that are won by one run than in games that are won by two or more runs.

In Model 5, *Extra* is added as a variable. The negative coefficient on the variable indicates that when a game goes into extra innings, the likelihood of the home team winning the game decreases. The inclusion of this variable does not cause much of a change in the magnitude of the other variables in the model, however. Thus the estimated effect of the other variables on the home team's probability of winning is about the same as in Model 4.

Table 8 reports the estimated probabilities of a home team winning a game, based on the number of runs it scores (up to 15). The probabilities are computed from equation (8) using the values of Z that are estimated from the five regressions. Models 3a, 4a, 5a, and 5b are the models that apply to games that are won by one run; Models 3b, 4b, 5c, and 5d are the models that apply to games that are won by two or more runs; and Models 1 and 2 are the models that don't take into account whether or not the game is won by one run.

Most of the models show that the estimated probability of a home team winning a game increases as the number of runs it scores increases. The marginal increase tends to decrease with the number of runs scored, however. In Model 2, for example, when a home team increases the number of runs it scores from three to four, its probability of winning increases by .1534, but when it increases the number of runs it scores from six to seven, its probability of winning increases by only .0659. A similar pattern holds in Model 3a. Here, when a home team increases the number of runs it scores from three to four, its probability of winning increases by .1762, but when it increases the number of runs it scores from six to seven, its probability of winning increases by only .0314.

A second pattern that emerges in the estimated probabilities is that the probability of the home team winning a game when it scores a given number of runs is generally higher in games that are won by one run. If we compare Models 3a to 3b, 4a to 4b, 5a to 5c, and 5b to 5d, the probability of the home team winning is higher in games that are won by one run than in games that aren't. At least that's the case up to about five runs.

A final pattern that emerges is seen in Models 4a, 5a, and 5b. These are the models that include the interaction term, *Interact*, and that apply to games won by one run. In all three models, the probability of the home team winning with respect to the number of runs it scores is an inverted U-shape. The likelihood of the home team winning increases up to about seven runs, but then the probabilities begin to *decrease* with additional runs scored. A possible reason is that in games won by one run, when the home

team scores a large number of runs the visiting team also scores a large number of runs. When the visiting team scores a large number of runs, the probability of the home team winning will decrease.

Table 8
Probabilities of the Home Team Winning a Game by Runs Scored for Models 1-5

H_Runs	Model 1	Model 2	Model 3a	Model 3b	Model 4a	Model 4b
1	0.1749	0.1400	0.2161	0.0997	0.3814	0.0487
2	0.2681	0.2538	0.3841	0.2004	0.4999	0.1264
3	0.3875	0.4011	0.5853	0.3618	0.5980	0.2729
4	0.5221	0.5541	0.7615	0.5620	0.6699	0.4717
5	0.6536	0.6849	0.8784	0.7438	0.7175	0.6608
6	0.7652	0.7818	0.9423	0.8679	0.7446	0.7958
7	0.8492	0.8477	0.9737	0.9370	0.7543	0.8774
8	0.9068	0.8907	0.9882	0.9711	0.7477	0.9233
9	0.9438	0.9183	0.9947	0.9870	0.7242	0.9490
10	0.9667	0.9360	0.9977	0.9942	0.6808	0.9634
11	0.9804	0.9471	0.9990	0.9974	0.6138	0.9716
12	0.9886	0.9539	0.9995	0.9989	0.5207	0.9761
13	0.9934	0.9575	0.9998	0.9995	0.4051	0.9780
14	0.9961	0.9585	0.9999	0.9998	0.2814	0.9781
15	0.9978	0.9572	1.0000	0.9999	0.1711	0.9762

H_Runs	Model 5a	Model 5b	Model 5c	Model 5d
1	0.3951	0.3051	0.0493	0.0337
2	0.4950	0.4188	0.1281	0.0899
3	0.6049	0.5203	0.2762	0.2041
4	0.6820	0.5994	0.4761	0.3791
5	0.7294	0.6542	0.6648	0.5713
6	0.7524	0.6868	0.7987	0.7273
7	0.7545	0.6998	0.8792	0.8302
8	0.7360	0.6942	0.9244	0.8916
9	0.6940	0.6697	0.9496	0.9269
10	0.6234	0.6241	0.9638	0.9471
11	0.5201	0.5547	0.9718	0.9587
12	0.3890	0.4616	0.9762	0.9650
13	0.2511	0.3509	0.9781	0.9677
14	0.1368	0.2381	0.9780	0.9676
15	0.0629	0.1421	0.9760	0.9647

Model 3a: The game is won by one run

Model 3b: The game is won by two or more runs

Model 4a: The game is won by one run

Model 4b: The game is won by two or more runs

Model 5a: The game is won by one run and the game does not go into extra innings

Model 5b: The game is won by one run and the game does go into extra innings

Model 5c: The game is won by two or more runs and the game does not go into extra innings

Model 5d: The game is won by two or more runs and the game does go into extra innings

SUMMARY AND CONCLUDING REMARKS

This study has examined the home-field advantage in Major League Baseball by utilizing results from the 24,297 regular-season games that were played during the ten seasons from 2006 through 2015. Since teams play 81 home games per season (unless a game is cancelled due to weather), approximately 810 home games for each of the 30 major league teams were included in the data analysis.

Five different logit models were estimated, where the dependent variable is a binary variable that indicates whether or not the home team won the game. The models allow us to estimate the probability that the home team will win a game, given certain values for the explanatory variables. Once the probability of winning is determined, the home-field advantage can be easily calculated.

Several important findings regarding the probability of the home team winning a game emerge from the results of the logit models. Among them are the probability of the home team winning a game increases with the number of runs it scores, but at a decreasing rate. Scoring an additional run tends to increase the probability of winning by a much larger amount when the team scores a relatively small number of runs than when it scores a relatively large number of runs. Perhaps the most important finding of the study is that the likelihood of the home team winning a game is much larger in games that are won by a single run than in games that are won by two or more runs.

A somewhat surprising finding of the study is that even though the home team has an advantage in extra-inning games as well as in games that don't go into extra innings, the advantage is substantially smaller in extra-inning games. A second surprising finding is that in games that are won by one run, the probability of the home team winning increases as it scores more runs, but only up to a point (about 8 runs). After that point, additional runs actually diminish the likelihood that the home team wins. Perhaps this is because in a game that's won by one run, when the home team scores a large number of runs, the visiting team also scores a large number of runs.

REFERENCES

- Anders, A. and K. W. Rotthoff (2014). "Is Home-Field Advantage Driven by the Fans? Evidence from Across the Ocean." *Applied Economics Letters*. 21(16). 1165-1168.
- Beck, N. and M. Meyer (2012). "Modeling Team Performance: Theoretical and Empirical Annotation of the Analysis of Football Data." *Empirical Economics*. 43(1). 335-356.
- Berdell, J., J. Ciecka, and A. C. Krautmann (2013). "There's No Place Like Home: Home Court Advantage in North American Sports Leagues." *International Journal of Sports Management and Marketing*. 14(1/2/3/4). 133-145.
- Bray, S. R., J. Obara, and M. Kwan (2005). "Batting Last as a Home Advantage Factor in Men's NCAA Tournament Baseball." *Journal of Sports Sciences*. 23(7). 681-686.
- Carmichael, F. and D. Thomas (2005). "Home-Field Effect and Team Performance: Evidence from English Premiership Football." *Journal of Sports Economics*. 6(3). 264-281.
- Forrest, D., J. Beaumont, J. Goddard, and R. Simmons (2005). "Home Advantage and the Debate about Competitive Balance in Professional Sports Leagues." *Journal of Sports Sciences*. 23(4). 439-445.

Gomez, M. A., R. Pollard, and J. Luis-Pascual (2011). "Comparison of the Home-Advantage in Nine Different Professional Team Sports in Spain." *Perceptual and Motor Skills*. 113(1). 150-156.

Koyama, M. and J. J. Reade (2009). "Playing Like the Home Team: An Economic Investigation into Home Advantage in Football." *International Journal of Sport Finance*. 4(1). 16-41.

Leard, B. and J. M. Doyle (2011). "The Effect of Home Advantage, Momentum and Fighting on Winning in the National Hockey League." *Journal of Sports Economics*. 12(5). 538-560.

Pindyck, R. S. and D. L. Rubinfeld (1991). *Econometric Models and Economic Forecasts*. (New York: McGraw-Hill, Inc.)

Pollard, R. and M. A. Gomez (2009). "Home Advantage in Football in South-West Europe: Long-term Trends, Regional Variations, and Team Differences." *European Journal of Sport Science*. 9(6). 341-352.

_____ and G. Pollard (2005). "Long-term Trends in Home Advantage in Professional Team Sports in North American and England (1876 – 2003)." *Journal of Sports Sciences*. 23(4). 337-350.

Rogerson, P. A. (2014). "Place Matters in Sports: Effects of the Length of Championship Series on Winning Probabilities for the Team with Home-Field Advantage." *International Journal of Geographical Information Science*. 28(6). 1264-1271.

2-GAME ROAD TRIPS: ANY FALL-OFF IN PERFORMANCE?

Mark Mitchell, Coastal Carolina University
Sam Wathen, Coastal Carolina University
John Bowles, Coastal Carolina University

ABSTRACT

Coastal Carolina University joined the Sun Belt Conference in 2016. In many sports, the Sun Belt Conference uses 2-team travel partners for scheduling. That is, teams schedule 2-game road trips to maximize rest while minimizing travel times and missed classes. This manuscript examines the results of the 2-game road trip to assess whether team performance (i.e., wins and losses) differed in Game 2 from Game 1.

INTRODUCTION

In 1983, Coastal Carolina University (CCU) was a founding member of the Big South Conference, a Division I sports conference with teams located in Virginia, North Carolina, and South Carolina. In 2015, CCU accepted an invitation to join the Sun Belt Conference. At the time of the invitation, the Sun Belt was actively seeking a member institution in close proximity to Appalachian State (located in Boone, NC) to further implement its ‘travel partner’ strategy for the scheduling of athletic competitions. Coastal’s recent athletic success, along with its academic profile, facilities, and growing student body, made it an attractive expansion partner.

Coastal Carolina University officially joined the Sun Belt Conference on July 1, 2016 (the day after its Men’s Baseball Team won the NCAA Championship). A press release from the Sun Belt Conference on that day outlined this geographic strategy this way [7]:

With the addition of Coastal Carolina, the Sun Belt Conference will now have a symmetrical, geographic structure that is unparalleled in the history of the conference. The league will have two universities in Alabama (South Alabama and Troy), Arkansas (Arkansas State and Little Rock), Georgia (Georgia Southern and Georgia State), Louisiana (UL Lafayette and UL Monroe) and Texas (UT Arlington and Texas State) to go with Appalachian State in North Carolina and Coastal Carolina in neighboring South Carolina.

When announcing the Men’s Basketball schedule for 2016-17, Sun Belt Conference Commissioner Karl Benson noted [8]:

"This is an exciting time for the Sun Belt Conference as we have created a membership structure that makes perfect sense with six sets of travel partners located in seven states," Sun Belt Conference commissioner Karl Benson said. "Not only does the 12 team league allow for an 18-game regular season but it will allow for a much more manageable travel schedule for our men's and women's student-athletes that will result in less missed class time and much more time back on their respective campuses rather than on airplanes and buses."

Further in the same press release [8], the conference communication notes that “each team will only travel four times for two-game road trips during the upcoming season. Travel partners will be utilized for two-game road trips throughout the conference schedule to maximize rest, minimize travel times and limit missed class time for men’s and women’s basketball student-athletes. Men’s and women’s basketball

programs will each take just one, single-game road trip all season. Those single-game road trips will be for rivalry games.”

As Coastal Carolina completes year one in the Sun Belt Conference (SBC), data is available on the performance of each SBC team in its home and away conference games during the first year of full implementation. Further, team success in GAME 1 and GAME 2 of these 2-game road trips can be analyzed. The purpose of this manuscript is to present an analysis of the results of these 2-game road trips in the Sun Belt Conference. Specifically, the results are presented for Women’s Soccer, Women’s Volleyball, Women’s Basketball, and Men’s Basketball. These four sports are the primary users of the 2-game road trip. Win-Loss records will be analyzed in addition to some measure of competitive strengths of the teams. With the resultant data, coaches and athletic administrators can formulate strategies to improve team performance or, if viewed differently, to minimize the ‘effects of the road’ on their teams.

IMPETUS FOR THIS STUDY

In the book “Scorecasting: The Hidden Influences Behind How Sports are Played and Games are Won,” authors Tobias Moskowitz and Jon Wertheim note that home teams win 62% of their games in the National Basketball Association (NBA). However, they note that not all road games are equal. Occasionally, NBA teams will play on back-to-back nights in separate cities. And, when doing so, these teams seem to be ‘a step slow.’ On average, NBA teams playing on back-to-back nights win 36% of their games (for both home and away games). NBA Hall of Famer Charles Barkley referred to these games as ‘throwaways. [3, p. 125]. He once described such games this way: “*You show up because they pay you to show up. But, deep in your belly, you know you ain’t gonna win.*” (NOTE: In March 2017, NBA Commissioner stated the issue of resting players “is an extremely significant issue for our league.” [5].

Of the approximately 20 back-to-back games NBA teams play each year, 14 of these games are 2-game road trips. Moskowitz and Wertheim note that NBA teams can only expect to win 36% of the 14 games (or, on average, have a record of 5-9) [3]. Winston [10], also looking at NBA team performance in back-to-back games, found that NBA tend to score at least 4 points less when their back-to-game is against a rested team (i.e., a team that did NOT play the night before). Winston offers an anonymous quote often attributed to Coach Vince Lombardi ... “fatigue makes cowards of us all.”

Coastal Carolina University has just completed its first year of membership in the Sun Belt Conference. The researchers were curious to see how Sun Belt Conference teams did on these 2-game road trips. That is, did team performance in GAME 2 differ from team performance in GAME 1? And, what impact did the quality of the opponent have on team performance?

THE COMFORTS OF HOME (FOR HOME TEAMS)

Historically, there has been some advantage to sports teams playing in their home stadiums and communities. These advantages can include: a raucous crowd of fans, a familiar environment, the lack of travel to the game destination, and other factors. Over the last 10 years, on average, home teams have won the majority their home games in the following sports [3, p. 112]:

- NBA = 61%
- Major League Baseball = 54%
- NFL = 57%
- NHL = 56%
- Major League Soccer (USA) = 69%

- NCAA College Football = 63%
- NCAA Men’s Basketball = 69%

Jamieson [1], reporting a meta-analysis of studies on home field advantage, noted that home field advantage tends to be strongest for basketball, hockey, and soccer and less for football and baseball. It should be note that, for NCAA sports these records also includes non-conference competition. In scheduling their non-conference games, some institutions choose non-peers for such games, and often provide an appearance fee for that team. For example, The Ohio State University played the following non-conference games at home in 2016-17 [9]:

Football (2-0)	Men’s Basketball (10-0)
W = Bowling Green W = Tulsa	W = North Carolina Central W = Providence W = Western Carolina W = Jackson State W = Marshall W = Fairleigh Dickinson W = Florida Atlantic W = Connecticut W = Youngstown State W = UNC Asheville

And, these games are included in overall Home and Road records (which can overstate the true benefits of playing at home ... playing against a lesser opponent). As such, there is value in looking specifically at in-conference competition as such games are considered to be more peer-to-peer competition.

TRAVEL PARTNERS IN NCAA SPORTS

Recent research by the Knight Commission on Intercollegiate Athletics [2] found that athletics expenses are rising at an annual rate of approximately 7% and that revenues (from current sources) are not expanding as quickly. NCAA research [4] found spending for athletics increased 43 percent between 2004 and 2008 while revenue increased by 33% during the same period. Against this backdrop, member institutions are looking at (a) new revenue sources, and (b) sensible cost reductions. As noted earlier, scheduling 2 games in a geographic area can help reduce operating costs while concurrently reducing lost class time for student-athletes. Consider these two options for a team from South Carolina to play 2 teams in Texas or Arkansas.

- **FIRST** Single Game Trip: Day 1 = FLY to area, Day 2 = Game, Day 3 = FLY home.
- **SECOND** Single Game Trip: Day 1 = FLY back to area, Day 2 = Game, Day 3 = FLY home.
- **Total Days = 6**

Now, let’s have that same team play two games in that region or state.

- **2-Game Road Trip:** Day 1 = Fly to Area, Day 2 = Game, Day 3 = Bus to second site, Day 4= Game, Day 5 = FLY home.
- **Total Days = 5**

As illustrated above, the school incurs the cost of one airfare per person to play 2 games. And, students miss one fewer day of class for each trip (5 days as opposed to 6 days). Conference USA, a neighboring Division I FBS Conference with 14 member schools, uses a similar pattern of scheduling with the following travel partner paired institutions:

- Florida Atlantic / Florida International
- UT El Paso, UT San Antonio
- Marshall / Western Kentucky
- UAB / Middle Tennessee State
- Rice / North Texas
- Southern Miss / LA Tech
- Charlotte / Old Dominion

The Power 5 Conferences (ACC, Big 10, Big 12, PAC 12, and SEC) tend not to use this format. Other Group-of-5 conferences use selected travel partners (such as the Mountain West, Mid-American, and American Athletic) but the Sun Belt and Conference USA rely more heavily on this geographic strategy for scheduling purposes.

DATA SOURCE

The Sun Belt Conference provides a longitudinal look at the results of all its sanctioned sports on its website [6]. For each athletic competition, researchers can identify: Date, Home Team, Visiting Team, and Final Score. Analysis of Date allows researchers to determine if the game was a single-game or part of a 2-game road trip for that institution. The following example pattern would be self-evident in the schedule/data: Play THURSDAY at Appalachian State, Play SATURDAY at Coastal Carolina University. In total, we would see SINGLE GAME road trips and 2-GAME road trips. For comparison purposes, the results of both types of games were evaluated. However, the focus for this study is the 2-GAME road trip.

ANALYSIS OF THE DATA

The data was extracted from the website and input into EXCEL to track the won-loss records of the various teams and institutions. From this information, the researchers could identify the won-loss records of both HOME and VISITING teams for each contest. Independent of the strength of the opponents, the won-loss records (and winning percentages) for both HOME and VISITOR teams for each sport is provided in **TABLE 1** (Women's Soccer), **TABLE 2** (Women's Volleyball), **TABLE 3** (Women's Basketball) and **TABLE 4** (Men's Basketball).

**TABLE 1
WOMEN'S SOCCER**

Type of Contest	Home Team Record	Visiting Team Record
All SBC Games	29-16-9 (0.54 winning %)	16-29-9 (0.30 winning %)
SBC Single Games	6-4-2 (0.50 winning %)	4-6-2 (0.33 winning %)
SBC Game 1 of 2-Game Trip	11-7-3 (0.52 winning %)	7-11-3 (0.33 winning %)
SBC Game 2 of 2-Game Trip	12-5-4 (0.57 winning %)	5-12-4 (0.23 winning %)
Number of 2-0 Road Trips	Number of SPLIT Road Trips (1-1, 1-0-1, 0-1-1)	Number of 0-2 Road Trips
3 (14%)	11 (53%) 7 = Win/Tie First Game 4 = Win/Tie Second Game	7 (33%)

NOTE: Soccer matches can end in ties.

**TABLE 2
WOMEN'S VOLLEYBALL**

Type of Contest	Home Team Record	Visiting Team Record
All SBC Games	49-47 (0.51 winning %)	47-49 (0.49 winning %)
SBC Single Games	8-7 (0.53 winning %)	7-8 (0.47 winning %)
SBC Game 1 of 2-Game Trip	23-17 (0.58 winning %)	17-23 (0.42 winning %)
SBC Game 2 of 2-Game Trip	18-23 (0.44 winning %)	23-18 (0.56 winning %)
Number of 2-0 Road Trips	Number of 1-1 Road Trips	Number of 0-2 Road Trips
12 (30%)	15 (38%) 6 = Win First Game 9 = Win Second Game	13 (32%)

**TABLE 3
WOMEN'S BASKETBALL**

Type of Contest	Home Team Record	Visiting Team Record
All SBC Games	62-46 (0.57 winning %)	46-62 (0.43 winning %)
SBC Single Games	5-7 (0.42 winning %)	7-5 (0.58 winning %)
SBC Game 1 of 2-Game Trip	29-19 (0.60 winning %)	19-29 (0.40 winning %)
SBC Game 2 of 2-Game Trip	28-20 (0.58 winning %)	20-28 (0.42 winning %)
Number of 2-0 Road Trips	Number of 1-1 Road Trips	Number of 0-2 Road Trips
9 (19%)	21 (44%) 10 = Win First Game 11 = Win Second Game	18 (37%)

TABLE 4
MEN'S BASKETBALL

Type of Contest	Home Team Record	Visiting Team Record
All SBC Games	71-37 (0.66 winning %)	37-71 (0.34 winning %)
SBC Single Games	9-3 (0.75 winning %)	3-9 (0.25 winning %)
SBC Game 1 of 2-Game Trip	30-18 (0.63 winning %)	18-30 (0.37 winning %)
SBC Game 2 of 2-Game Trip	32-16 (0.67 winning %)	16-32 (0.33 winning %)
Number of 2-0 Road Trips	Number of 1-1 Road Trips	Number of 0-2 Road Trips
8 (17%)	18 (37%)	22 (46%)
	10 = Win First Game 8 = Win Second Game	

Summary Statements

As illustrated in **TABLES 1-4**, there was NOT a significant reduction in Road Team performance in GAME 2 of 2-game road trips. Game 2 outcomes for road teams were comparable in Women's Soccer, Women's Basketball, and Men's Basketball. And, Game 2 performance (i.e., winning percentage) was improved in Women's Volleyball. When a team split a road trip (i.e., one win / one loss), women's volleyball teams showed a marked higher likelihood to win Game 2 to complete their road trip.

DIGGING DEEPER INTO THE DATA: ANALYSIS OF OPPONENT QUALITY

Over a season of competition, a team will typically play 3 types of contents: (1) games between comparable teams – no favorite to win; (2) games where one team is slightly favored to win; and (3) games where one team is heavily favored to win. As the old saying goes, “that’s why we play the games” ... these mathematical likelihoods do not always occur. Teams have unexpected wins and unexpected losses. Arguably, all teams have the potential to experience each outcome over the life of a season.

Final Standings at Season's End

One measure of competitive parity for use is the FINAL STANDINGS IN CONFERENCE PLAY. This after-the-fact analysis provides a ranking of the team's body of work over the season. From this measure, overall stronger teams can be identified and the actual outcomes of the games identified and evaluated. For a 12-team league, there tends to be 3 clusters of teams: (1) Upper (2) Middle, and (3) Lower. This division of teams allows for a breakdown of games into 3 clusters:

1. **No Clear Favorite:** 2 comparable teams compete. Win, Lose, or Tie ... you played a comparable opponent.
2. **One Slightly Favored Team:** teams are 1 cluster apart (such as an UPPER playing a MIDDLE or a MIDDLE playing a LOWER).
3. **One Heavily Favored Team:** teams are 2 clusters apart (such as an UPPER playing a LOWER).

By season's end, the clustering of Sun Belt Conference Schools is presented in **TABLE 5** by Sport.

TABLE 5
CLUSTERING OF TEAMS – SEASON SENDING STANDINGS

Women's Soccer	Women's Volleyball	Women's Basketball	Men's Basketball
South Alabama (1) (7-3) Coastal Carolina (2) (6-2-2) Little Rock (3) (6-3-1)	Coast. Carolina (T1) (15-1) ARK State (T1) (15-1) Texas State (3) (13-3)	Little Rock (1) (17-1) UT Arlington (2) (14-4) Troy (3) (12-6)	UT Arlington (1) (14-4) GA State (2) (12-6) Arkansas State (T3) (11-7) GA Southern (T3) (11-7) TX State (T3) (11-7)
App. State (T4) (4-4-2) Louisiana (T4) (4-4-2) UL Monroe (T4) (4-4-2) Arkansas State (7) (4-5-1)	UT Arlington (4) (10-6) Little Rock (5) (8-8) So. Alabama (T6) (7-9) GA Southern (T6) (7-9) GA State (T8) (6-10) Louisiana (T8) (6-10)	Louisiana (T4) (11-7) TX State (T4) (11-7) GA Southern (6) (9-9) GA State (T7) (8-10) Coastal Carolina (T7) (8-10)	Louisiana (T6) (10-8) Troy (T6) (10-8) Coastal Carolina (T6) (10-8)
Troy (T8) (3-5-2) Texas State (T8) (3-5-2) GA State (10) (2-4-4) GA Southern (11) (3-7)	Troy (10) (4-12) UL Monroe (11) (3-13) App. State (12) (2-14)	App. State (9) (6-12) Arkansas State (10) (5-13) South Alabama (11) (4-14) UL Monroe (12) (3-15)	South Alabama (9) (7-11) Little Rock (10) (6-12) App. State (11) (4-14) UL Monroe (12) (2-16)

Source: [6].

The focus of this study is ROAD GAMES and, specifically, 2-GAME road trips. Using these 3 clusters for each sport, the researchers can determine the following outcomes for both GAME 1 and GAME 2 for each sport?

1. How often did the VISITING TEAM win or lose to a comparable opponent?
2. How often did the VISITING TEAM win or lose versus a slightly favored opponent (one cluster apart)?
3. How often did the VISITING TEAM win or lose versus a heavily favored opponent (two clusters apart)?

To provide a baseline for comparison, this information is presented for each sport in **TABLE 6** (Women's Soccer), **TABLE 7** (Women's Volleyball), **TABLE 8** (Women's Basketball) and **TABLE 9** (Men's Basketball).

TABLE 6
WOMEN'S SOCCER (BY FINAL STANDINGS)

Type of Contest	Game 1		Game 2	
	Home Record	Visiting Record	Home Record	Visiting Record
From TABLE 1 : All Opponents, regardless of strength		7-11-3 (0.33 winning %)		5-12-4 (0.23 winning %)
2 Comparable Teams (Same Cluster)	2-1-1 (0.50 winning %)	1-2-1 (0.25 winning %)	5-2-1 (0.63 winning %)	2-5-1 (0.25 winning %)
1 Slightly Favored Team (1 Cluster Separation)	6-3-2 (0.55 winning %)	3-6-2 (0.27 winning %)	5-2-3 (0.50 winning %)	2-5-3 (0.22 winning %)
1 Heavily Favored Team (2 Cluster Separation)	3-3-0 (0.50 winning %)	3-3-0 (0.50 winning %)	2-1-0 (0.67 winning %)	1-2-0 (0.33 winning %)
Records of Heavily-Favored Teams On the Road		3-0		1-0

NOTE: Visiting team performance tended to be better in GAME 1 than GAME 2.

TABLE 7
WOMEN'S VOLLEYBALL (BY FINAL STANDINGS)

Type of Contest	Game 1		Game 2	
	Home Record	Visiting Record	Home Record	Visiting Record
From TABLE 2 : All Opponents, regardless of strength		17-23 (0.42 winning %)		23-18 (0.56 winning %)
2 Comparable Teams (Same Cluster)	7-6 (0.54 winning %)	6-7 (0.46 winning %)	4-9 (0.31 winning %)	9-4 (0.69 winning %)
1 Slightly Favored Team (1 Cluster Separation)	14-8 (0.64 winning %)	8-14 (0.36 winning %)	10-12 (0.45 winning %)	12-10 (0.55 winning %)
1 Heavily Favored Team (2 Cluster Separation)	2-3 (0.40 winning %)	3-2 (0.60 winning %)	4-2 (0.67 winning %)	2-4 (0.33 winning %)
Records of Heavily-Favored Teams On the Road		3-0		2-0

NOTE: Visiting team performance tended to improve in GAME 2 over GAME 1 for comparable and slightly favored teams. Further, heavily favored road teams were expected winners in Games 1 and 2.

TABLE 8
WOMEN'S BASKETBALL (BY FINAL STANDINGS)

Type of Contest	Game 1		Game 2	
	Home Record	Visiting Record	Home Record	Visiting Record
From TABLE 3 : All Opponents, regardless of strength		19-29 (0.40 winning %)		20-28 (0.42 winning %)
2 Comparable Teams (Same Cluster)	10-3 (0.77 winning %)	3-10 (0.23 winning %)	10-6 (0.63 winning %)	6-10 (0.37 winning %)
1 Slightly Favored Team (1 Cluster Separation)	15-11 (0.58 winning %)	11-15 (0.42 winning %)	13-11 (0.54 winning %)	11-13 (0.46 winning %)
1 Heavily Favored Team (2 Cluster Separation)	4-5 (0.44 winning %)	5-4 (0.56 winning %)	5-3 (0.63 winning %)	3-5 (0.37 winning %)
Records of Heavily-Favored Teams On the Road		5-0		3-0

NOTE: Visiting team performance was better in GAME 2 when comparable teams played.

TABLE 9
MEN'S BASKETBALL (BY FINAL STANDINGS)

Type of Contest	Game 1		Game 2	
	Home Record	Visiting Record	Home Record	Visiting Record
From Table 4 : All Opponents, regardless of strength		18-30 (0.37 winning %)		16-32 (0.33 winning %)
2 Comparable Teams (Same Cluster)	6-8 (0.43 winning %)	8-6 (0.57 winning %)	5-1 (0.83 winning %)	1-5 (0.17 winning %)
1 Slightly Favored Team (1 Cluster Separation)	13-5 (0.72 winning %)	5-13 (0.28 winning %)	14-10 (0.58 winning %)	10-14 (0.42 winning %)
1 Heavily Favored Team (2 Cluster Separation)	11-5 (0.69 winning %)	5-11 (0.31 winning %)	13-5 (0.72 winning %)	5-13 (0.28 winning %)
Records of Heavily-Favored Teams On the Road		5-3		5-4

NOTE: Visiting team performance tended to be better in GAME 1 than GAME 2 when comparable teams played. This influence did not carry over to games where one opponent was a light or heavy favorite. In fact, home teams beat heavily-favored teams 4 times (APP State had 2 of these wins). APP State had 4 wins in conference all season. Three (3) of these wins were 'upset wins' on their home court.

Summary Statements

As illustrated in **TABLES 6-9**, there was NOT a significant reduction in Road Team performance in GAME 2 of 2-game road trips when the quality of the opponent was introduced into the analysis in Women's Soccer, Women's Volleyball and Women's Basketball. However, Men's Basketball teams tended to win more often during GAME 1 than GAME 2 when looking playing comparable teams. When two evenly-matched teams played GAME 2, the home team won 83% of the time. And, heavily-favored road teams were upset in 37% of the time (3 of 8 games) in GAME 1 and 44% of the time in GAME 2 (4 of 9 games). Interestingly, Sun Belt Conference Men's Basketball teams scored 3.25 fewer points (on average) in GAME 2 than GAME 1. This is consistent with Winston's [10] finding that NBA teams scored 4 fewer points in back-to-back games. However, only 1 of the 6 games of comparable teams was a 4-point differential in this study. So, scoring 4 more points would have only changed the outcome of one game.

IMPLICATIONS FOR ATHLETIC ADMINISTRATORS AND COACHES

Athletic administrators scheduling multi-game road trips for their teams may wonder if the format affects team performance. In this one-season analysis (2016-2017) of one conference (Sun Belt Conference), any influence of the 2-game road trip format tends to be sport specific and not broad-based. As such, athletic administrators do not face a trade-off: save time and money but be lesser-competitive in the back-end of a road trip. The only exception for this analysis is Men's Basketball. When comparable teams played, there was more of a home-court advantage for GAME 2 than other sports evaluated.

Coaches may pay particular attention to the intensity of team practices, player nutrition, and player rest during road trips to guard against tired athletes in GAME 2. A coach may attempt to 'keep them off of their feet' or try to rest players and conserve energy. Side travel that introduces extended periods of walking may also be minimized to conserve player energy.

CLOSING REMARKS

It is recognized here that this research examined a single conference for a single season across four sports. At a minimum, this study can serve as a baseline for further analysis. Power 5 conferences (ACC, BIG 10, BIG 12, PAC 12, and SEC) may be less inclined to use the 2-game road trip format as their geographic footprints tend to be greater and they tend to have larger team travel budgets. However, GROUP OF 5 and other mid-major conferences and their members face greater pressure for cost control.

The use of 2-game road trips is a cost-effective solution while concurrently reducing student-athlete time away from the institution. For this analysis, the 2-game road trip does not appear to introduce a systemic and significant home field advantage, particularly for GAME 2. Influences tend to be sport-specific. The feared cost/benefit trade-off of 'saving money' versus 'being competitive on the road' is not prevalent in this analysis. Conference personnel and university athletic administrators may take comfort in their drive to control costs that they are not affecting the competitiveness of their teams.

REFERENCES

1. Jamieson, Jeremy (2010), The Home Field Advantage in Athletics: A Meta-Analysis. *Journal of Applied Social Psychology*, 40, 7, 1819-1848.
2. Knight Commission on Intercollegiate Athletics (2014). College sports 101. Retrieved electronically in Spring 2017: <http://www.knightcommission.org/collegesports101/table-of-contents>
3. Moskowitz, Tobias and L. Jon Wertheim (2011), *Scorecasting: The Hidden Influences Behind How Sports are Played and Games are Won*. New York: Three Rivers Press.
4. National Collegiate Athletics Association (2009). 2004-06 NCAA revenues and expenses of division I intercollegiate athletics programs report. Retrieved electronically in Spring 2017: <http://www.ncaapublications.com/productdownloads/RE2008.pdf>
5. Shelburne, Ramona (2017), "Adam Silver: Resting Star Players 'a Significant Issue for the League.'" ESPN online. Retrieved electronically in Spring 2017: http://www.espn.com/nba/story/_/id/18962901/resting-star-players-significant-issue-league
6. Sun Belt Conference Website (2017). www.sunbeltsports.org
7. Sun Belt Conference (2016a), Coastal Carolina Officially Joins the Sun Belt. Retrieved electronically in Spring 2017. http://sunbeltsports.org/news/2016/6/30/BB_0630163323.aspx?path=general
8. Sun Belt Conference (2016b), Sun Belt Conference Announces 2016-17 Men's and Women's Basketball Conference Schedules. Retrieved electronically in Spring 2017. <http://www.goccusports.com/sports/m-baskbl/spec-rel/042816aac.html>
9. The Ohio State University Athletics Website (2017), <http://www.ohiostatebuckeyes.com/>.
10. Winston, Wayne (2009), *Mathletics: How Gamblers, Managers, and Sports Enthusiasts use Mathematics in Baseball, Football, and Basketball*. Princeton and Oxford: Princeton University Press.

Introduction to Privacy Engineering for Business and Management

Harry Katzan, Jr.
Webster University

Abstract

This paper gives an introduction to the fundamental concepts of privacy and its risk management counterpart. Basic research into the subjects of cybersecurity, cloud computing, intrusion detection, and application containers has generated a discipline that safeguards the availability, accuracy, authenticity, confidentiality, and integrity of information stored and processed by modern computer systems. The concepts apply to government, business, education, and private individuals. But, what about the privacy of individuals addressed by information systems? The protection of personally identifiable information (PII) is covered somewhat by information security principles, but the critical aspects of personal privacy are far less developed. A trustworthy system meets the critical requirements of its stated purpose. A system with trustworthy privacy attributes meets specific needs of information systems concerning the creation, collection, use, processing, retention, dissemination, and disclosure of PII. The methods of identifying privacy problems are covered, and techniques for designing trustworthy systems are supplied. Three objectives are described: predictability, manageability, and disassociability. Finally, vocabulary and examples are included.

Predicting First Year Student Attrition in Higher Education: A Design Theoretic Approach

(Research-in-Progress)

Caleb Bradberry, Radford University; Andrew Ray, Radford University; Jeff Pittges, Radford University

Abstract

It is known that retaining customers is more cost effective than attracting new customers. Retaining students in higher education mirrors this business scenario. Multiple academic journals have examined student attrition and retention through various lenses ranging from demographic and academic factors to qualitative studies presenting grounded theory of understanding student retention. There remains an unexplored area in student retention: designing and modeling student retention through advanced analytics to predict student attrition a priori. The fields of machine learning and computational statistics provide the ability to sort and classify huge amounts of data in real time; enabling predictive reporting to key stakeholders of students that are at risk of dropping out. Predictive reporting allows education and advising specialists provide interventions for students are at risk. This paper proposes a design theoretic process for predicting student retention in real time and examines post facto a dataset with this process.

Introduction

Student attrition in higher education is a perennial challenge (Tinto 2007). This challenge has led to various approaches by which researchers have examined the factors that contribute to student retention. Common approaches are academic measures, financial measures, and social measures (Pritchard and Wilson 2003; Yu et al. 2010). Researchers have employed various methods to examine the problem of student attrition ranging from qualitative methods to machine learning (Arnold et al. 2012; Siekpe and Barksdale 2013). However, it is commonly concluded that student retention and attrition is a problem that must be custom tailored for each instance of a university. To compound the problem, very few solutions are able to *a priori* predict an at risk student (Greller et al. 2014; Moore and Byers 2014).

To create a model that is generalizable, this research presents a design theoretic view of modeling student retention. Design theory enables researchers to deconstruct a problem domain and solution domain into their attributes and methods at an instance level, test the solution as an instance, validate the solution, and then theorize and generalize based on the results of the design (March and Smith 1995; Walls et al. 1992). Design theory has been further expanded in the field of information systems to examine a problem in terms of a *process* and a *product* (Hevner et al. 2004).

The current state of research in retention analytics uses post facto models that explain student retention. For these models to be actionable, key stakeholders need to apply interventions to students before they leave the university. This research combines modeling student retention using machine learning with design theory to provide a unique process and a product that provides actionable insight for the key stakeholders in preventing student attrition.

The foundation of the process is a simple question: *how can student retention be modeled in a way that allows for interventions?* To answer this question, this research first examines the current state of knowledge in the problem domain of retention analytics. Next, this research puts forward a brief overview of the solution domain of design theory and advanced analytics. With the attributes identified in both the

problem and solution domain, the resulting research is a process allowing for a one week rolling report of ‘academically at-risk’ students.

This research contributes in three ways. First, a review of predicting student retention in terms of the factors that are assigned in the predictive model is put forward. While other literature reviews look at the entire domain of student retention through multiple lenses, this research’s literature review frames the factors in terms of what has been shown to be statistically important. Next, this research frames the problem of student attrition in such a way that it can be addressed *a priori* to provide interventions to at risk students. Lastly, this research contributes by putting forward a design theoretic framework that addresses this problem as a process and a product.

Review of the Literature

This review of literature examines the academic, financial, and social factors that have been explored to contribute to student attrition. Additionally, this review presents a design theoretic framework. Lastly, student retention is integrated into the design framework in order to build a process for prediction.

Student Retention

Predicting student retention is typically broken into three separate conceptual areas: academic factors such as GPA, financial factors such as student loan percentage, and social factors such as engagement on campus (Siekpe and Barksdale 2013; Tinto 2007). Additionally, factors that comprise these conceptual areas are identified.

Academic factors

For student retention, academic factors have been proven to have the most statistically significant predictive power (Nakhkob and Khademi 2016; Scott et al. 2004). An academic factor is typically defined as a quantifiable measurement of the student’s academic performance in the classroom. Table 1 presents an overview of the factors identified in research and their related sources, as well as if the factor was shown to have predictive power. The most commonly identified predictor of student retention is that of high-school grade point average for incoming freshmen, and then the student’s grade point average throughout their time in higher education.

Factor Name	Evidence of Predictive Power	Reference
Degree	Partial support.	(Delen 2010; Nakhkob and Khademi 2016; Thammasiri et al. 2014)
Major	Partial support.	(Delen 2010; Murtaugh et al. 1999; Nakhkob and Khademi 2016; Thammasiri et al. 2014)
Concentration	Partial support.	(Delen 2010; Nakhkob and Khademi 2016; Thammasiri et al. 2014)
Hours Registered	Supported.	(Delen 2010; Nakhkob and Khademi 2016; Thammasiri et al. 2014)
Hours Earned	Supported.	(Delen 2010; Nakhkob and Khademi 2016; Thammasiri et al. 2014)
Semester GPA	Supported.	(Bogard et al. 2011; Bukralia et al. 2012; Delen 2010; Nakhkob and Khademi 2016; Thammasiri et al. 2014)

Cumulative GPA	Supported.	(Delen 2010; Nakhkob and Khademi 2016; Thammasiri et al. 2014)
High School GPA	Supported.	((Bogard et al. 2011; Bukralia et al. 2012; Delen 2010; Nakhkob and Khademi 2016; Thammasiri et al. 2014)
SAT/ACT Score	Supported.	(Aguiar et al. 2014; Delen 2010; Murtaugh et al. 1999; Nakhkob and Khademi 2016; Thammasiri et al. 2014)
High school graduation year	No support.	(Delen 2010; Nakhkob and Khademi 2016; Thammasiri et al. 2014)
Starting term/year	Partial support.	(Delen 2010; Nakhkob and Khademi 2016; Thammasiri et al. 2014)
Transfer Hours	Partial support.	(Delen 2010; Nakhkob and Khademi 2016; Thammasiri et al. 2014)
Admission Type	Supported.	(Delen 2010; Nakhkob and Khademi 2016; Thammasiri et al. 2014)
Mode of Enrollment (on/off Campus)	Supported.	(Palmer 2013)
Freshman Orientation	Supported.	(Bogard et al. 2011; Delen 2010)

Table 1. Academic Factors of Predicting Student Attrition.

Financial factors

Financial factors are any factor that influences the student's financial obligations while enrolled in higher education. Of these factors, the most predictive of student attrition is federal work study. The full set of factors include fall financial aid amount, spring financial aid amount, fall loan amount, spring loan amount, and federal work study (Delen 2010; Nakhkob and Khademi 2016; Thammasiri et al. 2014).

Factor Name	Evidence of Predictive Power
Fall Financial Aid Amount	Partial Support.
Spring Financial Aid Amount	Partial Support.
Fall Loan Amount	Partial Support.
Spring Loan Amount	Partial Support.
Federal Work Study	Supported.

Table 2. Financial Factors of Predicting Student Attrition.

Social and demographic factors

The last set of factors researched are a student's social interactions and social background. The most predictive of these factors found in the literature is a student's age. Freshmen students are younger and have a higher attrition rate, while older and returning students are enrolled to either gain a new set of skills or advance their career in some manner. These factors include ethnicity, race, sex, age, and zip code (Delen 2010; Nakhkob and Khademi 2016; Thammasiri et al. 2014)

Factor Name	Evidence of Predictive Power
Ethnicity	No support.
Race	No support.
Sex	Partial support.
Age	Supported.
Zip Code	Partial Support.

Table 3. Demographic Factors of Predicting Student Attrition.

This research extends pre-existing research in social and demographic factors by examining fields and datasets available that could be predictors of student attrition and retention. These factors are found in Table 4.

The most intuitive factors to be tested are: campus residency, first generation student, commuter, and international student. These factors can potentially lend evidence towards a student's expectations and social interactions within a higher education community. However, four little researched factors are being proposed to be examined as well: campus identification card swipes, email utilization, LMS utilization, and WiFi usage.

For card swipes, it has been shown that a simple count of the number of times a student uses their ID card on campus is a strong indicator of student retention (Bradberry et al., 2017); this utilization includes dorm usage, lab usage on campus, and accessing recreational buildings. The underlying motivation of card swipe data is providing an explanatory view of how students socially interact with their higher education environment. For example, if a student is swiping their card only at 4am every night, they are most likely engaging in non-academic activities which could negatively impact their academic activities.

Similarly, a student's WiFi usage could potentially provide similar insight. By capturing the amount of data usage that a student has on campus, as well as the time of that usage, a prediction could be made on the success of the student. The utility of this data comes from the ability to determine the router or access point the student that the student was using. This provides a stronger picture of where the students are spending their time on campus.

Lastly, email utilization and learning management system (LMS) utilization can provide insight into student communication with their professors and academic advisors, as well as providing baseline web analytics on LMS usage. These analytics include the amount of time a student spent on any one course in

the LMS, as well as their click through and bounce rate. Additionally, if a student is communicating through either email or the LMS, then that can provide both quantifiable information as well as unstructured information as to signaling a student that is potentially at risk academically. The added benefit of examining email utilization is that it can provide a categorical view of how the student communicates in their higher education environment: are the students talking to each other about quiz answers or are they email professors questions.

Factor	Evidence of Predicted Power
On Campus Resident	To be tested.
First generation Student	To be tested.
Commuter	To be tested.
International Student	To be tested.
Card Swipes of ID Card	To be tested.
Email Utilization Time	To be tested.
Learning Management System Utilization	To be tested.
WiFi Usage	To be tested.

Table 4. Additional Social Factors to be Tested.

Design Theory – Designing an Actionable Prediction System for Student Retention

Design theory provides a theoretical view of creating new knowledge through the creation of a new process and product (Markus et al. 2002; Walls et al. 1992). Design theory has been used in information systems research before, and there is currently a call for more scholars to engage in more design theoretic research (Gregor and Hevner 2013).

Design as a Process

Design as a process includes the design method, and kernel theories. The design method prescribes the procedures for creating an artifact, and maps the required characteristics for an artifact. These procedures are guided by theories embedded in both process and product (kernel theory). Kernel theories provide the bridge between process and product. For the purposes of this research, the kernel theory is that student attrition can be predicted before it happens, and the product is interventions that will have a positive impact on student retention.

Figure 1 outlines the process that will be examined. The process begins with the identification of the factors, as presented in the review of literature. The embedded kernel theory in this process is that of predictive factors outlined in the prior section. Based on the most statistically significant factors, reports will be generated to academic stakeholders, such as the student's advisor or the department chair.

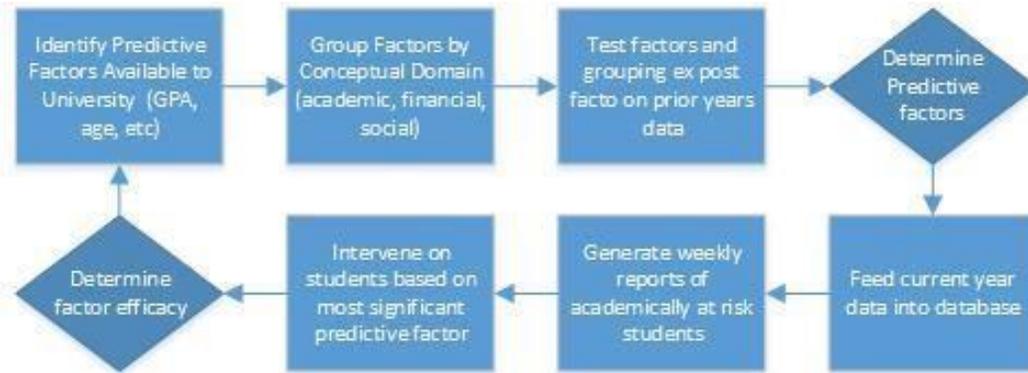


Figure 1. Design Process for Predicting and Intervening in Student Attrition.

Design theory enables the refinement of the artifact through the kernel theory as well. This becomes useful as factors are assessed as predictive and enables the tuning of the artifact through multiple iterations, as design theory prescribes (Walls et al., 1992; Gregor and Hevner 2013). Effectively, the guiding process from figure 1 allows this research to progress as data is being collected.

Design as a Product – Retention Prediction Reporting

Design as a product has been identified to contain four components: meta-requirements, meta-design, kernel theories, and testable design product hypotheses (Hevner et al. 2004). Meta-requirements are the classes of the goals that the product must achieve, such as predicting student attrition for incoming freshman. Meta-design describes the class of artifacts to be created, such as two new data models for predicting both student attrition and retention. Kernel theories are the theories embedded in the design and specify the design requirements, i.e.: the model must be predictive, so what constitutes prediction in retention literature. Lastly, a design theoretic approach must have a testable design product hypotheses, which tests if the requirements were met: were the factors identified to be predictive in the case of the tested data? The resulting product of this work will be a database, stored procedure, and reporting mechanism that will generate a weekly report.

Next Steps

This work is currently on-going. The researchers are working to collect data from the various identified sources in order to further develop a prototype reporting product. Once the data sources have been identified, the process will be implemented at an enterprise scale. The efficacy of this work will be evaluated at the end of the academic calendar year to measure the accuracy of prediction, as well as gather qualitative evidence as to the efficacy of the interventions.

References

- Aguiar, E., Ambrose, G. A. A., Chawla, N. V., Goodrich, V., and Brockman, J. 2014. "Engagement vs Performance: Using Electronic Portfolios to Predict First Semester Engineering Student Persistence," *Journal of Learning Analytics* (1:3), pp. 7–33 (doi: 10.1145/2567574.2567589).
- Arnold, K. E., Pistilli, M. D., and Arnold, K. E. 2012. "Course Signals at Purdue: Using Learning Analytics to Increase Student Success," *2nd International Conference on Learning Analytics and Knowledge* (May), pp. 2–5 (doi: 10.1145/2330601.2330666).

- Bogard, M., Helbig, T., Huff, G., and James, C. 2011. "A comparison of empirical models for predicting student retention," *White paper. Office of Institutional Research, Western Kentucky University*.
- Bradberry, C., Ray, A., Pittges, J., Dhamri, J., Charnock, J., and Wayman, M. 2017. "Explaining and Predicting First Year Student Retention via Card Swipe Systems," 2017 Americas Conference of Information Systems. Forthcoming.
- Bukralia, R., Deokar, A. V., Sarnikar, S., and Hawkes, M. 2012. "Using Machine Learning Techniques in Student Dropout Prediction," *Cases on Institutional Research Systems*, pp. 117–131 (doi: 10.4018/978-1-60960-857-6.ch007).
- Delen, D. 2010. "A comparative analysis of machine learning techniques for student retention management," *Decision Support Systems* (49:4), Elsevier B.V., pp. 498–506 (doi: 10.1016/j.dss.2010.06.003).
- Gregor, S., and Hevner, A. R. 2013. "Positioning and Presenting Design Science Research for Maximum Impact," *MIS Quarterly* (37:2), pp. 337–355 (doi: 10.2753/MIS0742-122240302).
- Greller, W., Ebner, M., and Schön, M. 2014. "Learning Analytics: From Theory to Practice – Data Support for Learning and Teaching," *Research into E-Assessment* (JUNE 2014), pp. 79–87 (doi: 10.1680/udap.2010.163).
- Hevner, A. R., March, S. T., Park, J., and Ram, S. 2004. "Design Science in Information Systems Research," *MIS Quarterly* (28:1), pp. 75–105 (doi: 10.2307/25148625).
- March, S., and Smith, G. 1995. "Design and Natural Science Research on Information Technology," *Decision support systems* (15), pp. 251–266 (doi: 10.1016/0167-9236(94)00041-2).
- Markus, L. M., Majchrzak, A., and Gasser, L. 2002. "A Design Theory for Systems That Support Emergent Knowledge Processes," *MIS Quarterly* (26:3), p. 179- 212 (doi: 10.2307/4132330).
- Moore, J. S., and Byers, S. E. 2014. "Using Pattern Recognition to Identify Academically 'At-Risk' Undergraduate Business Students," (available at [http://rwahlers.iweb.bsu.edu/abd2011/submissions%5Cn%5CnPDF/p11_moore_byers.pdf%5Cnhttp://rwahlers.iweb.bsu.edu/abd2011/submissions in PDF/p11_moore_byers.pdf](http://rwahlers.iweb.bsu.edu/abd2011/submissions%5Cn%5CnPDF/p11_moore_byers.pdf%5Cnhttp://rwahlers.iweb.bsu.edu/abd2011/submissions%5CnPDF/p11_moore_byers.pdf)).
- Murtaugh, P. A., Burns, L. D., and Schuster, J. 1999. "Predicting the Retention of University Students," *Research in Higher Education Research in Higher Education* (40:3), pp. 355–371 (doi: 10.1023/A:1018755201899).
- Nakhkob, B., and Khademi, M. 2016. "Predicted Increase Enrollment in Higher Education Using Neural Networks and Data Mining Techniques," *Journal of Advances in Computer Research Quarterly* (7:4), pp. 2345–606 (available at www.jacr.iausari.ac.ir).
- Palmer, S. 2013. "Modelling engineering student academic performance using academic analytics," *International Journal of Engineering Education* (29:1), pp. 132–138.
- Pritchard, M. E., and Wilson, G. S. 2003. "Using Emotional and Social Factors to Predict Student Success," *Journal of College Student Development* (44:1), pp. 18–26 (doi: 10.1353/csd.2003.0008).
- Scott, D., Spielmans, G. G., Julka, D., DeBerard, M. S., Spielmans, G. G., and Julka, D. 2004. "Predictors of Academic Achievement and Retention Among College Freshmen: a Longitudinal Study," *College Student Journal* (38:1), pp. 66–80 (available at <http://search.proquest.com/openview/1511ceaa3cb57eb44fb25d91176ed704/1?pqorigsite=gscholar>).
-

- Siekpe, J., and Barksdale, T. 2013. "Assessing student retention: toward a parsimonious model.," *Review of Higher Education and Self-Learning* (6:22), pp. 44–52.
- Thammasiri, D., Delen, D., Meesad, P., and Kasap, N. 2014. "A critical assessment of imbalanced class distribution problem: The case of predicting freshmen student attrition," *Expert Systems with Applications* (41:2), Elsevier Ltd, pp. 321–330 (doi: 10.1016/j.eswa.2013.07.046).
- Tinto, V. 2007. "Research and Practice of Student Retention: What Next?," *Journal of College Student Retention* (8:1), pp. 1–19 (doi: 10.2190/C0C4-EFT9-EG7W-PWP4).
- Walls, J. G., Widmeyer, G., and Sawy, O. a E. 1992. "Building an Information System Design Theory for Vigilant EIS," *Information Systems Research* (3:1), pp. 36–60.
- Yu, C. H., Digangi, S., Jannasch-pennell, A., and Kaprolet, C. 2010. "A Data Mining Approach for Identifying Predictors of Student Retention from Sophomore to Junior Year," *Journal of Data Science* (8), pp. 307–325 (available at <http://ww.w.creative-wisdom.com/pub/mirror/JDS-574.pdf>).

INVESTIGATING THE IMPACT OF AGILE DEVELOPMENT METHODOLOGY ON INFORMATION TECHNOLOGY PROFESSIONALS

Paige S. Rutner
Texas Tech University
paige.rutner@ttu.edu

Feruzan Irani Williams
Texas Tech University
feruzan.i.williams@ttu.edu

Abstract: Software development is a critical process for organizations who wish to compete in a market that is increasingly dependent on information technology. Yet, despite the extensive investments in technology, software development projects are prone to cost overruns, missed deadlines, and lack of full functionality in the end-product. Organizations have moved to adopt agile software development methodologies in order to alleviate these problems. However, the intensive user-developer interaction required by such methodologies may represent a potential source of strain for information technology and information systems professionals. This study proposes to examine this potential strain from the perspective of person-environment fit.

Keywords: IT workforce, agile development, person-environment fit, strain

Introduction

Software development is an important activity for businesses who wish to gain competitive advantage in the marketplace through effective use of technology. However, the software development process is difficult and historically prone to failure [16]. Nevertheless, organizations continue to invest time, money and effort in IT initiatives and systems. According to the Gartner research firm, worldwide spending on IT is projected to be \$3.76 trillion in 2013, up 4.1% from 2012 [10]. Given the importance of these investments, many organizations have sought to improve the software development process by focusing on the methodologies used.

The software development process within an organization is by its nature complex and interconnected. Traditional structured analysis and design methodologies, including planned methods such as waterfall, follow prescribed guidelines for the steps, documentation, and activities to be performed. These methods recommend that a design and development team complete all of the requirements determination and planning for a project before moving on to design and development activities. However, the rigid nature of such methodologies makes it difficult to adapt to the changing requirements that are inherent to a rapidly changing business environment. Critics of these traditional methods cite their inflexibility as a key contributor to cost overruns and difficulties meeting deadlines for delivering fully functional systems [15]. As one researcher points out, “One aspect of the challenge is simply that software development is

inherently a complex activity that is embedded with interdependencies, requires the collective input of multiple individuals with often nonoverlapping knowledge sets, and entails significant coordination and project management” [20, p. 377]. In order to respond to this challenge, a number of more flexible methodologies, termed agile processes (including Scrum and Extreme Programming) have been developed. These techniques emphasize short cycle times focused on incremental delivery of small, well-defined components. They also demand intensive interaction between IT personnel and technology users [20].

The trend towards adoption of agile software development practices may also have implications for the interaction skills required of IT professionals. While substantive user involvement has long been cited as a key component of successful systems development projects, there is evidence that traditional software development methodologies emphasize distinctions between users and developers by placing users in a subordinate role [2] [11]. Communication with users is a component of traditional methodologies but they may not be seen as equal partners in the development process. Implementation of agile practices such as Extreme Programming and Scrum place greater emphasis on effective communication and collaboration; such collaboration must occur not only among developers but also between developers and users [3]. With their emphasis on rapid cycle times, quick response to changing requirements, and intensive tacit communications, agile methodologies depend on trust and shared knowledge between team members. IT employees who are unaccustomed to such intensive interactions may be at a disadvantage in such environments and may jeopardize the projects’ success. As one researcher points out, “problems with projects can invariably be traced back to somebody not talking to somebody else about something important” [23, p. 440].

Therefore, IT professionals must not only have technical expertise, but must also be adept at developing and maintaining good working relationships and effective communications with the business colleagues and technology users in their organizations [25] [26]. IT professionals are an especially interesting group in which to examine workplace social interactions because, while the profession requires that its members interact effectively with business customers and colleagues [1] [26], many individuals who are drawn to working with technology often tend to be unprepared for these interpersonal demands. As a group, members of the profession tend to be introverted [4] [19], as are students intending to enter the profession [7]. Recruiters seeking to fill IT jobs place less emphasis on interpersonal skills than they do on technical skills of applicants [17] [29]. It is not surprising that social interaction with technology users represents a source of stress for IT professionals [12] [13]. Thus, the move toward software development methodologies, with their emphasis on intensive user interaction, represents a potential source of strain for IT professionals [24]. The research question to be investigated in the proposed project is “How does the adoption of agile software development methodologies affect information technology professionals?” We propose to examine this issue from the perspective of person-environment fit.

Person-Environment Fit

Person-environment fit theory argues that the better the match between the individual and his/her work environment, the better the outcomes as measured by such factors as job satisfaction, motivation, performance, and turnover [9] [18]. P-E fit is an intuitively appealing theory suggesting that if there is compatibility between the person and the environment, then the outcomes of work will be improved for both individuals and organizations. Misfit and strain

may reduce desirable outcomes such as job satisfaction and organizational commitment and increase undesirable outcomes such as intention to leave the organization.

Fit can be conceptualized in a variety of ways. The needs-supplies perspective evaluates fit as the extent to which an environment provides characteristics, resources, and rewards meeting individual expectations [18]. The demands-abilities perspective on fit examines the extent to which an employee's capabilities meet expectations of the job or organization [18]. Moving from a traditional waterfall methodology to an agile approach represents a change in how employees must approach job responsibilities. Thus, the demands placed on IT professionals by agile methodologies may be less compatible with employee capabilities. Therefore, for this study, the demands-abilities fit perspective is most appropriate.

Given the broad applicability of P-E fit theory, it is somewhat surprising that it has not received more extensive attention in the IT workforce literature. McLean and colleagues [21] [22] [28] conducted a series of studies in which they examined job perceptions and preferences of entry-level and early-career IT professionals. Taking a needs-supplies perspective, these studies identified desirable job characteristics including extrinsic rewards, fairness in evaluation, and challenging work. Respondents who reported a job environment meeting those needs also reported greater overall job satisfaction. Jiang and Klein [14], also taking a needs-supplies perspective, examined the extent to which IT professionals' environments were compatible with respondents preferred career anchors. Originally developed by Schein, a career anchor represents an individual's self-perceptions of his or her talents, values and motives, and serves as a guide for making career decisions [27]. In examining fit between IT professional career anchors and their jobs, Jiang and Klein found that better fit was related to career satisfaction and turnover intention for individuals holding the creativity/entrepreneurship anchor [14]. Chilton, Hardgrave, and Armstrong [5] used a demands-abilities perspective to examine fit between software developers' cognitive style and the expectations of the workplace finding that higher fit was associated with lower levels of strain and increased performance. In a later study, Chilton, Hardgrave, and Armstrong [6] found similar results when examining the fit between software developer's needs for supervisory support and job ambiguity with the resources provided by their environment. Most recently, Wingreen, LeRouge, and Nelson [30] used a needs-supplies perspective to examine the effect of IT professionals' need for social support, job challenge, and role stress on job satisfaction, alienation, burnout, and self-esteem. Taken as a whole, the work examining P-E fit in the IT workforce offers some insight into IT professionals' work lives, but clearly more work remains to be done.

Proposed Study

In order to gain additional insight into IT professionals' experience working in an agile environment, we plan to build on the literature cited here. The research model will compare fit between the demands of the agile environment with IT professionals' abilities to meet those demands. As of the writing of this proposal, we are in the process of extending our review of the agile development literature in order to identify a parsimonious set of demands for study. Based on this review, we intend to develop a survey to be administered to IT professionals in different development environments. The survey will be constructed using commensurate measures for the demands and abilities components of P-E fit as recommended by Kristof [18] and Edwards [8]. Possible outcome variables include job strain as well as others such as job satisfaction and turnover intentions. We anticipate having a draft of that survey available at the conference and look forward to the opportunity for feedback to help improve the instrument.

References

- [1] Bassellier, G. and Benbasat, I., "Business competence of information technology professionals: Conceptual development and influence on IT-business partnerships," *MIS Quarterly*, (28:4), 2004, pp. 673-694.
- [2] Beath, C. M. and Orlikowski, W. J., "The Contradictory Structure of Systems Development Methodologies: Deconstructing the IS-User Relationship in Information Engineering," *Information Systems Research*, (5:4), 1994, pp. 350-377.
- [3] Boehm, B. and Turner, R., "Management challenges to implementing Agile Processes in traditional development organizations," *IEEE Software*, (22:5), 2005, pp. 30-39.
- [4] Capretz, L. F., "Personality types in software engineering," *International Journal of Human-Computer Studies*, (58:2), 2003, pp. 207-214.
- [5] Chilton, M. A., Hardgrave, B. C., and Armstrong, D. J., "Person-job cognitive style fit for software developers: The effect on strain and performance," *Journal of Management Information Systems*, (22:2), 2005, pp. 193-226.
- [6] Chilton, M. A., Hardgrave, B. C., and Armstrong, D. J., "Performance and Strain Levels of IT Workers Engaged in Rapidly Changing Environments: A Person-Job Fit Perspective," *The DATA BASE for Advances in Information Systems*, (41:1), 2010, pp. 8-35.
- [7] Clark, J. G., Walz, D. B., and Wynekoop, J. L., "Identifying exceptional application software developers: A comparison of students and professionals," *Communications of the Association for Information Systems*, (11:8), 2003, pp. 137-154.
- [8] Edwards, J. R., "Person-job fit: A conceptual integration, literature review and methodological critique," *International Review of Industrial/Organizational Psychology*, (6), 1991, pp. 283-357.
- [9] Edwards, J. R., "Person-Environment Fit in Organizations: An Assessment of Theoretical Progress," *Academy of Management Annals*, (2), 2008, pp. 167-230.
- [10] Gartner, "Gartner Says Worldwide IT Spending on Pace to Reach \$3.7 Trillion in 2013," 2013.
- [11] Howcroft, D. and Wilson, M., "Participation: 'bounded freedom' or hidden constraints on user involvement," *New Technology Work and Employment*, (18:1), 2003, pp. 2-19.
- [12] Huarng, A. D., "Burnout syndrome among IS professionals," *Information Systems Management*, (18:2), 2001, pp. 15-20.
- [13] Huarng, A. S., "The effect of interpersonal environments on IS personnel," *Journal of Computer Information Systems*, (38:4), 1998, pp. 52-59.
- [14] Jiang, J. and Klein, G., "A discrepancy model of information system personnel turnover," *Journal of Management Information Systems*, (19:2), 2002, pp. 249-272.
- [15] Kautz, K., Madsen, S., and Norbjerg, J., "Persistent problems and practices in information systems development," *Information Systems Journal*, (17:3), 2007, pp. 217-239.

- [16] Kim, H. W. and Kankanhalli, A., "Investigating User Resistance to Information Systems Implementation: A Status Quo Bias Perspective," *MIS Quarterly*, (33:3), 2009, pp. 567-582.
- [17] Kirlidog, M., Aykol, M., and Gulsecen, S., "Interpersonal Communication and Gender in the ICT Profession," *IEEE Technology and Society Magazine*, (28:1), 2009, pp. 48-56.
- [18] Kristof, A. L., "Person-organization fit: An integrative review of its conceptualizations, measurement, and implications," *Personnel Psychology*, (49:1), 1996, pp. 1-49.
- [19] Lyons, M. L., "The DP psyche," *Datamation*, 1985, pp. 103-109.
- [20] Maruping, L. M., Venkatesh, V., and Agarwal, R., "A Control Theory Perspective on Agile Methodology Use and Changing User Requirements," *Information Systems Research*, (20:3), 2009, pp. 377-399.
- [21] McLean, E. R., Bryan, N. B., Tanner, J. R., and Smits, S. J., "The structure of job attitudes among entry-level I/S professionals: a path-analytic analysis," in *Proceedings of the 1993 Conference on Computer Personnel Research*, 1993, pp. 27-36.
- [22] McLean, E. R., Tanner, J. R., and Smits, S. J., "Self-perceptions and job preferences of entry-level IS professionals: Implications for career development," *Computer Personnel*, (13:3), 1991, pp. 33-43.
- [23] Mishra, D. and Mishra, A., "Effective Communication, Collaboration, and Coordination in eXtreme Programming: Human-Centric Perspective in a Small Organization," *Human Factors and Ergonomics in Manufacturing*, (19:5), 2009, pp. 438-456.
- [24] Rutner, P., Williams, F. I., Campbell, C., and Riemenschneider, C., "The Politics of Emotion: Exploring Emotional Labor and Political Skill Across Job Types within the IT/IS Profession," *The DATA BASE for Advances in Information Systems*, (46:3), 2015, pp. 52-73.
- [25] Rutner, P. S., Hardgrave, B. C., and McKnight, D. H., "Emotional dissonance and the information technology professional," *MIS Quarterly*, (32:3), 2008, pp. 635-652.
- [26] Rutner, P. S., Riemenschneider, C., O'Leary-Kelly, A., and Hardgrave, B. C., "Work Exhaustion in Information Technology Professionals: The Impact of Emotional Labor," *The DATA BASE for Advances in Information Systems*, (42:1), 2011, pp. 102-120.
- [27] Schein, E. H., *Career Dynamics: Matching Individual and Organizational Needs*. Reading, Massachusetts: Addison-Wesley, 1978.
- [28] Smits, S. J., Tanner, J. R., and McLean, E. R., "Job characteristic preference-reality discrepancies and the job and career attitudes of I/S professionals," in *Proceedings of the 1993 Conference on Computer Personnel Research*, 1993, pp. 120-130.
- [29] Todd, P. A., McKeen, J. D., and Gallupe, R. B., "The evolution of IS job skills: A content analysis of IS job advertisements from 1970-1990," *MIS Quarterly*, 1995, pp. 1-27.
- [30] Wingreen, S. C., LeRouge, C. M., and Nelson, A. C., "Managing IT Employee Attitudes that Lead to Turnover: Integrating a Person-Job Fit Perspective," *International Journal of Human Capital and Information Technology Professionals*, (8:1), 2017, pp. 25-41.

Tourism seasonality and jobs, the case of the Myrtle Beach area and South Carolina

Taylor Damonte, Coastal Carolina University; Darla Domke-Damonte, Coastal Carolina University; Robert Salvino, Coastal Carolina University

Introduction

Tourism can have many impacts on the economy of a destination area. Perhaps the most frequently mentioned of these is jobs. As tourism visitation, increases the economic flow-through effect can create jobs not only in hospitality and the retail economy, but in construction, health care, and many other professions (Mason, 2016). This study seeks to explore how tourism seasonality can impact total destination employment in South Carolina, and more specifically in the Myrtle Beach area. Further, researchers attempt to measure the impact of the religious holiday calendar and weather events on tourism seasonality.

Resort destination areas in beach communities can be subject to more extreme seasonality. For example, in the Myrtle Beach area of South Carolina, tourism seasonality may be impacted by both religious and U.S. federal holidays. While the timing of the federal holidays are codified into law, the timing of religious holidays can vary each year. For example, Easter and Passover can fall in during either March or April. Since the religious holiday calendar may also influence school calendars, changes in the religious holiday calendar may indirectly influence the timing of spring break travel as well.

In destination areas where the primary purpose of visit is to enjoy the natural environment, adverse weather can also influence travel plans. Travel plans to beach communities on the U.S.

Eastern seaboard from mid-summer to early fall are frequently impacted by weather forecasts for named-storms. Winter storms can also impact visitation, especially during long holiday weekends, those that include a federal holiday on a Monday. In this study researchers primarily seek to understand the degree to which the total number of jobs in the Myrtle Beach area on a monthly basis is impacted by tourism seasonality and, and how that might be different than the impact that tourism seasonality has on total jobs statewide.

Literature Review

In an open destination area, the relative strength of tourist visitation can be difficult to measure on a monthly basis. For example, the Myrtle Beach Area Chamber of Commerce utilizes results from a panel study done by a private consulting company, D.K. Shifflet and Associates, which is a tourism and travel research company, to estimate the annual number of tourists visiting the area. Their most recent study puts the total annual number of visitors at near 16.1 million. For a combination of methodological and financial reasons no attempt is made by the Shifflet or the MBACOC to estimate monthly visitation totals.

In an economic sense, tourism demand is a function of tourist volume and tourist spending. It is true that the change in the amount of taxes collected on accommodations, attractions, and restaurants could be utilized as an indicator of the relative strength of tourism at the destination level. However, the level of tourism tax collections is a function not only of the volume of visitors in the market but also the level of spending per visitor. The average percentage of transient rooms occupied (APO), which is a measure of capacity utilization, is often used instead as an indicator of the relative level of visitation. Smith Travel Research (STR in SCPRT monthly lodging report) is a consulting company that focuses on the lodging sector. STR tracks and

reports the average percentage of hotel rooms occupied in the Myrtle Beach area, and also statewide. Consequently, average percent occupancy at the destination level, as reported by STR, is often utilized by state tourism bureaus (SCPRT, 2016) as an indicator of the relative strength of tourism demand.

Tourism researchers elsewhere currently utilize a number of advanced multivariate regression techniques in modeling the seasonality of tourist visitation. For example, Cankurt and Subasi (2016) compared multi linear regression (MLR), multi layer perception, and support vector regression (SVR) techniques in forecasting tourism demand in Turkey. Their study found SVR to have the best predictive power, especially when using small samples. Similarly, Shuang (2014) and, Lin and Lee (2013) tested different approaches for modeling linear and non-linear data. Again, SVR techniques were found to have better predictive capability when modeling nonlinear data. Song, Gao, and Lin (2013) utilized quantitative forecasting techniques, but sought to inform the results utilizing qualitative input from expert reviewers.

Methodology and Results

Based on the work of tourism scholars such as Mason (2016), and the forecasting research mentioned above, researchers hypothesize that the variance in monthly APO for hotels will be positively associated with total employment. Stated in null form, APO will have no impact on total employment. They further expect that the Easter holiday calendar, severe storms, and level of consumer confidence nationally may moderate the impact of APO on total employment. Therefore, in the current study researchers utilize multi linear regression to test the impact of average percent occupancy of hotels on total jobs, after controlling for year, month, the timing of the Easter holiday, the timing of severe storms, and change in national consumer confidence.

Monthly average percent occupancy (APO) for hotels in the Myrtle Beach area and monthly APO for hotels in the state of South Carolina, as reported by STR, are the measures of the independent variables in two regression analysis. Total jobs in in Horry County, and in South Carolina, respectively, are the dependent variables in the two regression analyses. In each of the regression models, 15 years of monthly data beginning with January, 2001, and ending with December, 2016, were studied. The year variable was coded relative 2009. The month of the Easter holiday was coded as 1 with all other months coded as 0. The variable created to indicate each month during which a severe storm impacted the area during at least one weekend day was coded as either 1 or 0. Lastly, researchers controlled for monthly change in national consumer demand by utilizing the Michigan consumer sentiment index, which was lagged by two months.

The SPSS analysis output tables are shown below. Table 1 below shows the adjusted R square for the MLR model created to predict total jobs in Horry County, SC. In Model 1 researchers control for month and year only. Results indicate that Model 1 was statistically significant at the .01 level. The impact of the variables reflecting the timing of severe storms and the timing of the Easter holiday, included in Model 2, was not statistically significant at the .01 level, nor was the impact of national consumer sentiment. Myrtle Beach area hotel APO was a statistically significant predictor of total jobs in Horry County, when controlling for both month and year. The Beta coefficient for Myrtle Beach area APO (Table 2, model 4) is 356.1, which indicates that every 1 additional occupancy point is associated with 356 jobs, county-wide.

Table 1
Model Summary for Jobs in Horry County, SC^e

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change S				Sig. F Change	Durbin-Watson
					R Square Change	Change	df1	df2		
1	.652 ^a	.426	.419	7629.098	.426	65.550	2	177	.000	
2	.654 ^b	.427	.414	7659.685	.002	.295	2	175	.745	
3	.669 ^c	.447	.431	7547.805	.020	6.226	1	174	.014	
4	.891 ^d	.794	.787	4624.591	.346	290.494	1	173	.000	.273

a. Predictors: (Constant), Month Order, Year from 2009

b. Predictors: (Constant), Month Order, Year from 2009, Month when a severe storm occurs, Month When Easter falls

c. Predictors: (Constant), Month Order, Year from 2009, Month when a severe storm occurs, Month When Easter falls, Confidence

d. Predictors: (Constant), Month Order, Year from 2009, Month when a severe storm occurs, Month When Easter falls, Confidence, Average Percent Occupancy in the MB area e. Dependent Variable: Horry County Total Jobs

Table 2
Coefficients for Control Variables in the Predictive Model for Total Jobs in Horry County^a

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	114799.587	1212.343		94.692	.000		
	Year from 2009	1466.537	131.614	.635	11.143	.000	1.000	1.000
	Month Order	433.968	164.725	.150	2.634	.009	1.000	1.000
2	(Constant)	114538.424	1314.088		87.162	.000		
	Year from 2009	1463.007	132.235	.633	11.064	.000	.999	1.001
	Month Order	445.733	170.961	.154	2.607	.010	.936	1.069
	Month When Easter falls	733.536	2143.462	.020	.342	.733	.929	1.077
	Month when a severe storm occurs	1482.720	2075.714	.041	.714	.476	.990	1.010
3	(Constant)	103750.712	4512.984		22.989	.000		

	Year from 2009	1523.817	132.562	.660	11.495	.000	.965	1.036
	Month Order	472.588	168.808	.163	2.800	.006	.932	1.073
	Month When Easter falls	619.351	2112.649	.017	.293	.770	.928	1.077
	Month when a severe storm occurs	1198.937	2048.555	.033	.585	.559	.987	1.013
	Confidence	130.246	52.197	.144	2.495	.014	.959	1.043
4	(Constant)	96280.292	2799.658		34.390	.000		
	Year from 2009	1496.113	81.238	.648	18.416	.000	.964	1.037
	Month Order	428.506	103.462	.148	4.142	.000	.931	1.074
	Month When Easter falls	-1855.878	1302.556	-.051	-1.425	.156	.917	1.091
	Month when a severe storm occurs	1071.321	1255.186	.030	.854	.395	.987	1.013
	Confidence	-4.122	32.939	-.005	-.125	.901	.904	1.106
	Average Percent Occupancy in the MB area	356.092	20.893	.610	17.044	.000	.930	1.076

a. Dependent Variable: Horry County Total Jobs

Table 3 below shows the adjusted R square for the MLR model created to predict total jobs in South Carolina. In Model 1 researchers control for month and year only. Results indicate that model 1 was statistically significant at the .01 level. The impact of the variables reflecting the timing of severe storms and the timing of the Easter holiday, included in Model 2, was not statistically significant at the .01 level. However, national consumer sentiment (Model 3), was a statistically significant predictor of jobs statewide, as was hotel APO in the State (Model 4), after controlling for both month and year. The Beta coefficient for South Carolina area hotel APO

(Table 4, Model 4) is 1,958.3, which indicates that every 1 additional APO for South Carolina is associated with an additional 1,958 jobs statewide.

Table 3
Model Summary for Jobs in South Carolina^e

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.841 ^a	.708	.704	53129.946	.708	214.142	2	177	.000	
2	.842 ^b	.709	.702	53303.852	.001	.423	2	175	.655	
3	.902 ^c	.813	.807	42870.332	.104	96.546	1	174	.000	
4	.920 ^d	.846	.841	38951.442	.034	37.773	1	173	.000	.138

a. Predictors: (Constant), Month Order, Year from 2009

b. Predictors: (Constant), Month Order, Year from 2009, Month when a severe storm occurs, Month When Easter falls

c. Predictors: (Constant), Month Order, Year from 2009, Month when a severe storm occurs, Month When Easter falls, Confidence

d. Predictors: (Constant), Month Order, Year from 2009, Month when a severe storm occurs, Month When Easter falls, Confidence, Average Percent Occupancy in SC e. Dependent Variable: SC Jobs

Table 4
Coefficients for Control Variables in the Predictive Model for Total Jobs in South Carolina^a

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1959135.065	8442.903		232.045	.000		
	Year from 2009	18814.806	916.579	.834	20.527	.000	1.000	1.000
	Month Order	3016.970	1147.165	.107	2.630	.009	1.000	1.000

2	(Constant)	1956873.515	9144.758		213.989	.000		
	Year from 2009	18785.794	920.222	.833	20.414	.000	.999	1.001
	Month Order	3124.526	1189.723	.111	2.626	.009	.936	1.069
	Month When Easter falls	6564.126	14916.382	.019	.440	.660	.929	1.077
	Month when a severe storm occurs	12185.153	14444.922	.035	.844	.400	.990	1.010
3	(Constant)	1715598.846	25633.030		66.929	.000		
	Year from 2009	20145.848	752.933	.893	26.756	.000	.965	1.036
	Month Order	3725.155	958.801	.132	3.885	.000	.932	1.073
	Month When Easter falls	4010.299	11999.513	.011	.334	.739	.928	1.077
	Month when a severe storm occurs	5838.154	11635.465	.017	.502	.616	.987	1.013
	Confidence	2913.045	296.469	.329	9.826	.000	.959	1.043
4	(Constant)	1655050.222	25287.803		65.449	.000		
	Year from 2009	19246.101	699.594	.853	27.510	.000	.923	1.084
	Month Order	3915.146	871.703	.139	4.491	.000	.931	1.074
	Month When Easter falls	-9825.245	11132.586	-.028	-.883	.379	.890	1.123
	Month when a severe storm occurs	4147.262	10575.416	.012	.392	.695	.987	1.014
	Confidence	2280.909	288.337	.258	7.911	.000	.837	1.195
	Average Percent Occupancy in SC	1958.325	318.634	.203	6.146	.000	.814	1.228

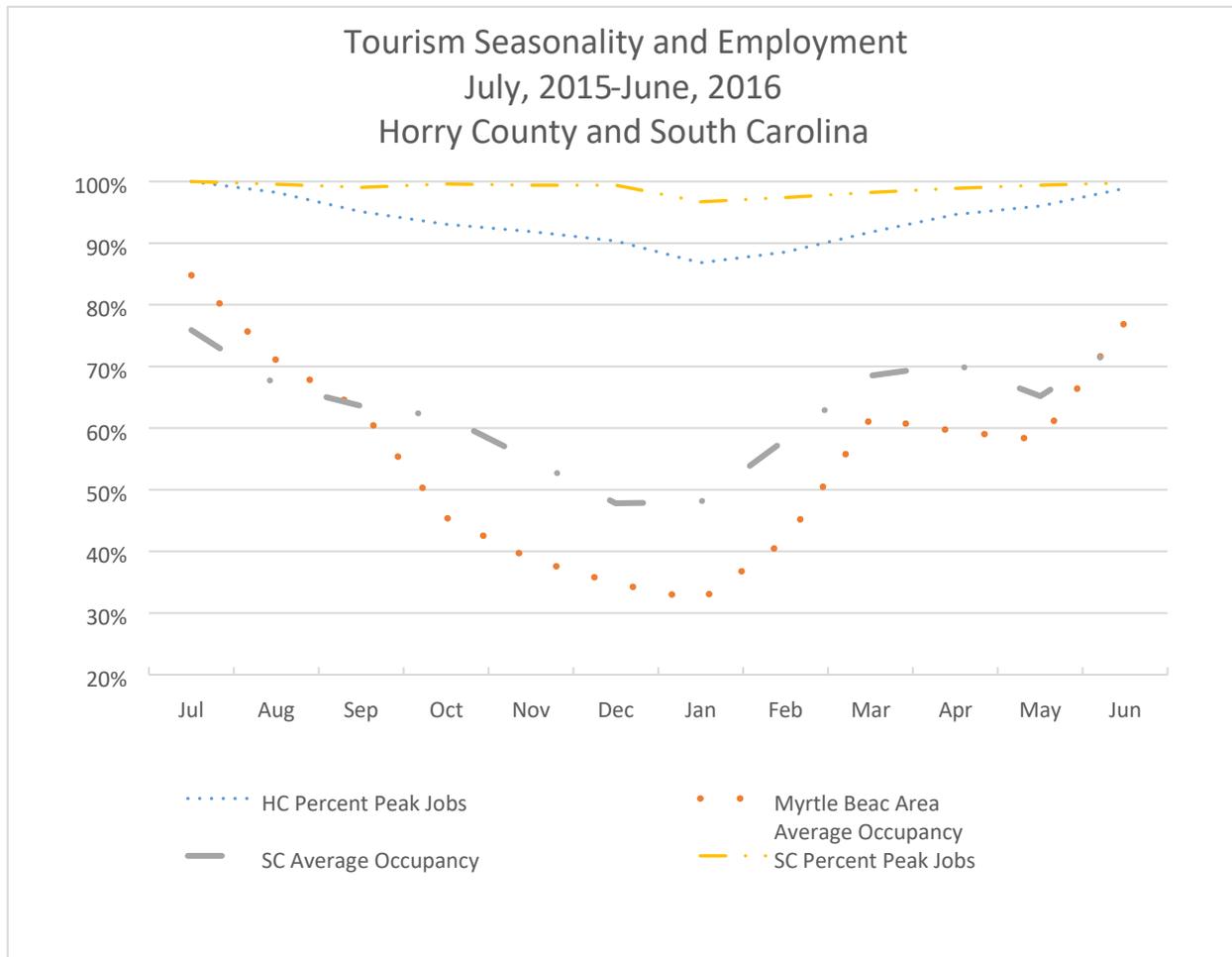
a. Dependent Variable: SC Jobs

Discussion

Results of the regression models clearly indicate that tourism seasonality, as measured by hotel APO is positively associated with total jobs in the destination area. Therefore, the null hypothesis is rejected. However, the relative impact of a 1 occupancy point change in APO in South Carolina on the job market in South Carolina overall may be quite different than the impact of a 1 occupancy point change in APO in the Myrtle Beach area on the job market in the Myrtle Beach area in particular. A closer look at monthly total jobs and APO during the most recent year (Figure 1) may help readers to better understand the greater relevance of this finding to the Myrtle Beach area.

The peak month for employment in South Carolina during 2015 was July. During that month there were 2,157,480 individuals employed statewide. For January, 2016, there were 2,138,812 individuals employed statewide, which is still 96.7 percent of peak month employment for 2016. In Horry county, July is also the peak month for employment. During July 2015, there were 135,347 individuals employed in Horry county, the Myrtle Beach area of South Carolina. During January 2016, there were 121,427 individuals employed, which is only 86.8 percent of the peak monthly employment level of 2016. So, during this analysis year, as it does every year, Horry county loses a greater percentage of its total jobs from July to January than does the state as a whole.

Figure 1



This analysis suggests that tourism seasonality should be a much greater issue in the Myrtle Beach area than it may be statewide. Logically, the development and marketing of shoulder/winter season tourism assets should be a greater priority for community planners and tourism marketers in the Myrtle Beach area than it might be at the state level. For example, facilities that serve organized sports in which the peak participation months occur during the fall and spring, or indoor facilities wherein usage can be year round, could help to smooth the seasonality of the jobs market, not only for tourism jobs but in the entire economy. A more stable job market may also be indicative of a stronger and broader-based economy, which may be associated with other positive social

impacts such as a lower incidence of some types of crime (Andresen, 2015). The relationship between tourism seasonality, jobs, and crime is also a potentially fertile area for researchers studying the impact of tourism seasonality on society.

References

- Andresen, Martin A. (2015). Unemployment, GDP, and Crime: The Importance of Multiple Measures In The Economy. *Canadian Journal of Criminology & Criminal Justice*, 57(1), pp 35-58.
- CANKURT, S., & SUBAŞI, A. (2016). Tourism demand modelling and forecasting using data mining techniques in multivariate time series: a case study in Turkey. *Turkish Journal Of Electrical Engineering & Computer Sciences*, 24(5), 3388-3404.
- LAUS of the Bureau of Labor Statistics, obtained from SC Department of Employment and Workforce. <https://dew.sc.gov/tools-resources/data-statistics>
- Lin, C., & Lee, T. (2013). Tourism Demand Forecasting: Econometric Model Based on Multivariate Adaptive Regression Splines, Artificial Neural Network and Support Vector Regression. *Advances In Management And Applied Economics*, 3(6), 1-18.
- Mason Peter (2016). *Tourism Impacts, Planning and Management*, Routledge, p. 43.
- SHUANG, C. (2014). A Comparative Analysis of Three Types of Tourism Demand Forecasting Models: Individual, Linear Combination and Non-linear Combination. *International Journal Of Tourism Research*, 16(6), 596-607.

Song, H., Gao, B. Z., & Lin, V. S. (2013). Combining Statistical and Judgmental Forecasts via a Web-Based Tourism Demand Forecasting System. *International Journal Of Forecasting*, 29(2), 295-310.

Song, H., & Witt, S. F. (2000). *Tourism Demand Modelling and Forecasting*. Amsterdam: Routledge.

South Carolina Parks, Recreation, and Tourism (SCPRT), State level lodging report, Smith Travel Research. <https://www.scpert.com/research>

Statistical Abstract for the Myrtle Beach Area of South Carolina, 24, 9.

<http://www.myrtlebeachareachamber.com/research/docs/24theditionstatisticalabstract.pdf>

University of Michigan Consumer Sentiment. <https://fred.stlouisfed.org/series/UMCSENT>

**Forecasting the performance of hotel properties in the coastal section of
Horry and Georgetown, South Carolina**

Pierre Valdema, MBA, Class of 2015

**E. Craig Wall Sr. College of Business Administration
Coastal Carolina University**

L. Taylor Damonte, Professor/Director

**Clay Brittain Jr. Center for Resort Tourism
E. Craig Wall Sr. College of Business Administration
Coastal Carolina University**

Abstract

This study focuses on the performance of properties in the Coastal sections of Horry and Georgetown, South Carolina, with the objective of trying to forecast performance based on the weekly vacation rental reservations data that have been collected for the years 2011, 2012, and 2013. The reservation status data have been collected as far out as six-weeks prior the date of arrival. For this research, we compare six-week data forecasts with the actual hotel industry averages for this market. The main purpose was to determine if the weekly vacation rental reservations status data could be utilized to predict hotel industry performance results. In other words, the intent was to determine whether local vacation rental properties (VRPs) reservations data collected weekly for the past three years could be used to predict the actual average weekly occupancy rates for hotels located in Myrtle Beach, South Carolina.

Introduction

Tourism has a good impact on the local economy of Horry and Georgetown Counties. Myrtle Beach is one of the best East Coast family vacation destinations. Millions of people from all over the world visit this area every year. According to Cho (2003), "Forecasting plays a major role in tourism planning. The promotion of tourism projects involving substantial sums of money requires an estimate of future demand

and market penetration. The commitment to developing tourism would be much easier if it were possible to analyze current and past tourist traffic and predict the nature of changes in tourism demand". The accuracy of this research is important because it could help increase the hotel's revenues and profit margin.

Literature Review

For the purpose of this study, finding a good forecasting technique would play a major role in determining whether the six week forecasts could predict actual results reported in the Smith Travel Research (STR), a nationally recognized measurer of hotel industry performance. Julia (n.d.) mentioned, "Forecasting techniques can be categorized in two broad categories: quantitative and qualitative. The techniques in the quantitative category include mathematical models such as moving average, straight-line projection, exponential smoothing, regression, trend-line analysis, simulation, life-cycle analysis, decomposition, Box-Jenkins, expert systems, and neural network". For the vacation rental properties, weekly data were collected from February 2011 to February 2013. A mathematical model was possible and appropriate for this study because VRP and STR data were collected in numerical formats.

Box-Jenkins Technique

According to Lin (2013), "Time-series models have been widely used in tourism demand forecasting literature with the dominance of the autoregressive integrated moving average (ARIMA) models". The Box-Jenkins Technique can also be named as the ARIMA modeling. This method can be used for time-series analysis and forecasting. "The term ARIMA is in short stands for the combination that comprises of Autoregressive/Integrated/Moving Average Model [12]. This model can be used when the time series data is in stationary state and there is no missing data within the time series data" (Ahmad & Ahmad, 2013). There are some data missing for certain weeks for the Vacation Rental Properties. This has happened either because

the source where the data should have been retrieved was not available or unavailability of weekly data during the last two weeks of December. In order to use this model there should be no missing data. For this reason, this method was not the best strategy for this study.

Trend-line Analysis

Gupta (2015) stated, “Trend analysis is a graphical representation of data over a period of time in order to predict the future. Trend-lines are used to extrapolate the data beyond the available data to forecast future values”. The trend-line analysis could be useful for this study because it is easy to implement using excel. In excel, it is good visually, but it would not give any statistical verification on whether VRP is useful in predicting STR data. As noted by Stevenson (2012), As linear trend equation has the form $y(t) = a + b(t)$ where

t = Specified number of time periods from $t = 0$

$y(t)$ = Forecast for period t

a = Value of $y(t)$ at $t = 0$

b = Slope of the line

Trend-line in excel should be able to display the equation in the form of $y(x) = m(x) + b$. It should also display the R Squared. If R squared is high (i.e. close to 100%), then we can assume VRP is a good predictor.

Exponential Smoothing methods

Stevenson (2012) mentioned in his book, “Exponential smoothing is a sophisticated weighted averaging method that is still relatively easy to use and understand. Each new forecast is based on the previous plus a percentage of the difference between that forecast and the actual value of the series at that point” (p. 80). This could be a good approach for prediction, but VRP data tends to have trend or seasonal pattern. The Exponential Smoothing methods would be more appropriate for forecasting data with no trend or seasonal pattern.

Regression Analysis

Regression analysis can be used to examine a relationship between two variables. According to Nau (n.d.), "Regression analysis is the art and science of fitting straight lines to patterns of data. In a linear regression model, the variable of interest (the so called "dependent" variable) is predicted from k other variables (the so-called "independent" variables) using a linear equation". This method is useful because it can be used to determine if the reservation status data have been collected, as far out as six-weeks prior the date of arrival, is useful in predicting the Smith Travel Research's hotel industry daily average occupancy. Regression analysis is easy to implement using excel. Similar to the Trend-line analysis, the regression analysis would display the R squared and the values of the equation $y(x) = m(x) + b$. Both methods (Regression and Trend-line analysis) could be used to verify the agreement on what has been done. For the purpose of this study, it appeared that Trend-line and regression analysis were more appropriate. They both could be implemented using Excel, which would decrease the amount of time to complete the analysis.

Analysis

The main purpose of the study was to determine whether local vacation rental property reservations data collected three times for each rental week for the past three years could be used to predict the occupancy rate for hotels located in Myrtle Beach, South Carolina. The VRP reservations data were collected weekly, whereas the STR data were gathered daily. The reservation status data were collected as far out as six-weeks prior the date of arrival. VRP reservations forecasts were divided into three observations of property status. The third sample was collected one week before the date of arrival, the second sample was collected two weeks before the date of arrival; the first sample was collected two weeks before the second sample, which was five weeks before the date of arrival. This approach allow researchers to provide nightly-lodging industry managers with a barometer of the relative demand for their services as early as six weeks in advance.

Data for Horry and Georgetown counties were retrieved from the vacation rental websites. Data collected from those websites were as follows: Maximum occupancy for either condo or house, sample units, sample bedrooms, bedrooms rented, asking price, and rental revenue. From the data collected we were able to calculate separately population units, sample units, sample units occupied, population bedrooms, sample bedrooms, sample bedrooms occupied, average weekly rate, and average percentage of occupancy for Horry and Georgetown counties. This was done for observation samples 1, 2, and 3 for both Horry and Georgetown counties each week. To prepare the data for analysis, data from Horry and Georgetown were added together. From this new table, we computed delta from the previous year for each week.

The STR data also needed to be re-formatted prior to analysis. We decided to compare VRP results against STR hotels' results for categories of properties based on the amount of meeting space. These categories included properties with no meeting space, properties with meeting space less than 2,500 sq./ft., and properties with meeting space greater than 2,500 sq./ft. The delta compared to the previous year was computed for each of these categories for each week.

Sample 1 - VRP vs. STR data (combined)

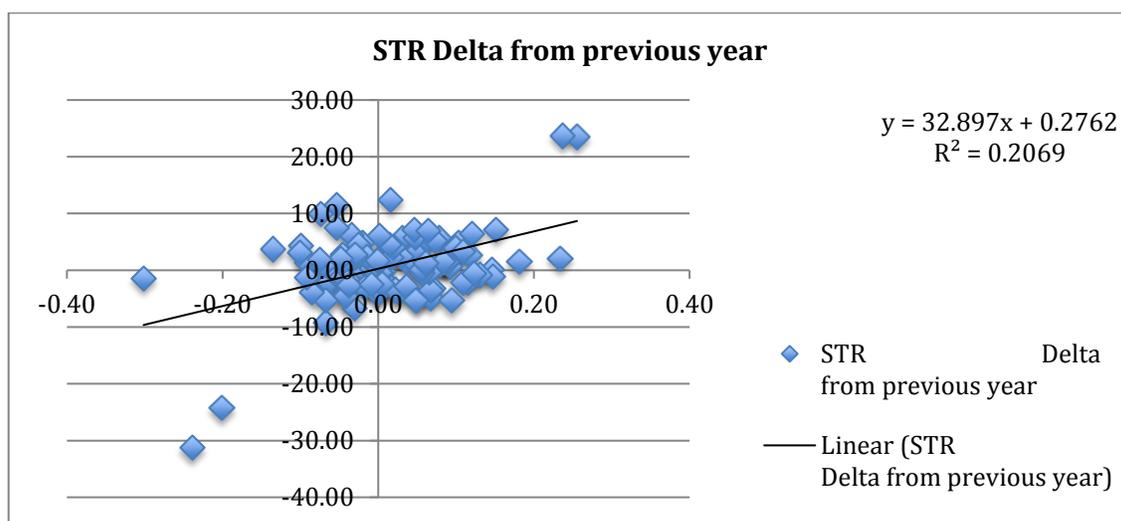


Figure 1.1 - Screen shot of VRP vs. STR data Scatterplots/trend line (1st Sample)

Linear Regression							
Regression Statistics							
R	0.45						
R Square	0.21						
Adjusted R Square	0.20						
S	5.71						
Total number of observations	105.00						
3.8 = 0.2743 + 32.8721 * 0.09975483359513776							
ANOVA							
	d.f.	SS	MS	F	p-level		
Regression	1.00	866.96	866.96	26.60	0.00		
Residual	103.00	3,357.10	32.59				
Total	104.00	4,224.05					
	Coefficients	Standard Error	LCL	UCL	t Stat	p-level	HO (5%) rejected?
Intercept	0.27	0.57	- 0.85	1.40	0.48	0.63	No
0.09975483359513776	32.87	6.37	20.23	45.51	5.16	0.00	Yes
T (5%)	1.98						
LCL - Lower value of a reliable interval (LCL)							
UCL - Upper value of a reliable interval (UCL)							

Figure 1.2 - Screen shot for linear regression analysis between VRP vs. STR data (1st Sample)

Sample 2 - VRP vs. STR data (combined)

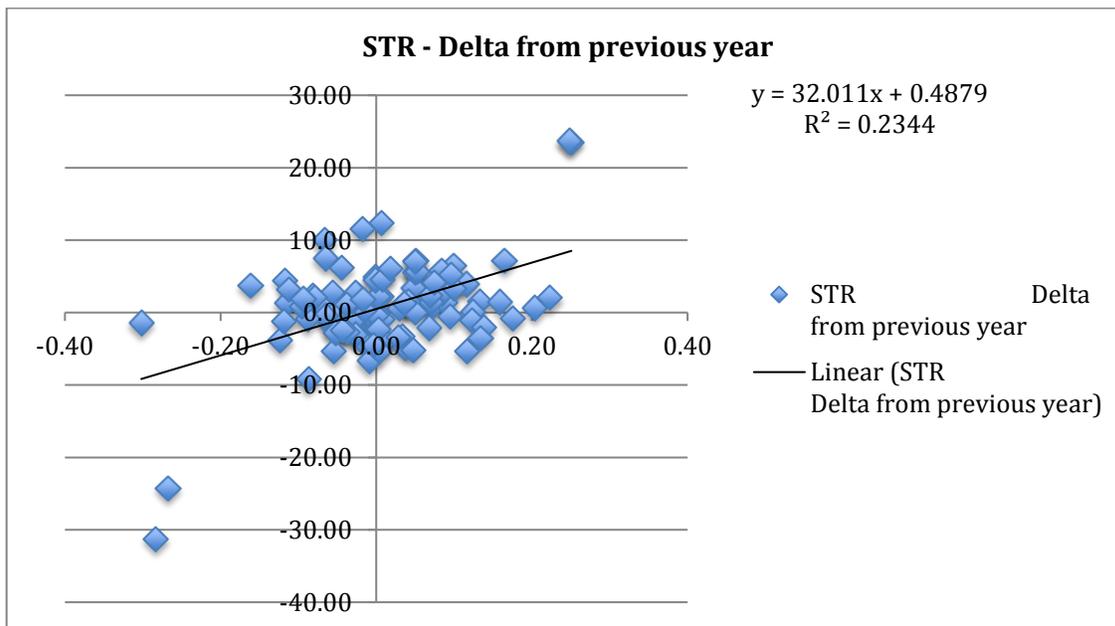


Figure 1.3 - Screen shot of VRP vs. STR data Scatterplots/trend line (2nd Sample)

Linear Regression								
Regression Statistics								
R	0.48							
R Square	0.23							
Adjusted R Square	0.23							
S	5.61							
Total number of observations	105.00							
3.8 = 0.4867 + 31.9976 * 0.09909330213512724								
ANOVA								
	<i>d.f.</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p-level</i>			
Regression	1.00	983.36	983.36	31.25	0.00			
Residual	103.00	3,240.70	31.46					
Total	104.00	4,224.05						
	<i>Coefficients</i>	<i>Standard Error</i>	<i>LCL</i>	<i>UCL</i>	<i>t Stat</i>	<i>p-level</i>	<i>H0 (5%) rejected?</i>	
Intercept	0.49	0.55	0.60		1.58	0.88	No	
0.09909330213512724	32.00	5.72	20.65		43.35	5.59	0.00	Yes
T (5%)	1.98							
LCL - Lower value of a reliable interval (LCL)								
UCL - Upper value of a reliable interval (UCL)								

Figure 1.4 - Screen shot for linear regression analysis between VRP vs. STR data (2nd Sample)

Sample 3 - VRP vs. STR data (combined)

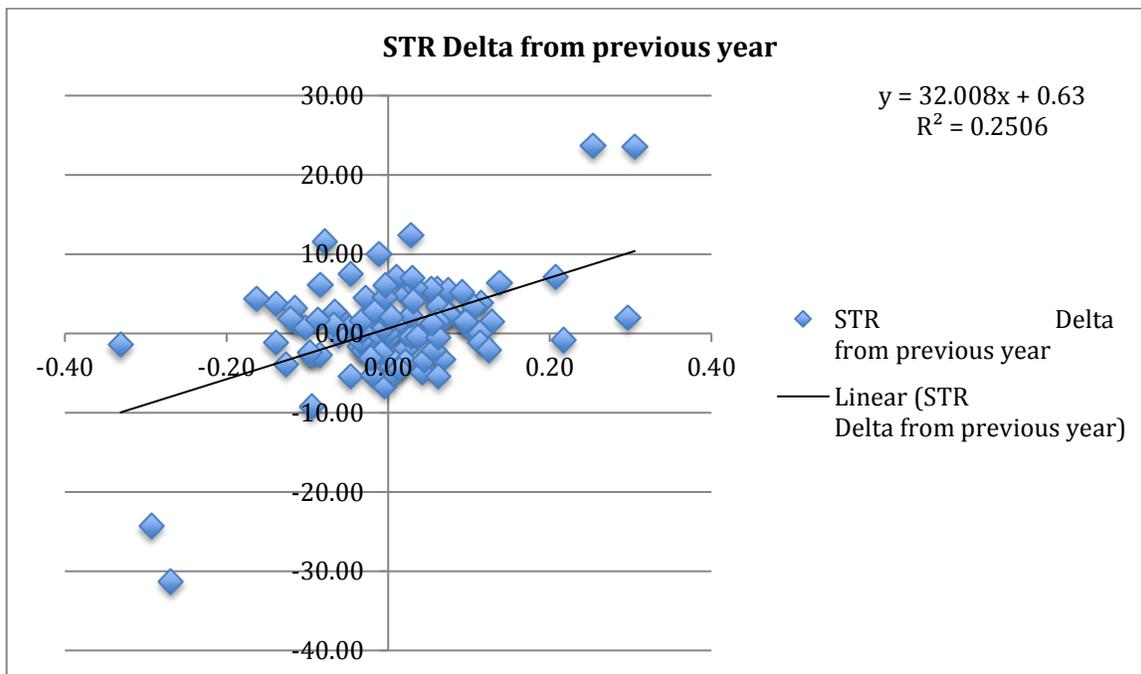


Figure 1.5 - Screen shot of VRP vs. STR data Scatterplots/trend line (3rd Sample)

Linear Regression							
Regression Statistics							
<i>R</i>	0.50						
<i>R Square</i>	0.25						
<i>Adjusted R Square</i>	0.24						
<i>S</i>	5.55						
<i>Total number of observations</i>	105.00						
3.8 = 0.6189 + 31.9425 * 0.06142146826557476							
ANOVA							
	<i>d.f.</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p-level</i>		
<i>Regression</i>	1.00	1,053.37	1,053.37	34.22	0.00		
<i>Residual</i>	103.00	3,171.02	30.79				
<i>Total</i>	104.00	4,224.39					
	<i>Coefficients</i>	<i>Standard Error</i>	<i>LCL</i>	<i>UCL</i>	<i>t Stat</i>	<i>p-level</i>	<i>H0 (5%) rejected?</i>
Intercept	0.62	0.54	- 0.46	1.69	1.14	0.26	No
0.06142146826557476	31.94	5.46	21.11	42.77	5.85	0.00	Yes
<i>T (5%)</i>	1.98						
<i>LCL - Lower value of a reliable interval (LCL)</i>							
<i>UCL - Upper value of a reliable interval (UCL)</i>							

Figure 1.6 - Screen shot for linear regression analysis between VRP vs. STR data (3rd Sample)

Findings for Combined Analysis

The 3rd VRP observation sample (Figure 1.5 and 1.6) estimation appeared to provide the best a forecasting STR results. In Figure 1.1 and 1.2, the R Squared value was .20; in Figure 1.3 and 1.4, the R Squared value was .23; in Figure 1.5 and 1.6, R Squared value was .25. This was still a relatively low R Squared value, but as expected the third sample had the highest R Squared value.

Furthermore, we noticed the P-values in the regression analysis for Figure 1.2, 1.4, and 1.6 were all less than .05, indicating that the reservations status data could be utilized to predict hotel industry performance results even if the R Squared values were low in all three samples for the combined analysis.

Sample 1 - VRP vs. STR data with no Meeting Space

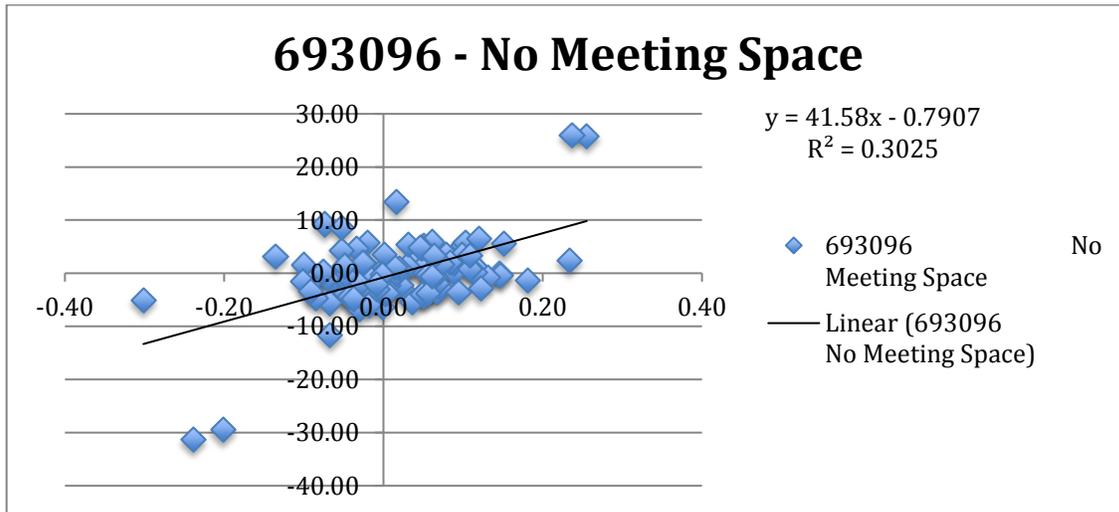


Figure 2.1 - Screen shot of VRP vs. STR data Scatterplots/trend line with no meeting Space (1st Sample)

Linear Regression							
Regression Statistics							
R	0.55						
R Square	0.30						
Adjusted R Square	0.29						
S	5.59						
Total number of observatio	105.00						
5.20344077736503 = - 0.8052 + 41.3866 * 0.09975483359513776							
ANOVA							
	<i>d.f.</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p-level</i>		
Regression	1.00	1,374.24	1,374.24	43.92	0.00		
Residual	103.00	3,222.97	31.29				
Total	104.00	4,597.21					
	<i>Coefficients</i>	<i>Standard Error</i>	<i>LCL</i>	<i>UCL</i>	<i>t Stat</i>	<i>p-level</i>	<i>H0 (5%) rejected?</i>
Intercept	- 0.81	0.55	- 1.91	0.30	- 1.45	0.15	No
0.09975483359513776	41.39	6.25	29.00	53.77	6.63	0.00	Yes
T (5%)	1.98						
<i>LCL - Lower value of a reliable interval (LCL)</i>							
<i>UCL - Upper value of a reliable interval (UCL)</i>							

Figure 2.2 - Screen shot for linear regression analysis between VRP vs. STR data With no meeting space (1st Sample)

Sample 2 - VRP vs. STR data with no Meeting Space

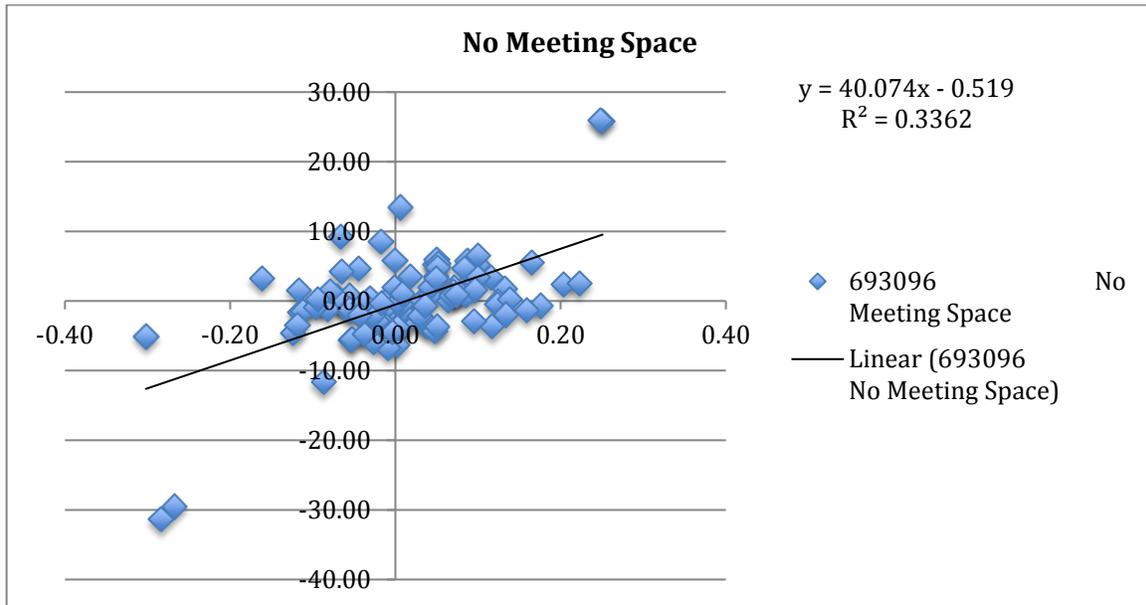


Figure 2.3 - Screen shot of VRP vs. STR data Scatterplots/trend line with no meeting Space (2nd Sample)

Linear Regression							
Regression Statistics							
R	0.58						
R Square	0.33						
Adjusted R Square	0.33						
S	5.46						
Total number of observations	105.00						
5.203440777736503 = - 0.5341 + 39.9112 * 0.09909330213512724							
ANOVA							
	<i>d.f.</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p-level</i>		
Regression	1.00	1,529.92	1,529.92	51.37	0.00		
Residual	103.00	3,067.30	29.78				
Total	104.00	4,597.21					
	<i>Coefficients</i>	<i>Standard Error</i>	<i>LCL</i>	<i>UCL</i>	<i>t Stat</i>	<i>p-level</i>	<i>H0 (5%) rejected?</i>
Intercept	- 0.53	0.54	- 1.60	0.53	- 1.00	0.32	No
0.09909330213512724	39.91	5.57	28.87	50.95	7.17	0.00	Yes
T (5%)	1.98						
LCL - Lower value of a reliable interval (LCL)							
UCL - Upper value of a reliable interval (UCL)							

Figure 2.4 - Screen shot for linear regression analysis between VRP vs. STR data With no meeting space (2nd Sample)

Sample 2 - VRP vs. STR data with no Meeting Space

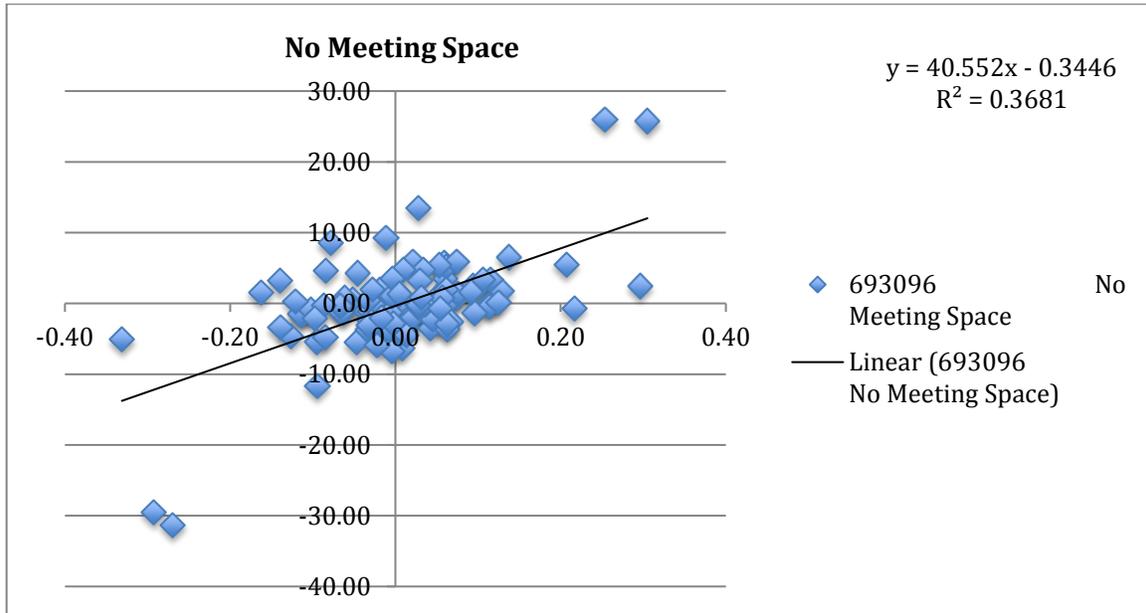


Figure 2.5 - Screen shot of VRP vs. STR data Scatterplots/trend line with no meeting Space (3rd Sample)

Linear Regression							
Regression Statistics							
R	0.61						
R Square	0.37						
Adjusted R Square	0.36						
S	5.32						
Total number of observations	105.00						
5.203440777736503 = - 0.3728 + 40.3862 * 0.06142146826557476							
ANOVA							
	<i>d.f.</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p-level</i>		
Regression	1.00	1,683.87	1,683.87	59.53	0.00		
Residual	103.00	2,913.34	28.28				
Total	104.00	4,597.21					
	<i>Coefficients</i>	<i>Standard Error</i>	<i>LCL</i>	<i>UCL</i>	<i>t Stat</i>	<i>p-level</i>	<i>H0 (5%) rejected?</i>
Intercept	- 0.37	0.52	- 1.40	0.66	- 0.72	0.47	No
0.06142146826557476	40.39	5.23	30.01	50.77	7.72	0.00	Yes
T (5%)	1.98						
LCL - Lower value of a reliable interval (LCL)							
UCL - Upper value of a reliable interval (UCL)							

Figure 2.6 - Screen shot for linear regression analysis between VRP vs. STR data With no meeting space (3rd Sample)

Findings for Comparison of VRP vs. STR with no Meeting Space

Our expectation for this particular analysis was the same as the previous analysis. The 3rd sample (Figure 2.5 and 2.6) estimation was expected to provide a better estimate.

As can be seen, it appeared that our assumption was right. In Figure 2.1 and 2.2, the R Squared value was .30; in Figure 2.3 and 2.4, the R Squared value was .33; in Figure 2.5 and 2.6, R Squared value was .37. This also displayed low R Squared values again the third sample produced the highest R Squared value.

Furthermore, we noticed the P-values in the regression analysis for Figure 2.2, 2.4, and 2.6 were all less than .05 indicating that the reservations status data could be utilized to predict hotel industry performance results even if the R Squared values were low in all three samples for the combined analysis with no meeting space.

Sample 1 - VRP vs. STR data with Meeting Space < 2,500 sq./ft.

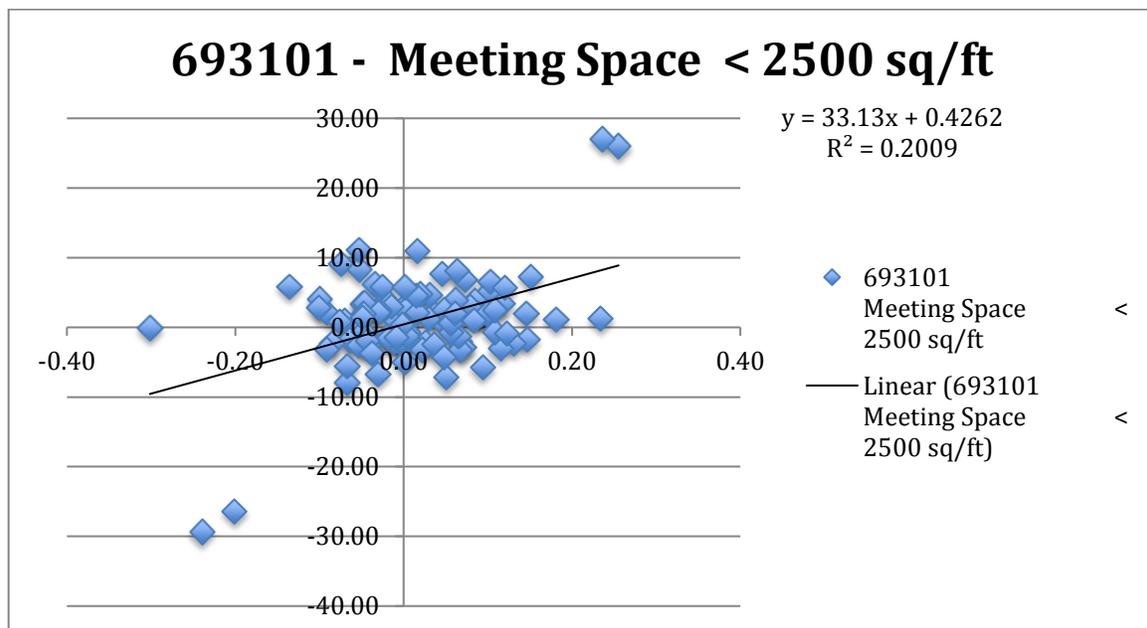


Figure 2.1 - Screen shot of VRP vs. STR data Scatterplots/trend line with meeting Space < 2,500 sq./ft. (1st Sample)

Linear Regression							
Regression Statistics							
R	0.45						
R Square	0.20						
Adjusted R Square	0.19						
S	5.86						
Total number of observations	105.00						
4.920645647801987 = 0.4168 + 33.0060 * 0.09975483359513776							
ANOVA							
	d.f.	SS	MS	F	p-level		
Regression	1.00	874.04	874.04	25.49	0.00		
Residual	103.00	3,531.66	34.29				
Total	104.00	4,405.70					
	Coefficients	Standard Error	LCL	UCL	t Stat	p-level	H0 (5%) rejected?
Intercept	0.42	0.58	- 0.74	1.57	0.72	0.47	No
0.09975483359513776	33.01	6.54	20.04	45.97	5.05	0.00	Yes
T (5%)	1.98						
LCL - Lower value of a reliable interval (LCL)							
UCL - Upper value of a reliable interval (UCL)							

Figure 3.2 - Screen shot for linear regression analysis between VRP vs. STR data With meeting space < 2,500 sq./ft. (1st Sample)

Sample 2 - VRP vs. STR data with Meeting Space < 2,500 sq./ft.

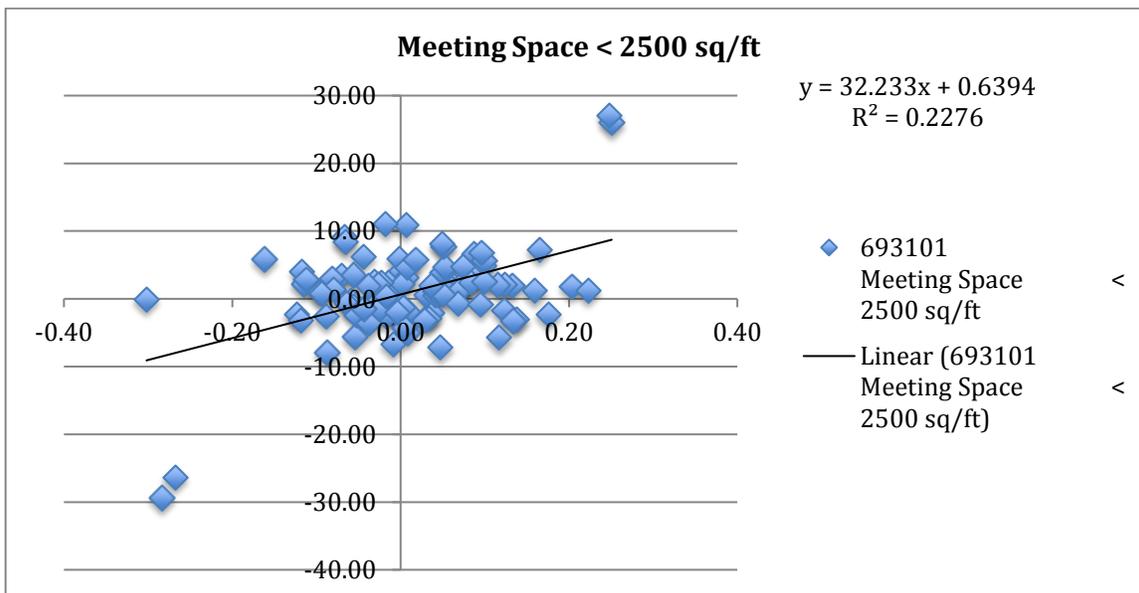


Figure 3.3 - Screen shot of VRP vs. STR data Scatterplots/trend line with meeting Space < 2,500 sq./ft. (2nd Sample)

Linear Regression							
Regression Statistics							
R	0.47						
R Square	0.23						
Adjusted R Square	0.22						
S	5.76						
Total number of observations	105.00						
4.920645647801987 = 0.6301 + 32.1318 * 0.09909330213512724							
ANOVA							
	d.f.	SS	MS	F	p-level		
Regression	1.00	991.63	991.63	29.92	0.00		
Residual	103.00	3,414.08	33.15				
Total	104.00	4,405.70					
	Coefficients	Standard Error	LCL	UCL	t Stat	p-level	HO (5%) rejected?
Intercept	0.63	0.56	- 0.49	1.75	1.12	0.27	No
0.09909330213512724	32.13	5.87	20.48	43.78	5.47	0.00	Yes
T (5%)	1.98						
LCL - Lower value of a reliable interval (LCL)							
UCL - Upper value of a reliable interval (UCL)							

Figure 3.4 - Screen shot for linear regression analysis between VRP vs. STR data With meeting space < 2,500 sq./ft. (2nd Sample)

Sample 3 - VRP vs. STR data with Meeting Space < 2,500 sq./ft.

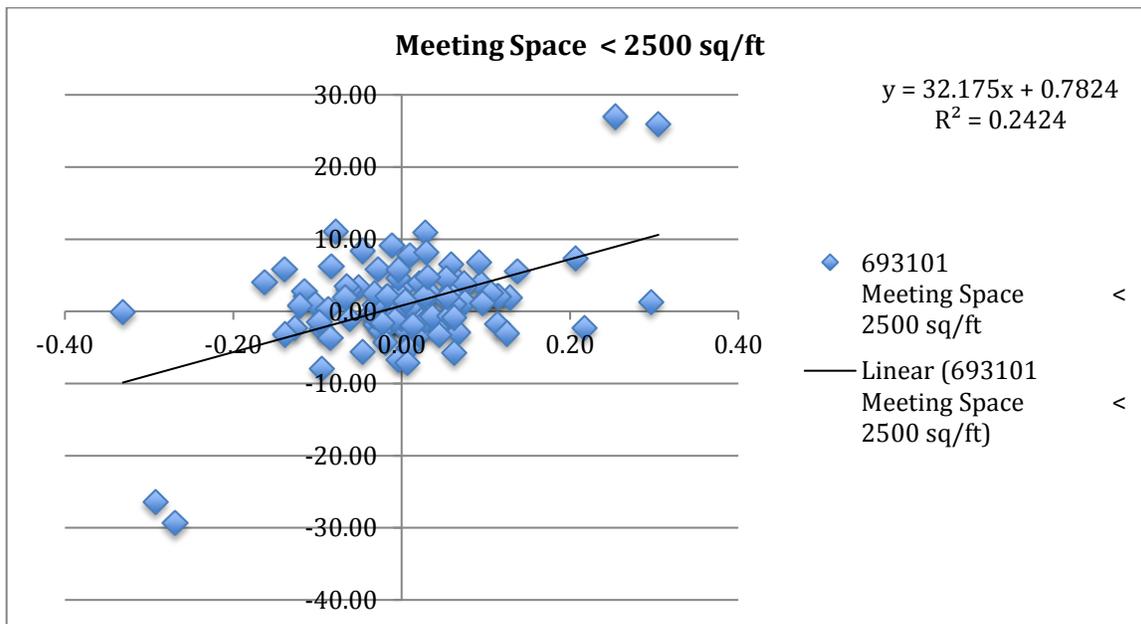


Figure 3.5 - Screen shot of VRP vs. STR data Scatterplots/trend line with meeting Space < 2,500 sq./ft. (3rd Sample)

Linear Regression							
Regression Statistics							
R	0.49						
R Square	0.24						
Adjusted R Square	0.23						
S	5.70						
Total number of observations	105.00						
4.920645647801987 = 0.7625 + 32.0579 * 0.06142146826557476							
ANOVA							
	d.f.	SS	MS	F	p-level		
Regression	1.00	1,060.99	1,060.99	32.67	0.00		
Residual	103.00	3,344.71	32.47				
Total	104.00	4,405.70					
	Coefficients	Standard Error	LCL	UCL	t Stat	p-level	H0 (5%) rejected?
Intercept	0.76	0.56	- 0.34	1.87	1.37	0.17	No
0.06142146826557476	32.06	5.61	20.93	43.18	5.72	0.00	Yes
T (5%)	1.98						
LCL - Lower value of a reliable interval (LCL)							
UCL - Upper value of a reliable interval (UCL)							

Figure 3.6 - Screen shot for linear regression analysis between VRP vs. STR data
With meeting space < 2,500 sq./ft. (3rd Sample)

Findings for Comparison of VRP vs. STR With Meeting Space < 2,500 sq./ft.

Again, we noticed that our expectations were correct. In Figure 3.1 and 2.2, the R Squared value was .20; in Figure 2.3 and 2.4, the R Squared value was .23; in Figure 2.5 and 2.6, R Squared value was .24. This also displayed low R Squared values. However, It was noticeable that the third sample was more accurate because it had the highest R Squared.

In addition, we observed the P-values in the regression analysis for Figure 3.2, 3.4, and 3.6 were all less than 0.05. This implied that the reservations status data could be used to predict hotel industry performance results even if the R Squared values were low in all three samples for the analysis with meeting space less than 2,500 sq./ft.

Another thing that caught our attention was the fact that R Squared values for the analysis of VRP vs. STR with meeting space less than 2,500 seemed to be lower than the analysis of VRP vs. STR with no meeting space.

Sample 1 - VRP vs. STR data with Meeting Space > 2,500 sq./ft.

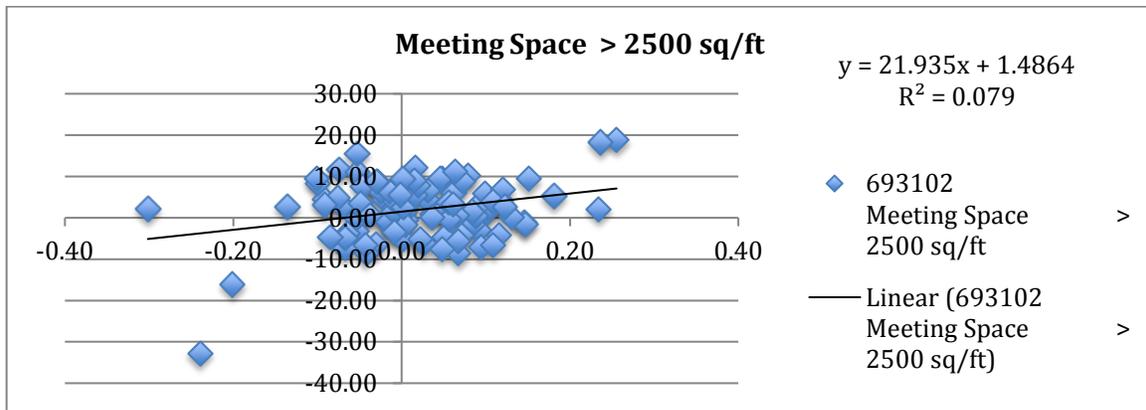


Figure 4.1 - VRP vs. STR data Scatterplots/trend line with meeting Space > 2,500 sq./ft. (1st Sample)

Linear Regression							
Regression Statistics							
R	0.28						
R Square	0.08						
Adjusted R Square	0.07						
S	6.63						
Total number of observatio	105.00						
1.24 = 1.5056 + 22.1896 * 0.09975483359513776							
ANOVA							
	<i>d.f.</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p-level</i>		
Regression	1.00	395.04	395.04	8.98	0.00		
Residual	103.00	4,530.87	43.99				
Total	104.00	4,925.92					
	<i>Coefficients</i>	<i>Standard Error</i>	<i>LCL</i>	<i>UCL</i>	<i>t Stat</i>	<i>p-level</i>	<i>H0 (5%) rejected?</i>
Intercept	1.51	0.66	0.20	2.81	2.29	0.02	Yes
0.09975483359513776	22.19	7.40	7.50	36.87	3.00	0.00	Yes
T (5%)	1.98						
<i>LCL - Lower value of a reliable interval (LCL)</i>							
<i>UCL - Upper value of a reliable interval (UCL)</i>							

Figure 4.2 - Screen shot for linear regression analysis between VRP vs. STR data With meeting space > 2,500 sq./ft. (1st Sample)

Sample 2 - VRP vs. STR data with Meeting Space > 2,500 sq./ft.

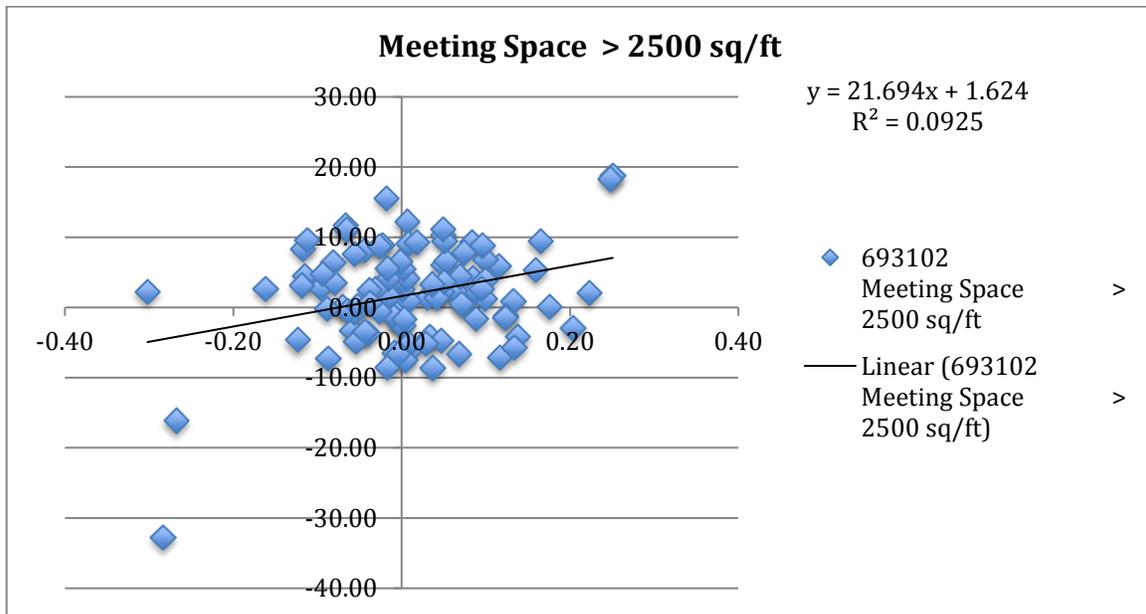


Figure 4.3 - VRP vs. STR data Scatterplots/trend line with meeting Space > 2,500 sq./ft. (2nd Sample)

Linear Regression							
Regression Statistics							
R	0.31						
R Square	0.09						
Adjusted R Square	0.08						
S	6.58						
Total number of observations	105.00						
$1.24 = 1.6458 + 21.9302 * 0.09909330213512724$							
ANOVA							
	d.f.	SS	MS	F	p-level		
Regression	1.00	461.92	461.92	10.66	0.00		
Residual	103.00	4,464.00	43.34				
Total	104.00	4,925.92					
	Coefficients	Standard Error	LCL	UCL	t Stat	p-level	H0 (5%) rejected?
Intercept	1.65	0.65	0.37	2.93	2.55	0.01	Yes
0.09909330213512724	21.93	6.72	8.61	35.25	3.26	0.00	Yes
T (5%)	1.98						
LCL - Lower value of a reliable interval (LCL)							
UCL - Upper value of a reliable interval (UCL)							

Figure 4.4 - Screen shot for linear regression analysis between VRP vs. STR data With meeting space > 2,500 sq./ft. (2nd Sample)

Sample 3 - VRP vs. STR data with Meeting Space > 2,500 sq./ft.

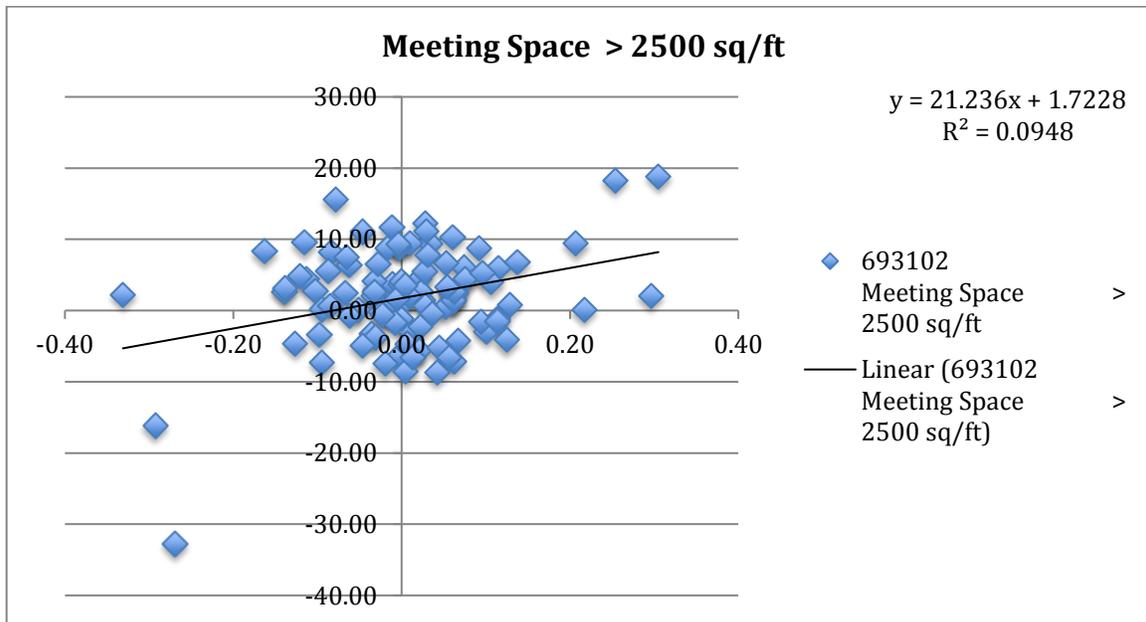


Figure 4.5 - Screen shot of VRP vs. STR data Scatterplots/trend line with meeting Space > 2,500 sq./ft. (3rd Sample)

Linear Regression							
Regression Statistics							
R	0.31						
R Square	0.10						
Adjusted R Square	0.09						
S	6.58						
Total number of observations	105.00						
1.241589958362177 = 1.7393 + 21.3325 * 0.06142146826557476							
ANOVA							
	<i>d.f.</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p-level</i>		
Regression	1.00	469.82	469.82	10.86	0.00		
Residual	103.00	4,455.16	43.25				
Total	104.00	4,924.97					
	<i>Coefficients</i>	<i>Standard Error</i>	<i>LCL</i>	<i>UCL</i>	<i>t Stat</i>	<i>p-level</i>	<i>H0 (5%) rejected?</i>
Intercept	1.74	0.64	0.46	3.01	2.71	0.01	Yes
0.06142146826557476	21.33	6.47	8.50	34.17	3.30	0.00	Yes
T (5%)	1.98						
<i>LCL - Lower value of a reliable interval (LCL)</i>							
<i>UCL - Upper value of a reliable interval (UCL)</i>							

Figure 4.6 - Screen shot for linear regression analysis between VRP vs. STR data With meeting space > 2,500 sq./ft. (3rd Sample)

**Findings for Comparison of VRP vs. STR
With Meeting Space > 2,500 sq./ft.**

R Squared values regressing data in the three observations samples against the performance of STR properties having greater than 2,500 sq.ft. of meeting space produced the lowest R-square results, though still statistically significant at the .05 level. In Figure 4.1 and 4.2, the R Squared value was .08; in Figure 4.3 and 4.4, the R Squared value was .09; in Figure 2.5 and 2.6, R Squared value was .10. Consequently, results indicated that the VRP reservations status data could be used to predict hotel industry performance results of properties having greater than 2,500 sq./ft. of meeting space.

Conclusion

This study attempted to determine if local VRP property reservations data publically available on the Internet could be used to predict the occupancy rate of hotels located in the coastal sections of Horry and Georgetown counties, South Carolina. The research indicated that the percentage of VRP units booked can be a predictor of demand for the nightly-rented hotel properties, particularly when those properties have limited convention space. The level of VRP reservations seemed to account for more of the variance in occupancy for properties with less meeting space than for properties with more meeting space. So, it may be that the level of reservations for the weekly-rented vacation properties may be indicative of the demand for the destination area, whereas convention properties seem to be able to drive more of their own demand separately from the demand for the resort destination area.

References

Anuradha Gupta (2015). Predictive Modeling of Athletic Footwear Sales using Trend Analysis. Retrieved April 12, 2015, from

<http://ojs.cnr.ncsu.edu/index.php/JTATM/article/view/7535>

Julia, Y. (n.d.). Overview of Forecasting. Retrieved March 5, 2015, from

<http://scholar.lib.vt.edu/theses/available/etd-02072001-164547/unrestricted/03chapttwo.pdf>

Robert Nau (n.d.). Notes on Linear Regression Analysis. Retrieved April 15, 2015, from http://people.duke.edu/~rnau/notes_on_linear_regression--robert_nau.pdf

Stevenson, W. J. (2012). Operation Manangement. Rochester Institute of Technology. ISBN:0073525251

Vera Shanshan Lin (2013). Improving Forecasting Accuracy by Combining Statistical and Judgmental Forecasts in Tourism. *Journal of China Tourism Research*, 9: 325-352, 2013. Doi: 10.1080/19388160.2013.812901

Vincent Cho, A comparison of three different approaches to tourist arrival forecasting, *Tourism Management*, Volume 24, Issue 3, June 2003, Pages 323-330, ISSN 0261-5177, [http://dx.doi.org/10.1016/S0261-5177\(02\)00068-7](http://dx.doi.org/10.1016/S0261-5177(02)00068-7).
(<http://www.sciencedirect.com/science/article/pii/S0261517702000687>)

Wan Ahmad, W. A., & Ahmad, S. (2013). Arima model and exponential smoothing method: A comparison. *AIP Conference Proceedings*, 1522(1), 1312-1321. doi:10.1063/1.4801282

Watchlist Concepts for Business and Management – Getting Started

Harry Katzan, Jr.
Webster University
U.S.A.

Abstract

A *watchlist* is generally regarded as a database the government uses to track terrorists. While that is partially true, there is clearly more to it. Otherwise, all of the terrorists would be easily rounded up and the world would be free of the immense security problems that we now face. It follows that if the methodology were genuinely effective, then the inherent techniques could perhaps be used for marketing and other business and societal concerns. Although the methods developed thus far by government agencies are indeed impressive, they necessarily have to be updated as the underlying problems mature. Many subjects need to be analyzed and solutions implemented. The problem domain must be precisely defined and related considerations delineated. To start, a few basic questions need to be answered concerning where society is essentially going with the notion of watch listing and whether or not the concepts of listing are applicable to other areas of business, government, and education. This paper gives an introduction to this very important topic.

KEYWORDS: Watchlist, terrorism criteria, watchlist database, terrorist attributes.

Introduction

Watchlist management is customarily associated with terrorism and firearms control, but the inherent methodology is applicable to a wide variety of business and management situations. Operational procedures for federal and local facilities are commonly designed to facilitate the identification and apprehension of persons of interest. Modern government at all levels is exceedingly complex, and the protocol for Watchlist screening mirrors that complexity. This paper covers the structure and operation of the Watchlist screening process with an emphasis on terrorism and management control. The primary objective is to identify persons of interest, leaving incident handling and social issues to subsequent papers. There are benefits to employers from watchlist screening because background checks historically fail to expose the complicated psychological picture of an employee, and subsequent updates from watchlist systems can provide an additional level of control.

Most managers are familiar with the process of background checks for determining the eligibility of an individual for the acquisition of firearms from a licensed gun dealer. The National Instant Criminal Background Check System (NICS) is commonly used for this purpose. The 2009 Fort Hood shooting and the 2013 Boston Marathon bombing generated renewed interest in terrorist watchlist screening. The alleged perpetrators were possibly entered in the National Counterterrorism Center's (NCTC's) Terrorist Identities Datamart Environment (TIDE), and consequently watchlisted in the FBI-led Terrorist Screening Center's Terrorist Screening Database. (Krause, 2013) In the latter case, the Russian Federal Security Service (FSB, which stands for Federal'naya Sluzba Bbezopasnost) notified the FBI and the CIA that one of the terrorists had possibly become an Islamic extremist and subsequently relevant information had been entered into the Department of Homeland Security's TECS (Treasury Enforcement Communications System) and the National Counterterrorism's TIDE system. However, because of the complexity of terrorist databases and the technicalities of information quality, none of the intelligence agencies was alerted.

In the United States, there are several databases related to terrorist activities and more than a few federal agencies and departments in the intelligence community that include: the Office of the Director of National Intelligence (ODNI); Central Intelligence Agency (CIA); the National Security Agency (NSA); the Defense Intelligence Agency (DIA); the National Geospatial-Intelligence Agency (NGA); the National Reconnaissance Office (NRO); the other DOD offices that specialize in national intelligence through reconnaissance programs; the intelligence components of the Army, Navy, Air Force, and Marine Corps; the FBI; the Drug Enforcement Agency (DEA); the Department of Energy; the Coast Guard; the Bureau of Intelligence and Research (INR) at the Department of State (DOS); the Office of Intelligence and Analysis at the Department of the Treasury; and elements of the Department of Homeland Security (DHS) that are concerned with the analyses of foreign information. It would seem clear at this point that the maintenance and use of terrorist watchlists is a major undertaking. (Krause, *op cit*, p.9)

Organization and Operation of the Watchlist System

In order to have a collection of files and databases that store the information that constitutes the watchlist system, it is necessary to have sophisticated groups of individuals that build, maintain, and use the data. A terrorist database can be managed by an established department from within the intelligence community. For example, the government contains an FBI-led Terrorist Screening Center (TSC) that runs its Terrorist Screening Database (TSDB). This makes good sense because the FBI does the terrorist screening for both international and domestic terrorists. In other cases, such as the Terrorist Identities Datamart Environment (TIDE), the maintenance is achieved by a special organization that in this instance is the National Counterterrorism Center (NCTC). The TIDE and TSDB are typical but not the only conceivable watchlist databases.

The various groups within the intelligence community forward watchlist nominations on to the NCTC for inclusion in the TIDE database and possibly to the TSDB database for screening. Alternately, entries are entered directly into TSDB. In actual practice, less than 2% of TIDE entries are domestic. The remaining entries are from international sources. The criteria for an entry into the TIDE database are based on a candidate's conduct in a variety of areas, such as the following:

- Performs international terrorist activity
- Plans international terrorist activity
- Gathers information concerning potential targets for terrorist activity
- Collects funds to support terrorist activity
- Offers membership in terrorist organizations
- Supports terrorist activity – such as housing or transportation
- Is a member of a terrorist group

Supporting agencies generally adhere to their own criteria for nomination to a watchlist. This has been a topic of intense discussion.

It is not entirely clear how entries are made into a watchlist database, and some sources are more reliable than others. An individual usually does not know if he or she is in a terrorist database until their name appears on a No-Fly list. It is almost impossible to have it removed, once it is discovered, and the source of the nomination cannot be determined in most cases. (American Civil Liberties Union, 2014) For example, Ted Kennedy, former U.S. Senator from Massachusetts, was frequently placed on a No-Fly list, as was a 8-year old Cub Scout. (Terror, nd) In spite of the inherent difficulties of terrorist watchlists, the U.S. government has had extremely good results with terrorism research, as evidenced by the quote by G. Weimann:

The threat posed by Cyberterrorism has grabbed headlines and the attention of politicians, security experts, and the public. But just how real is the threat? Could terrorists cripple critical military, financial, and service computer systems? ... Many of these fears, the report contends, are exaggerated: not a single case of terrorism has been recorded, hackers are regularly mistaken for terrorists, and cyberdefenses are more robust than is commonly supposed. (Weimann, 2004)

Watchlist Process

The basic objective of this paper is to describe the watchlist process, since it applies to employee management. As covered in the next section, the idea is that real-time updates on employees could be useful in some areas of U.S. business. Whether it applies to outsourcing is another question. The subject of this section is to present a generic description of a watchlist process. Clearly, there could be other ways of instantiating the process.

There are numerous definitions of terrorism and terrorists. The important aspects of a suitable definition would be that it is related to the following attributes or activities: coerce a civilian population, influence the effectiveness of a government policy, threaten national security, or to influence the execution of one of the stated activities. Further, an individual that is so engaged is identified by or through an intelligence agency. Associated with that individual is relevant personal identifiable information (PII), which is an enormous problem in its own right. The terrorist identifiers are the identity elements that enable a watch list to be effective. The originating agency is known as the originator of the known or suspected terrorist. There is wide range of behaviors that can be classed as terrorist in nature at varying degrees of severity.

The originator thereby nominates an individual for inclusion in a watchlist database and probably only a nomination is needed to get on a preliminary watch list. In a typical scenario, the NCTC, mentioned above, might be a receiving group. Next an analytic process – for lack of a better word – takes place and information is collected and consolidated. When necessary, screening takes place, followed by appropriate action, as required.

Unfortunately, there are lots of people who are jealous, or something else, of their neighbors. There is a story floating around of some guy who removed the back seat of his car. A nosy neighbor figured he was going to use the car to transport a bomb and notified a government agency. As it turns out, the car owner was just putting in new seats. Anyone who has taken a taxi to the airport in a major city has had to listen to the ranting and raving of a taxi driver, so it is easy to imagine how much work is involved with Watchlisting.

Watchlisting for Business and Management

There have been several cases where an employee has checked out OK during pre-employment screening, but later turned out to be a terrorist. There have been several civilian instances of this situation, but the major one is the Fort Hood shooting, where a Major in the Army, who was an Army psychiatrist, killed several soldiers. At some point during his enlistment, he was in contact with a terrorist organization that influenced his behavior.

The FBI has proposed or made a service whereby personnel in certain areas are placed on appropriate watch lists with the facility to obtain necessary feedback. This is an interesting topic for the future in modern management.

Summary

Watchlist management is customarily associated with terrorism and firearms control, but the inherent methodology is

applicable to a wide variety of business and management situations. Operational procedures for federal and local facilities are commonly designed to facilitate the identification and apprehension of persons of interest. Modern government at all levels is exceedingly complex and the protocol for Watchlist screening mirrors that complexity. There are benefits to employers from watchlist screening because background checks historically fail to expose the complicated psychological picture of an employee, and subsequent updates from watchlist systems can provide an additional level of control.

Most managers are familiar with the process of background checks for determining the eligibility of an individual for the acquisition of firearms from a licensed gun dealer. The National Instant Criminal Background Check System (NICS) is commonly used for this purpose. In the United States, there are several databases related to terrorist activities and more than a few federal agencies and departments in the intelligence community that include: the Office of the Director of National Intelligence (ODNI); Central Intelligence Agency (CIA); the National Security Agency (NSA); the Defense Intelligence Agency (DIA); the National Geospatial-Intelligence Agency (NGA); the National Reconnaissance Office (NRO); the other DOD offices that specialize in national intelligence through reconnaissance programs; the intelligence components of the Army, Navy, Air Force, and Marine Corps; the FBI; the Drug Enforcement Agency (DEA); the Department of Energy; the Coast Guard; the Bureau of Intelligence and Research (INR) at the Department of State (DOS); the Office of Intelligence and Analysis at the Department of the Treasury; and elements of the Department of Homeland Security (DHS) that are concerned with the analyses of foreign information.

In order to have a collection of files and databases that store the information that constitutes the watchlist system, it is necessary to have sophisticated groups of individuals that build, maintain, and use the data. A terrorist database can be managed by an established department from within the intelligence community. For example, the government contains an FBI-led Terrorist Screening Center (TSC) that runs its Terrorist Screening Database (TSDB). This makes good sense because the FBI does the terrorist screening for both international and domestic terrorists. In other cases, such as the Terrorist Identities Datamart Environment (TIDE), the maintenance is achieved by a special organization that in this instance is the National Counterterrorism Center (NCTC). The TIDE and TSDB are typical but not the only conceivable watchlist databases. The criteria for an entry into the TIDE database are based on a candidate's conduct in a variety of areas, such as the following:

- Performs international terrorist activity
- Plans international terrorist activity
- Gathers information concerning potential targets for terrorist activity
- Collects funds to support terrorist activity
- Offers membership in terrorist organizations
- Supports terrorist activity – such as housing or transportation
- Is a member of a terrorist group

Supporting agencies generally adhere to their own criteria for nomination to a watchlist.

There are numerous definitions of terrorism and terrorists. The important aspects of a suitable definition would be that it is related to the following attributes or activities: coerce a civilian population, influence the effectiveness of a government policy, threaten national security, or to influence the execution of one of the stated activities. Further, an individual that is so engaged is identified by or through an intelligence agency. Associated with that individual is relevant personal identifiable information (PII), which is an enormous problem in its own right. The terrorist identifiers are the identity elements that enable a watch list to be effective. The originating agency is known as the originator of the known or suspected terrorist. There is wide range of behaviors that can be classed as terrorist in nature at varying degrees of severity.

There have been several cases where an employee has checked out OK during pre-employment screening, but later turned out to be a terrorist. The FBI has proposed or made a service whereby personnel in certain areas are placed on appropriate watch lists with the facility to obtain necessary feedback. This is an interesting topic for the future in modern management.

References and Additional Reading

- American Civil Liberties Union (2014). *U.S. Government Watchlisting: Unfair Process and Devastating Consequences*, March, 2014.
- Currier, C. and Hussain, M. (2017). “48 Questions the FBI Uses to Determine if Someone is s Likely Terrorist,” *The Intercept*, February 13, 2017.
- Kofman, A. (2017). “The FBI is Building a National Watchlist That Gives Companies Real-Time Updates on Employees,” *The Intercept*, February 4, 2017.
- Krause, W.J. (2013), *Terrorist Watch List Screening and Background Checks for Firearms*, Congressional Research Service, 7-5700, www.crs.gov, R42336, May 1, 2013.
- Larence, E. (2010). *FBI Has Enhanced Its Use of Information from Firearm and Explosives Background Checks to Support Counterterrorism Efforts*, Testimony Before the Senate Committee on Homeland Security and Government Affairs, U.S. Senate, May 5, 2010.
- Terror (nd). *The Terror Watch List Database’s Troubles Continue*, Case Study from Information Technology Infrastructure.
- Weimann, G. (2004). *Cyberterrorism: How Real is the Threat?* United States Institute of Peace, December, 2004.

Author Information

Professor Harry Katzan, Jr. is the author of books and papers on computer science, service science, and security. He teaches cybersecurity in the graduate program at Webster University.

Information and Communications Technology in Africa: Enabling Big Data, to Enable Development

Donna M. Schaeffer, PhD, Professor, Marymount University, Arlington VA
Donna.schaeffer@marymount.edu

Patrick C. Olson, PhD, Professor, National University, San Diego CA
polson@nu.edu

Abstract

In 2009, United Nations (UN) established The Global Pulse, an innovation lab where big data from around the globe is analyzed. The Global Pulse works with universities, corporations, and other UN programs including the World Health Organization, the United Nations Development Program, (UNDP), the World Food Program (WFP), The United Nations Children's Emergency Fund (UNICEF), and the Joint United Nations Programme on HIV/AIDS (UNAIDS).

To implement and reap the benefits of big data projects, there must be a robust Information and Communications Technology (ICT) infrastructure. This paper examines the infrastructure on the African continent, which is home to 34 of the world's least developed countries (LDCs) according to the United Nations (UN). Over the past few decades, there has been much investment in projects such as Africa One, an underseas fiber optic cable around the continent and those initiated by the Regional African Satellite Communication Organization (RASCO). These projects should provide the necessary infrastructure for countries in Africa to move forward in big data, and the existence of a solid infrastructure should mitigate the costs for countries, companies, or organizations to start big data projects.

In this paper, we examine the impact of ICT infrastructure projects on big data efforts in two African countries that are classified as "least developed." The findings can be used to compare ICT infrastructure readiness for big data projects in other areas of the world.

Introduction. The African Continent. Africa is the world's second largest continent, comprising 6% of the earth's total surface and 20% of its land

mass (Sayre, 1999). It is the second most populated continent with a population of 1.1 billion people in 2013 and accounts for 15% of the world's population (Gusmastad, 2015). The continent is the world's poorest and most undeveloped, although it is quite rich in natural resources. There are many social problems including malnutrition, illiteracy, inadequate water supply, and corrupt governments. The UN includes several African nations on its list of least developed countries. These countries are shown in Table 1.

Table 1. Least Developed Countries on the African Continent

(Source: One World – Nations Online Project, 2016)

Angola	Benin	Burkina Faso	Burundi
Cape Verde	Central Africa Republic	Chad	Comoros
Congo, Democratic Republic of	Djibouti	Equatorial Guinea	Eritrea
Ethiopia	Gambia	Guinea	Guinea Bissau
Lesotho	Liberia	Madagascar	Malawi
Mali	Mauritania	Mozambique	Niger
Rwanda	Sao Tome and Principe	Senegal	Sierra Leone

Somalia	Sudan	Tanzania	Togo
Uganda	Zambia		

Global Big Data Initiatives.

The Global Pulse Initiative. The Global Pulse Initiative got its start following the global financial crisis of 2007 – 2008 when policy makers recognized the need to make decisions using real-time data from all around the world. In 2009, His Excellency Ban Ki-Moon, then Secretary General of the United Nations (UN), announced the Global Pulse Initiative. This is a network of innovation labs with the headquarters in New York, NY. At present, there are labs Jakarta, Indonesia and Kampala, Uganda. The Global Pulse Initiative has two goals: to be an innovation driver and to be an ecosystem catalyst. The Global Pulse has partnered with universities, corporations, and other UN programs including the World Health Organization (WHO), the United Nations Development Program, (UNDP), the World Food Program (WFP), The United Nations Children's Emergency Fund (UNICEF), and the Joint United Nations Programme on HIV/AIDS (UNAIDS).

Global Pulse projects demonstrate that big data can lead to sustainable development. In Africa, a project used speech recognition technology and translation tools to turn radio content into text as a means of discovering

topics of interest to Ugandan citizens who call into community-based radio talk shows (Global Pulse, 2016). Another project used data visualization and interactive mapping to track outbreaks of malaria, typhoid, and dysentery in the region.

Multinational Corporations. Based on revenues from big-data related hardware, software, and services, ten multinational corporations were identified: Accenture, Dell, HP, IBM, Oracle, Palantir, PwC, SAP, SAS Institute, and Teradata ((Information Management, 2016). PwC has an office in Uganda. All of these companies have initiated global big data projects.

Information and Communications Technology Infrastructure in the Least Developed Countries in Africa. For this research, we selected two LDCs on the African continent: Somalia and Uganda. Somalia is selected because it has the longest coastline on the African continent. As we will explain later, coastal access is important in Information and Communications Technology (ICT) infrastructure. Uganda is selected because it is the site of one of three UN Global Pulse Labs in the world. The Global Pulse Lab opened in Kampala, Uganda in 2015.

Open Data for Africa Project. The African Development Bank Group (AfDB) established the Open Data for Africa project in 2013. The group recognized the importance of reliable and timely data in decision making

and policy development, as well as for measuring the effectiveness of programs and projects. AfDB researchers produce statistical data on the economic and social situations of each country on the continent and also collaborate with global partners to provide background information on the progress towards achieving the UN's Millennium Development Goals (MDGs) and Poverty Reduction Strategies (PRSs). In addition to the UN, it has worked with international agencies including the International Monetary Fund (IMF), The Organization for Economic Co-operation and Development (OECD), and the World Bank.

ICT Needs. Important characteristics of big data include volume, velocity, variety, and veracity. These characteristics mean that the ICT infrastructure must be robust. Volume refers to the size of the data set which can often be terabit. Velocity refers to the speed that the data can be moved. For example, transferring a terabyte file on a local area network from the late 1980s would take 256 hours. Even today on a one gigabit network it would take 2 hours. Variety refers to what data is collected about and details about that data. For example, is it text, pictures, or video. Veracity refers to the amount the data can be relied upon. For example, it is correct. See Schaeffer and Olson (2014) for further discussion.

Volume. There is a significant volume of data available for both Somalia and Uganda through the Open Data for Africa Project. Open data for Somalia includes data on agriculture, demographics, economics, education, energy, health, healthcare, and international trade. Data is presented in tabular and graphic formats. The data is available for the whole country, as well as for its regions. Some data is current as of 2015.

Open data for Uganda includes data on agriculture, commodities, crime, demographics, economics, education, electricity, energy, the environment, food security, health, international trade, labor, and tourism. The data is presented in tabular and graphic form, and much of the data is current to 2015.

Velocity. In terms of velocity, Somalia has an average upload speed of 1.1 Mbps and an average download speed of 1.0 Mbps (Testmy.net, 2016). In 2014, fiber optic services were launched (British Broadcasting Network, 2014). The fiber optic cables run through Kenya, where they are connected to one of four underseas cables.

Uganda has an average download speed of 1.4 Mbps and an average upload speed of 1.4 Mbps (Testmy.net, 2016). In 2015, Google launched its first city-wide wi-fi network in Kampala, the nation's capital (British Broadcasting Network, 2015).

Variety. In addition to numerical data, big data projects use a variety of data, including sounds and images. A project in Somalia used satellite imagery to geolocate shelters. This provided good estimates of how many displaced people there are and how they are moving for international humanitarian aid efforts (Meier, 2011). In Uganda, cameras on drones and balloons took pictures of roofs. Since most people upgrade thatched roofs to metal roofs as soon as they can afford to, the data from the pictures helped indicate poverty levels (Global Pulse, 2014).

Veracity. Veracity means the integrity and accuracy of the data. Researchers have recognized veracity as a key challenge to working with big data in the least developed and developing countries. See Meier (2015), Moorthy et al (2015), and Sandovik et al (2014) for further discussion.

A Taxonomy of Big Data Projects in the Least Developed Countries of Africa

Country	Volume	Velocity	Variety	Veracity
Somalia	Yes	Average download speed: 1.1 Mbps Average upload speed:	Yes	Yes

		1.0 Mbps 2.0		
Uganda	Yes	Average download speed: 1.4 Mbps Average upload speed: 1.4 Mbps	Yes	Yes

Conclusion: ICT infrastructure Readiness for Big Data Projects. Using the analysis from Schaeffer et al (2014) it appears that the network infrastructure is likely to impact the utility of Big Data projects in Africa. While it appears that most big data initiatives in LDCs are humanitarian in nature, the casual description of these projects shows that it is reasonable to assume these will be very large data sets. They will have large volume. This is particularly true for pictures and video. The network speeds available mean that transferring data sets could take an order of magnitude longer than they would have on 1980s vintage local area networks. If the Big Data needs are not time sensitive this limitation is easily overcome by simply transporting the data on USB drives, however, it is likely that Big Data Systems used for health or even weather prediction are likely to be time sensitive.

References:

British Broadcasting Company (2014, 10 April). "Somalia in high speed internet 'culture shock.'" Retrieved 20 December, 2016:

<http://www.bbc.com/news/world-africa-26973587>

British Broadcasting Company (2015, 04 December). "Google launches wi-fi network in Kampala, Uganda." Retrieved 20 December, 2016:

<http://www.bbc.com/news/technology-35000544>

Global Pulse (2014). "Measuring Poverty with Machine Roof Counting." Retrieved 22 December 2016:

<http://www.unglobalpulse.org/projects/measuring-poverty-machine-roof-counting>

Global Pulse (2015). "Data Visualisation and Interactive Mapping to Support Response to Disease Outbreak", Global Pulse Project Series no. 20, 2015.

Global Pulse (2016). Public Radio Content Analysis Tool. Retrieved 21 December 2016:

<http://unglobalpulse.org/sites/default/files/Radio%20Content%20Analysis%20Tool%202-page%20brief%20May%202016.pdf>

Gudmastad, Ericha (2013). "2013 World Population Data Sheet."

Population Reference Bureau. Retrieved 18 August 2015:

<http://www.prb.org/publications/datasheets/2013/2013-world-population-data-sheet.aspx>

Information Management (2016). "Top Ten Big Data Companies."

Retrieved 19 December, 2016: <http://www.information-management.com/gallery/nov-top-reader-pick-top-10-big-data-companies-10026248-1.html>

Meier, Patrick (2011, 01 November). Crowdsourcing Satellite Imagery Tagging to Support UNHCR in Somalia. Retrieved 22 December 2016:

<https://irevolutions.org/2011/11/01/crowdsourcing-unhcr-somalia/>

Meier, Patrick. *Digital humanitarians: how big data is changing the face of humanitarian response*. Crc Press, 2015.

Moorthy, J., Lahiri, R., Biswas, N., Sanyal, D., Ranjan, J., Nanath, K., & Ghosh, P. (2015). Big data: prospects and challenges. *J. Decis. Makers*, 40, 74-96.

One World – Nations Online Project. (2016). Least Developed Countries. Retrieved 30 November, 2016:
http://www.nationsonline.org/oneworld/least_developed_countries.htm

Sandvik, K. B., Jumbert, M. G., Karlsrud, J., & Kaufmann, M. (2014). Humanitarian technology: a critical research agenda. *International Review of the Red Cross*, 96(893), 219-242.

Sayre, April Pulley (1999), *Africa*, Twenty-First Century Books.

Schaeffer, Donna M. and Olson, Patrick C. “Big Data Options For Small And Medium Enterprises,” *Review of Business Information Systems*, Volume 18, Number 1, June 2014.

Testmy.net (2016). Retrieved 20 December 2016: <http://Testmy.net>

LOW COST PRIVATE CLOUD

Dennis Baker
Georgia Southern University
P.O. Box 7999
Statesboro, GA 30460

Christopher Kadlec
Georgia Southern University
P.O. Box 8150
Statesboro, GA 30460

Brandon Kimmons
Georgia Southern University
P.O. Box 8150
Statesboro, GA 30460

ABSTRACT

Advances in private cloud computing technologies are changing how educational institutions approach IT [1], but the cost of private clouds put the technology out of reach of many smaller schools [2], primarily technical schools and K-12. This project aims to reduce the cost to smaller schools by recycling outdated university equipment into a low cost private cloud based on Microsoft technologies. The design of the infrastructure is described and possible uses of the technology are examined, including infrastructure and platform as a service models.

INTRODUCTION

In the fall of 2015, work completed on the Eagle TALONs (Taking Advantage of Low-cost Operational Nodes) project. That project researched the feasibility of using reclaimed computer equipment from computer labs and repurposing them as a rack-mounted research architecture. Eagle TALONs delivered a hardware design engineered for research workloads at the university. This project builds on the TALONs concept by designing a Microsoft System Center/Azure based private cloud capable of running on a reclaimed hardware infrastructure with the goal of delivering a solution that can be used as a computer lab platform for information technology courses.

The motivation behind the project derives from this researcher's Microsoft training at a technical college. Part of that training involved building virtual machines to simulate a network operating system environment based on Microsoft Active Directory. While the early part of the training involved installing and configuring the Windows operating system on bare metal hardware, the later courses focus on building a network operating system and not installing Windows. However, in order to work with that network operating system, the researcher, as a student, had to install Windows on all of the virtual machines needed. While it was good practice/review, it took away from what the class should have been learning in the course. That fact leaves the instructor with this conundrum: how do you provide students with the base operating systems they need without taking away from outcome focused instructional/lab time?

There are a few possible solutions to this problem. The first consists of the instructor pre-configuring virtual machines and then distributing them to, and setting them up on, their lab hardware. This solution requires the instructor to visit each lab machine and perform the necessary configuration, but preserves instruction time at the cost of the instructor's. The second involves the instructor configuring virtual machines and having the students perform the necessary configuration on each of the lab machines. This shifts some the configuration burden to the students, preserving the instructor's time, but likely involves the consumption of instructional time. The final solution, the one the researcher experienced, is devote instructional time to allow the students to build the configuration from bare metal. This approach places all of the configuration burden on the student, which could introduce anomalies in the configurations based on student errors that could require troubleshooting by the instructor.

Each of these solutions ultimately work to get the needed resources to the student, but it has its inherent short comings. The primary issue is the fact that their work is tied to a single workstation. A student can only work on assignments when the workstation is available. So if the building is closed, another class is being taught in the lab, or another student whose work is on that computer is using the resource, work cannot be completed. As a semester nears completion, the issue of sharing the single resource can become contentious.

That same issue drives some of the shortcomings these solutions provide to the instructor as well. In order for the instructor to grade assignments or help resolve issues, the instructor must be physically present in the lab, possibly at the same time as the student, potentially adding to the students' frustration. Additionally, the solutions are time consuming to setup. Because of that, there is little time to refine the materials being used

because so much time is being devoted to setting up the materials. The setup needs to be repeated each time the course is taught. Finally, the setup is nearly impossible to share with other instructors and institutions.

PRIVATE CLOUDS

This project offers a private cloud as a solution to each of these issues. In this scenario, the instructor could pre-configure an application on the cloud that includes all of the resources (virtual machines, networks, storage, etc.) that each student needs in a tenant, a sort of virtual sandbox, allowing one student's work to co-exist on the same server hardware with another student's without interference. Once configured, an application could be deployed to each student's tenant, each semester. The student would use the resources while in the class, at the end of which it would be deleted and redeployed to the next student in a clean state. These applications could also be presented in a gallery, giving students access to any resources they may need for any class, and the entire cloud could be made available to any Internet connected computer. This solution allows the instructor(s) to configure their environment only once and either deploy it to students if they desire or let the students self-provision the resources from the gallery. In addition, the resources could be made available to other instructors at the institution.

The cost of such a solution poses a barrier to entry for many schools however. To estimate the cost consider Microsoft's "Test Lab Guide: Windows Server 2012 R2 Base Configuration" [3] document. The Test Lab Guide (TLG) describes building a lab network, consisting of 5 virtual machines, similar to what at course at a technical school may build for a lab. If we assume 1GB of RAM, a processor core, and 25GB of storage per virtual machine for 30 students, the aggregate total of the hardware would be 150 processor cores, 150GB of RAM and 3,750GB of storage. According to Dell's website, one PowerEdge R430 server configured with two, eight core processors (16 cores total), 96 gigabytes of memory, and 3 terabytes of storage is about \$5,000 (this configurations assumes that the virtual machines will share processor cores). Two of these servers would meet, and slightly exceed, the required capacity at a price of \$10,000. That price does not include the required network equipment, datacenter equipment (racks, power, etc.) software licensing, and engineering expertise required to build a private cloud.

The introduction of reclaimed hardware shifts the balance. The TALONs project used computers with dual core processors, 8GB of RAM, and a 250GB hard disk in their design. If similar hardware were applied to this solution, assuming the virtual machines shared processor cores, all of the required hardware could be provided by 19 reclaimed computers at no additional cost. Nineteen computers alone do not constitute a private cloud though. For this to be a viable solution, an infrastructure for managing the physical computers and the virtual assets, and an interface for instructors and students to access and manage resource are required. This project delivers a basic private cloud infrastructure capable of running on as little physical hardware as possible. The infrastructure is delivered as a set of virtual machines that can be hosted on Microsoft Hyper-V.

METHOD

At its essence, a cloud, whether a public cloud like Microsoft Azure or private like the one in this project, is space where a user can create or store digital stuff. That stuff can be a bunch of cat photos stored in a cloud drive, a web API that backs a mobile application, or an entire datacenter for an organization. The stuff of this project is virtual machines for a class lab. In its most basic sense, the design is being presented as an infrastructure as a service (IaaS) model. In an IaaS model, the underlying cloud provides the necessary network, compute (processor and memory), and storage necessary to support the virtual machines. The instructors then create the virtual machines that run on the infrastructure. In reality, the cloud can also be used to support a platform as a service (PaaS) model as well. Under this model, another layer is created that presents a given platform (database server or web server for example) and the users interact with those services. While the presentation of the infrastructure is geared toward hosting virtual machines (you could look at them as the platform in this case), the virtual machines could easily be replaced by, or run in conjunction with, another service if the school desired to do so.

The design of the private cloud is partitioned into two sections, the management nodes and the compute nodes. The management nodes host the components necessary to run the private cloud interfaces and management components. These nodes represent the bulk of this project and are described in detail below.

The compute nodes host the work that is being carried out in the cloud, in this case the virtual machines being used for the labs.

All of the student workload is separated into tenants, one for each student. A tenant is defined in the private cloud interface, but the work being done in the tenant is carried out on the compute nodes. The tenant represents an administrative and security boundary within the cloud. Any resources defined in a tenant, in our case a virtual machine or network, is the responsibility of the tenant owner (the student). Access to the resources can be granted to another user, the instructor for grading or another student for group work for example, but this has to be done by the tenant owner. In general, the network defined for this project is separate from that within the tenant. This is important to note because some of the services in the infrastructure could affect the tenant, but the boundaries do not allow this to happen. A good example of this is the Dynamic Host Configuration Protocol (DHCP) described later. It assigns network addresses to the computers on the management network but not the virtual machines within a tenant.

From this point forward, the term infrastructure will be used to represent the management nodes. The compute nodes will be mentioned when relevant, but for reasons discussed later, they represent a fairly marginal portion of the overall project.

The design of the infrastructure consists of four layers: software, virtual machines, physical hardware, and network. They are presented here in a top down fashion in that order, with software at the top and network at the bottom, because the decisions made in one layer drive decisions made at the layer beneath it. For example, it is impossible to know what virtual hardware you need until you know what the software will require.

Software

The top most layer of the infrastructure is the software. All of the software, for this project is from Microsoft. Certainly Microsoft isn't the only vendor providing private cloud software, but in this case Microsoft provides a couple of advantages that make it a clear choice. The first is organizational fit. Using Ogeechee Technical College as a model, their IT courses are centered on Microsoft technologies. It makes sense then to use a platform that the instructors are already familiar with. The second is price. Microsoft provides DreamSpark licensing for education which allows for free use of the software for education purposes. All of the software used in this project is either licensed under the DreamSpark licensing or is available free-of-charge from Microsoft via their website.

At the core of the entire infrastructure is a network operating system centered on Windows Server 2012 R2. Windows Server 2012 R2 provides a number of distinct roles that can be installed as needed to build a network. Table 1 describes all of the roles used in this project and what the service provides to the infrastructure.

Table 1: Windows roles used in the infrastructure and descriptions of each role.

Role Name	Description
Active Directory Domain Services (ADDS)	Microsoft's authorization and authentication platform. It is used to manage all administrator accounts, service accounts, and computer accounts.
Domain Naming System (DNS)	Provides hostname resolution to all of the infrastructure virtual machines, management nodes, and compute nodes.
Dynamic Host Configuration Protocol (DHCP)	Provides IP address configuration to all of the infrastructure virtual machines, management nodes, and compute nodes.
Hyper-V	Microsoft's native hypervisor platform. It is installed on each of the physical computers and used to host the virtual machines on all of the management and compute nodes.
Routing and Remote Access Service (RRAS)	Windows built-in network routing platform. It is used to provide network address translation between the infrastructure and the outside network. Its use is described in the Network section below.
Windows Server Update Service (WSUS)	Used to distribute Windows updates to all of the infrastructure virtual machines, management nodes, and compute nodes.

The private cloud itself is broken into two parts, the management software and the interfaces. The management software is System Center Virtual Machine Manager (SCVMM) 2012 R2. This software manages the clouds, virtual machines, software defined networks, tenants and all of the Hyper-V host

servers. SCVMM also host a library of resources used to build the virtual machines. The library includes items like operating system and software disk images and virtual hard disk files. The interfaces are provided by Windows Azure Pack (WAP). Windows Azure is Microsoft's cloud service, providing a number of IaaS and PaaS offerings. The Windows Azure Pack is a downloadable free component that allows customers to install the Windows Azure Portal experience in their own private clouds. This platform provides a number of key components for this project described in Table 2 [4]:

Table 2 WAP roles and descriptions

Component Name	Function in Infrastructure
Management portal for tenants	Allows students to create user accounts and consume cloud resources from a gallery.
Management portal for administrators	Allows instructors to grant students' rights to access cloud resources, manage user accounts for the students, and gallery content.
Web-sites	If configured, allows students to create ASP.NET, PHP, and Node.js websites on the cloud.
Virtual Machines	If configured, allows students to create Windows and Linux virtual machines and networks.
Database as a Service	If configured, allows students to create SQL Server and MySQL databases on the cloud.
Service bus foundation	Allows for communication between the portals and the backend services required to host the cloud resources

The final component is Microsoft SQL Server 2012. In total, the environment requires 11 separate databases to function. One of the databases is for SCVMM, one is for WSUS, and the remaining 9 support the WAP and its service foundation. This version of SQL Server is a supported version of SQL Server common to all of the components so it was selected. For the most part, the SQL databases are managed by their respective applications and require little management by an administrator.

Virtual Machines

The virtual machines hosted on the management nodes of the infrastructure are the primary deliverable of this project. The idea is that they can be imported onto any physical hardware with the necessary capacity, started, and configured. The infrastructure consists of a total of five virtual machines, two domain controllers (DC) for ADDS, one SQL server to host the databases, one to host SCVMM, and one to host WAP. Two DCs are provided redundancy to this critical role. In order for communication to occur between any of the infrastructure virtual machines, the management nodes, and the control nodes to succeed, a domain controller must be present. Having two allows for restarting for one without affecting the entire infrastructure.

Each of the virtual machines are designed to be small enough to run on a computer with a minimum of 8GB of RAM available. The

Physical Hardware section describes the placement of the virtual machines on the management nodes. It is possible to build the entire infrastructure on as little as two virtual machines (some of the software cannot co-exist with other software pieces on the same server), but the resulting virtual machine would be too big to fit on most reclaimed hardware. The exact placement of each role is outlined in Appendix A – Host Reference Spreadsheet.

Each of the virtual machines was configured on a separate Hyper-V server, exported, and imported to the project hardware. This allows for the virtual machines to be reusable without needing reconfiguration (instructions for this process are presented in Appendix B – Deployment Details).

As a rule the virtual machines are as small as possible with exception to the SQL1 virtual machine. SQL Server is a memory intensive application. To accommodate that need, an entire management node needs to be allocated to this virtual machine. While it would run with less resources, the performance of the entire cloud would suffer as a result.

As mentioned previously, the primary deliverable of the project are the virtual machines. However, to test the virtual machine performance, reclaimed lab hardware was configured as Hyper-V host servers and the virtual machines were imported on the hardware (that process is described in Appendix B – Deployment Details). All of the computers were reclaimed from the computer labs and had the hardware described in Table 3.

Table 3 Description of the hardware in the Lenovo M58P ThinkCentre computers

Processor	Intel Core 2 Duo E8500, 3.16 Ghz
Memory	4 x 2 GB 1067 MHz DIMMs
Network	Intel 82567LM-3 Gigabit Adapter
Storage	Hitachi 250 GB HDD

As can be seen in Appendix A – Host Reference Spreadsheet, three computers are sufficient to host all five of the virtual machines and two are used as compute nodes. As mentioned previously, the main focus of this project is on the management infrastructure and not the compute nodes. The two presented here are for an example of how they are incorporated into the design. SCVMM 2012 R2 supports up to 1,000 virtual machine hosts[5], however that number may be limited by the resources provided. Each of the physical nodes is named HVHOST n , where n is a unique number.

Two of the management nodes required slight alterations to their hardware configuration. First, the machine used as HVHOST1 required a second network adapter. A Realtek PCI GBE Family Controller was used. This machine functions as a network router providing outside network connectivity to the infrastructure (this setup is described later in the Network section). The other machine, HVHOST3, had a 1 terabyte disk installed to replace the original 250 gigabyte disk. This machine hosts the SCVMM1 virtual server which includes the Virtual Machine Manager library. As mentioned earlier, this library holds the resources used to build cloud resource items. These resources include operating system ISO files, preconfigured virtual hard disks and the like and the items need to be available to the instructor or administrator when configuring new cloud resources and tend to take up space over time.

Network

The final layer of the design is the network. The design of the network is such that the private cloud is separate from the network of a school running it. This is an important part of the design because it allows for the solution to be implemented without considering the network it is running on. Without this separation, the virtual machine may not be portable and reusable. The only point of contact between the design and the outside network is on the second interface of HVHOST1, which is configured as a router.

The network used to host the design is deceptively simple. At a basic level, the network consists of a physical switch(es) with enough ports to connect all of the physical nodes, virtual switches to connect the virtual machines, and a software router to provide outside network access. However, as mentioned in the discussion of tenants earlier, each tenant has its own network. These networks are defined by the SCVMM software and are completely virtual. The SCVMM software provided the necessary configuration to allow the software defined networks to communicate with the physical network without any configuration inside the tenant while maintain separation between the networks in each of the tenants. For the use in technical schools this is good because each tenant can define the same network segment (192.168.0.x for example) but be on separate networks, allowing for consistency in the lab for the instructor.

Figure 1 shows how each of the layers of the design fit together. Each of the physical nodes are represented as a white box, with the virtual machines represented by named images. The arrows represent the physical network connections.

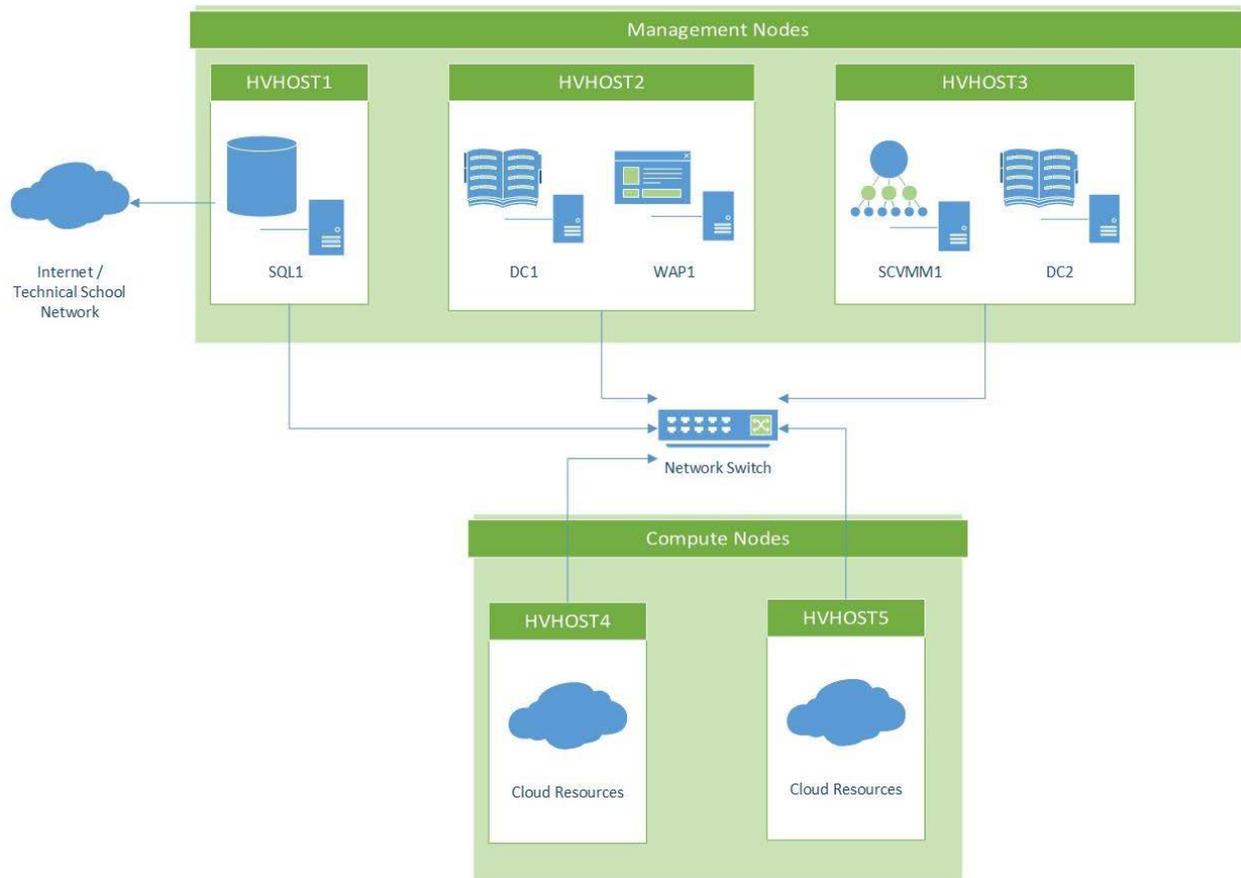


Figure 1 Design Overview

OUTCOMES

This section presents the results of the private cloud project by looking at each of the problems with existing solution and describing how the presented private cloud solutions overcomes them. The first problem, the effects students and instructors, centered on the students' work being locked to a single, physical workstation. By abstracting the students' work to a web based private cloud, that work can be accessed from any computer at any time regardless of the state of the classroom. With this solution, two students who before may have been in conflict over a single computer, can now work on assignments concurrently, whether or not the lab is open or occupied by another class. Instructors can grade assignments and address problems remotely and comfortably. Often, labs that are well designed for student success aren't necessarily design with instructor comfort in mind. Moving from station to station, bending over computers is not the best way to grade assignments, with this, grading can be carried out from the instructor's office.

With regards to the time consuming nature of existing solutions, this private cloud allows the instructor to build reusable build-blocks for the students. For example, if a class calls for three Windows server virtual machines, one Windows client virtual machine, and a basic network, each of those resources can be made available in a gallery for the students. The student simply provisions the network, three servers and the client without the instructor needing to do anything special. If the instructor plans to change the version of one of the operating systems, the new virtual machine can be presented without issue.

The final issue concerns the share-ability of the created resources. This issue can be viewed through two lenses. The first is sharing resources with instructors at the same institution. With this solution the problem is simply overcome. If multiple instructors are using the same cloud, the resources can be made available by granting the necessary permissions to the subsequent instructor(s). Once that has happened, any permitted resource will be available. The second lens would be sharing resources with an instructor at another institution. For this to occur, both institutions would need to have the cloud running. With that assumption, resources could be exported from the creating institution, transferred to the consuming institution (either via the Internet or they could be shipped on an external hard disk drive) and imported into the consuming institution's cloud. Once imported, those resources would be available.

For this solution to be viable for technical schools the cloud needs to perform adequately in three key areas: the solution must be stable, the web interfaces need to be adequately responsive, and virtual machines need to be adequately responsive. To measure stability, the availability of the solution is used. At the time of this writing, the private cloud has been running for 87 days without major issue. The infrastructure has had scheduled, automatic maintenance performed on a monthly basis to install software updates from Microsoft. These updates successfully installed at 3:00 AM each month and the servers were rebooted without incident. There was an unscheduled outage as well caused by the failure of a video card in one of the computers. Upon further investigation, the researcher learned that this was a known, common issue by the University support staff (unbeknownst to the researcher) with the particular model hardware selected for the project. The video card was not necessary for the project and was removed from the failing node to correct the issue and from the remained node as a preventive measure. A key takeaway here is to research the stability of the selected hardware to determine any potential issues prior to deploying the virtual machines.

In using the interfaces, the researcher noted that the longest wait time was during the logon process for the user. To measure that time, the Timeline feature of Google Chrome was used. This works by recording the activity performed by the browser and breaking that activity down into categories (loading, script execution, etc.). The recording must be manually started and stopped to get a measurement. The process used for this measurement was to manually start the recording, click the logon button in the interface, allow the interface to fully load, and then manually stop the recording. The result is presented in Figure 2 below. The total time was 7.32 s, but that is very misleading in terms of the performance of the private cloud. The 2,786.3 ms in the idle category reflects the time between starting the recording and clicking the logon button and the time between the interface finishing load and the recording being stopped. This figure represents the slowness of the research and not the cloud and can be ignored for this measurement. The scripting, rendering, and painting categories represent the Google Chrome browser displaying the page, not the private cloud delivering the page. Since this test was carried out on the researcher's computer, those times are attributable to that computer and not the private cloud and can be ignored. The resulting categories of loading and other, 606 ms, represent the time that the private cloud was actually working on the page load.

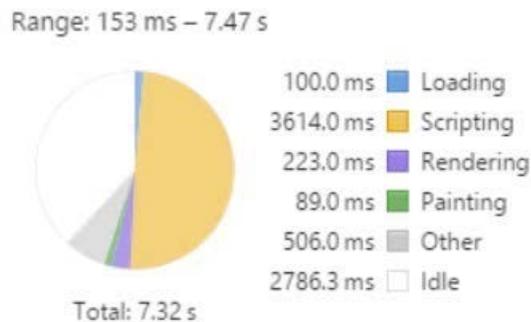


Figure 2 Page load summary showing load time for student interface

Due to a lack of computers for the project, it was difficult to determine how responsive the virtual machines on the compute nodes will be. However, the experience of the researcher working with the virtual machine on the management nodes can be anecdotally applied here. As discussed in greater detail in the next section, the projected use case for the technical schools is for small virtual machines, not private cloud infrastructures. The same physical hardware is used to host both however. In working with the management virtual machines, the research noticed that they were slow by modern data center standards, but performed adequately for the task at hand. The assumption would be that if the virtual machine running the infrastructure perform adequately, then virtual machines with less workload will perform adequately also, but no measurement could be accurately taken.

LIMITATIONS

A known limitation of this design is a lack of redundancy. In a full scale private cloud, resources are duplicated to minimize a disruption in service due to hardware failures or software updates. To achieve this redundancy, cloud environments employ multiple network switches, redundant, shared storage, and clustered servers. To keep the cost low, these features were omitted from the design and no attempt was made to overcome the issue. The design does however allow resources to be moved between the compute nodes within the infrastructure to allow for load balancing for performance reasons. An option that could

allow for redundancy would be to install a second infrastructure and configure it as a replica to the first. This would provide redundancy to the entire system.

Another limitation is the computational power of each node. Since each node is limited to two processor cores and eight gigabytes of memory, it is impossible to run truly demanding workloads. While this might not be a problem if the workloads are small virtual machines for building a lab environment, it could be a problem with providing some PaaS services like databases. While the problem can be overcome by simply deploying more virtual machines with SQL server installed, the issue is that more resources are then devoted to hosting multiple copies of Windows and SQL Server and not performing the SQL workload. This issue will be lessened over time however as the hardware being removed from the labs becomes more powerful.

Finally, the most notable limitation to the hardware is the performance of the disks. Because each of the nodes has a single spinning hard-disk drive, performance of the virtual machines is suboptimal. In a production level private cloud, a small RAID array or a solid state disk on each node or a shared disk array would be used to alleviate this bottleneck. In the current setup, this issue is softened somewhat by the power limitation mentioned above. Because the number of virtual machines on each node is limited by the amount of memory, the poor performance of the disk is minimized. As the amount of memory on each node is increased and more load is placed on each of them, the performance of the disk could greatly impact the performance of the virtual machines in the cloud.

With regards to the limitations presented by the hardware, the researcher feels that the core use of this platform will be for hosting small virtual machines. In most cases these virtual machines will run Windows with a small number of native roles installed for demonstrational purposes, not production ones. In that case, Windows essentially needs to be there and run at an acceptable level. While this platform will never be enough to run a corporate datacenter, it is more than adequate to support the use case presented by a typical technical school class.

CONCLUSION

The design described in this project can be used to answer the question how do you provide students with the base operating systems they need without taking away from outcome focused instructional/lab time, provided there are enough compute nodes to host the workload. Apart from providing a low cost private cloud, which is compelling in itself, the most important return from the project is the instructor's time. With the instructor freed from constant configuration of resources for class, they can devote more time to the quality of the resources being provided. In addition, the private cloud platform can promote sharing of resources between instructors and possibly between institutions.

From a personal point of view, this project gave the researcher a new appreciation of older hardware. On paper, the specifications of one of the computers used in this project are almost laughable by today's server standards. However, when combined in adequate numbers they have a great deal of potential. The server used to build the virtual machines was equipped with dual, quad-core Xeon processors and solid-state disks. Running all of the virtual machines was somewhat challenging for that machine given the low amount of hardware allotted to each of them. The researcher fully expected the performance to plummet once the virtual machines were imported onto the reclaimed hardware. The researcher was pleasantly surprised to be wrong. With the exception to the disk performance, which wasn't unusably bad, the performance of the virtual machines was more than acceptable.

The next step for this project would be to upgrade the components used to the latest available from Microsoft. Each of the products used is undergoing a transition that will likely benefit this design. Windows Server 2016 will include a new Nano Server installation type. This option will provide a very small installation of Windows, capable of running completely from memory, which will support Hyper-V. The use of Nano server would allow more of the resources of the nodes to go to workload instead of the Windows installation.

The exact details of the new version of SCVMM are still unknown at the time of this writing, but one promising feature is integration with Windows Azure. If a technical school already has access to Windows Azure (which is available through DreamSpark), it is possible to use those resources as part of this cloud, turning it into a hybrid rather than private cloud. It remains to be seen how that could be utilized.

Microsoft is replacing the Windows Azure Pack used in this project with the Microsoft Azure Stack. Again, exact details are limited, but rumors state that R programming, data mining, and business intelligence features may be added.

There is one final takeaway from this project. This infrastructure presents running examples of Active Directory, DNS, DHCP, SQL Server, System Center, Hyper-V, and WSUS in the classroom. For an instructor teaching Microsoft technology, having this resource as a demonstration of how all of the technologies work in concert with one another for a common purpose can be an invaluable teaching tool.

Appendix A – Host Reference Spreadsheet

Hostname IP	IP Address	Windows Version	Roles / Software Installed	Hardware Specifications
HVHOST1	192.168.0.1	Windows 2012 R2 Standard	Hyper-V, Routing and Remote Access (RRAS) (Network Gateway)	Physical, 2x1Gb NIC, 250GB HDD
HVHOST2	192.168.0.2	Windows 2012 R2 Hyper-V Server	Hyper-V	Physical, 1Gb NIC, 250GB HDD
HVHOST3	192.168.0.3	Windows 2012 R2 Hyper-V Server	Hyper-V	Physical, 1Gb NIC, 1000GB HDD
HVHOST4	192.168.0.4	Windows 2012 R2 Hyper-V Server	Hyper-V	Physical, 1Gb NIC, 250GB HDD
HVHOST5	192.168.0.5	Windows 2012 R2 Hyper-V Server	Hyper-V	Physical, 1Gb NIC, 250GB HDD
DC1	192.168.0.10	Windows 2012 R2 Standard	Active Directory Domain Services (ADDS), DHCP, DNS	Virtual, 1 NIC, MinMem 512, MaxMem 1536, 127GB HDD
SQL1	192.168.0.11	Windows 2012 R2 Standard	SQL Server 2012 SP3	Virtual, 1Gb NIC, MinMem 512, MaxMem 4096, 127GB HDD
WAP01	192.168.0.12	Windows 2012 R2 Standard	Windows Azure Pack, Service Provider Foundation	Virtual, 1Gb NIC, MinMem 512, MaxMem 6144, 127GB HDD
SCVMM01	192.168.0.13	Windows 2012 R2 Standard	System Center Virtual Machine Manager, WSUS (Fabric Connected)	Virtual, 1Gb NIC, MinMem 512, MaxMem 4096, 500GB HDD

DC2	192.168.0.14	Windows 2012 R2 Standard	Active Directory Domain Services (ADDS), DNS	Virtual, 1 NIC, MinMem 512, MaxMem 1536, 127GB HDD
	192.168.0.200 - 254		DHCP Range	

Appendix B – Deployment Details

This appendix discusses configuring the physical hardware of the infrastructure and the deployment of the virtual machines to that hardware. As discussed above, the project delivers the virtual machines exported from another Hyper-V server. These virtual machines must be imported into Hyper-V on the target infrastructure and configured for the customer. All of the configuration performed in these steps will be unique for each implementation of the project. For example, if this is being delivered to Ogeechee Technical College, the college may want to use their own DNS names on their network and may choose to provide their own certificates to secure the communications between their campus network and the private network provided.

DEPLOYING TO THE INFRASTRUCTURE

The first step is to deploy the physical nodes and the virtual machines needed to run the private cloud. The steps below give a fairly low level overview of this process.

1. Physically configure the three control nodes with the appropriate hardware as noted in the “Hardware Specifications” column in Appendix A.
2. Configure the physical network connections as described in Figure 1.
3. Install the appropriate version of Windows Server on each of the three control nodes as outlined in Appendix A. Ensure the date, time, and time zone settings are correct on each server.
4. Configure the network connections on HVHOST1.
 - a. In the network connections screen, change the name of the adapter connected to the outside network to “PublicInterface” and the adapter connected to the internal network to “PrivateInterface”
 - b. Set the IP settings on the PublicInterface to get access to the outside network.
 - c. Set the IP settings on the PrivateInterface as follows:

IP Address: 192.168.0.1

Subnet Mask: 255.255.255.0

Default Gateway: (blank)

DNS: 192.168.0.10, 192.168.0.14

5. Configure the network connections on HVHOST2 and HVHOST3 as described in Appendix A. The default gateway on each should be 192.168.0.1 and the DNS entries are 192.168.0.10 and 192.168.0.14.
 6. Execute the following PowerShell commands on each host:

`Get-NetFirewallRule -DisplayGroup "File and Printer Sharing" | Enable-NetFirewallRule`

`Get-NetFirewallRule -DisplayGroup "Remote Desktop" | Enable-NetFirewallRule`
 7. On HVHOST1, install the Hyper-V and Remote Access roles. When prompted, select the "Routing" role service under Remote Access.
 8. On each host, create an external Virtual Switch in Hyper-V called "PrivateCloud."
 9. Configure Routing and Remote Access for NAT. Use the PublicInterface as the interface to connect to the Internet when prompted.
 10. Place the files for each of the virtual machines in the C:\Users\Public\Documents\Hyper-V folder on the management hosts as described in Appendix A.
 11. Use Hyper-V Manager to import each of the virtual machines on their respective hosts. When asked on the "Choose Import Type" page of the wizard, select "Register the virtual machine in-place."
 12. Start the domain controller virtual machines.
 13. Log into one of the domain controller (administrator/Eagles!) virtual machines and create a new Active Directory user account for administration. Add it to the following groups:
 - a. Domain Admins
 - b. Enterprise Admins
 - c. Schema Admins
 14. Log into one of the domain controllers with the new account to ensure it has access.
 15. Ensure each of the host servers can access the domain by pingging talon.cloud. You should receive an IP address of one of the domain controllers (if the ping uses IPv6, add a -4 switch to the ping command ping -4 talon.cloud)
 16. Join each of the host computers to the domain one at a time and reboot the server. Rebooting more than one host at a time could bring both domain controllers offline at once.
-

17. Start the remaining virtual machines in the following order. Once started, log on to each virtual machine and ensure that it has network connectivity before starting the next virtual machine in the sequence.
 - a. SQL1
 - b. SCVMM1
 - c. WAP1
18. Forward the ports 80, 443, 444, and 445 to 192.168.0.12 in Routing and Remote Access on HVHOST1.
19. Add Hyper-V hosts to SCVMM fabric using Virtual Machine Manager.
 - a. Login to SCVMM01.
 - b. Launch Virtual Machine Manager.
 - c. Choose fabric node.
 - d. Choose “Add Resources” -> Hyper-V Hosts and Clusters from ribbon.
 - e. Complete wizard. When prompted, add to the Fabric Core group.

CONFIGURE TENANT PORTAL

This process sets the name of the Tenant Portal and configures certificates for the portal. The certificates must be issued by an authority that is trusted by the clients using the cloud. This can be from an Enterprise PKI (at which point the trust root certificate must be imported into the talon.cloud domain) or a globally trusted, third party issuer. Additionally, DNS records should be assigned to the external interface of the TALON router in the outside network with a name matching the certificates used.

1. Configure the following DNS entries in an external DNS server and point them to the outside IP address of the TALONs router:
 - a. *TenantHostname.yourdomain* - for tenant site.
 - b. *AdminHostname.yourdomain* - for admin site
 - c. *AuthHostname.yourdomain* - for authentication site
 - d. *WindowsAuthHostname.yourdomain* -for windows authentication site.
2. Create DNS zone and A records in TALONs.
 - a. Logon to DC1.
 - b. Launch DNS from administrative tools.
 - c. Create a new primary zone that matches DNS entries from step 1.
 - d. Create A records for each record in step 1. Point to 192.168.0.12.

3. Issue four certificates from an external authority, one for each of the DNS records created in step 1.
4. Import certificates into IIS on WAP01.
 - a. Logon to WAP01.
 - b. Open IIS manager from administrative tools.
 - c. Select WAP01 and open Server Certificates.
 - d. Click Import and select first certificate.
 - e. Repeat for three remaining certificates.
5. If certificates were issued by an enterprise authority, import the root certificate into the trust root authorities with Group Policy.
 - a. Logon to DC1.
 - b. Open Group Policy Management from administrative tools.
 - c. Edit WAP01 group policy object.
 - d. Navigate to Computer Configuration -> Policies -> Windows Settings -> Security Settings
> Public Key Policies -> Trusted Root Certification Authorities.
 - e. Add the root certificate.
 - f. Run gpupdate on WAP01.
6. Configure IIS sites to use certificates.
 - a. Logon to WAP01.
 - b. Launch IIS manager.
 - c. Expand WAP01 -> Sites.
 - d. Select MgmSvc-AdminSite.
 - e. Edit Bindings, change https to port 443, select admin site certificate from list, set hostname to match certificate.
 - f. Select Require Server Name Indication.
 - g. Select MgmSvc-TenantSite.
 - h. Edit Bindings, change https to port 443, select tenant site certificate from list, set hostname to match certificate.
 - i. Select Require Server Name Indication.
 - j. Select MgmSvc-AuthSite.

- k. Edit Bindings, change https to port 444, select authentication site certificate from list, set hostname to match certificate.
 - l. Select Require Server Name Indication.
 - m. Select MgmSvc-WindowsAuthSite.
 - n. Edit Bindings, change https to port 445, select authentication site certificate from list, set hostname to match certificate.
 - o. Select Require Server Name Indication.
 - p. Restart WAP01.
7. Configure portal with new name and port numbers.
- a. Logon to WAP01.
 - b. Launch PowerShell as an administrator.
 - c. Execute the following commands where AdminFQDN is the DNS name of the admin site and WindowsFQDN is the DNS name of the Windows authentication site, TenantFQDN is the DNS name of the tenant site, and AuthFQDN is the DNS name of the authentication site.
 - i. Set-MgmtSvcFqdn -Namespace "AdminSite" -FullyQualifiedDomainName "AdminFQDN" -Port 443 -Server "SQL1" ii. Set-MgmtSvcRelyingPartySettings -Target Admin -MetadataEndpoint <https://WindowsFQDN:445/FederationMetadata/2007-06/FederationMetadata.xml> -ConnectionString "Data Source=sql1.talon.cloud;User ID=sa;Password=Eagles!"
 - iii. Set-MgmtSvcIdentityProviderSettings -Target Windows -MetadataEndpoint <https://AdminFQDN/FederationMetadata/2007-06/FederationMetadata.xml> -ConnectionString "Data Source=sql1.talon.cloud;User ID=sa;Password=Eagles!"
 - iv. Set-MgmtSvcFqdn -Namespace "TenantSite" -FullyQualifiedDomainName "TenantFQDN" -Port 443 -Server 'sql1'
 - v. Set-MgmtSvcFqdn -Namespace "AuthSite" -FullyQualifiedDomainName "AuthFQDN" -Port 444 -Server 'sql1' vi. Set-MgmtSvcRelyingPartySettings -Target Tenant -MetadataEndpoint
-

'https://AuthFQDN:444/FederationMetadata/2007-06/FederationMetadata.xml'

ConnectionString "Data Source=sql1.talon.cloud;User ID=sa;Password=Eagles!"

vii. Set-MgmtSvcIdentityProviderSettings -Target Membership -MetadataEndpoint

'https://TenantFQDN/FederationMetadata/2007-06/FederationMetadata.xml' -

ConnectionString "Data Source=sql1.talon.cloud;User ID=sa;Password=Eagles!"

8. Configure Windows firewall to accept connection on ports 80, 443, 444, and 445.
9. Verify access to portals.
 - a. Logon to WAP01.

Connect to <https://AdminFQDN> in browser.

References

- [1] M. Mircea, and A. I. Andreescu, "Using cloud computing in higher education: A strategy to improve agility in the current financial crisis," *Communications of the IBIMA*, 2011.
- [2] T. Dillon, C. Wu, and E. Chang, "Cloud computing: issues and challenges." pp. 27-33.
- [3] M. Corporation, "Test Lab Guide: Windows Server 2012 R2 Base Configuration," 2013, p. 34.
- [4] "Windows Azure Pack Features," April 5, 2016; <https://www.microsoft.com/en-us/servercloud/products/windows-azure-pack/Features.aspx>.
- [5] "Overview of System Center 2012 - Virtual Machine Manager," April 16, 2016, 2016; [https://technet.microsoft.com/en-us/library/gg671827\(v=sc.12\).aspx](https://technet.microsoft.com/en-us/library/gg671827(v=sc.12).aspx).

Actioning Big Data

Bel Raggad, Pace University

Abstract

We propose to construct probability distributions for data subsets selected randomly from big data. A sequential decision support system will generate local decision support for every random data subset. At the end of the random data extraction process we obtain an equal number of decision support capabilities that can be fused together to produce the big data decision support information needed by the big data owner.

The big data owner can either act upon the decision support information on hand or collect more random data subsets. The random data extraction process continues until the big data owner judges a feasible decision can be made.

We use Dempster and Shafer theory and Smets' transferable belief model to generate feasible pignistic probabilities that the big data owner adopts. The sequential decision model is not treated in this study, but a numerical example is provided to illustrate the generation and the fusion of decision support capabilities.

This proposal will only briefly present an outline of the analytical model we use to produce business value from big data through the generation of specific decision support. The specificity relates to the limited number of decision parameters involved in the decision solving situation. Our intent is to set the mathematically sound framework to employ accepted decision science and related traditional utility theory.

Proposed model

We employ the Transferable Belief Model (TBM) to produce our probability distributions under the new name of pignistic probabilities. Here is a brief overview of the TBM model.

The TBM model is an interpretation of Dempster-Shafer Theory of belief function proposed by Philip Smets. It proposes a model to represent measurable beliefs, often unrelated to formal probabilities. Smets' model is merely based on credibility or belief functions as proper measures of beliefs. Also, belief functions are defined without any assumptions we often had in probability functions, as with randomness, additivity rules, and prior probability distribution (Smets, 1991, 1995, 2000; Smets et al., 1994).

The TBM consists of two stages of modeling: the credal stage submodel and the pignistic submodel. The credal level is concerned with beliefs that depend on two components: static and dynamic. In the static component, beliefs of a given user are quantified using belief function. In the dynamic component, we are instead concerned with the revision of belief as new pieces of information become available. The pignistic stage views belief based on its decision making properties. In this case, we measure beliefs using probability functions. Smets then proposes the pignistic transformation capable of constructing these probability functions from belief function at the credal level.

This TBM framework starts at the credal stages and advances to the pignistic stage for which we present the formula later in this proposal. At the first stage, we quantify, revise, and fuse beliefs. We then construct the pignistic probabilities from belief functions to prepare for the decisions we need to make.

The credal level

We start with the presentation and evaluation of beliefs. We then conduct the revision process of beliefs.

Static level

As in any problem solving case, the initial and most critical step is the definition of the frame of discernment, Ω . This set contains all states of the nature, $\omega_i: i=1, \dots, N$. Then, beliefs that support any subset $A \subseteq \Omega$ are measured using belief function of the power set 2^Ω to the interval $[0,1]$.

$$m : 2^\Omega \rightarrow [0,1]$$

$$\sum_{A \subseteq \Omega} m(A) = 1$$

Basic belief assignment (bba) $m()$, is one way to express belief functions. Belief mass, $m(A)$, quantifies that part of user belief allocated to the assertion A , i.e., that the actual world belongs to A while the decision maker however does not support any strict subset of A due to lack of information.

The decision maker's degree of belief on A , $bel(A)$, is obtained by summing all bba's given to $X \subseteq A$ and $X \cap A = \emptyset$, as: $bel(A) = \sum_{X \subseteq A} m(X)$

Smets' TBM framework does not assume the normality condition, $m(\emptyset)=0$, except under the hypothesis of closed world where Ω is exhaustive; otherwise, in an open world, the bba of the empty set, $m(\emptyset)$, is interpreted as the belief mass that supports the actual world does not belong to Ω . This means that the bba assigned to the empty set is not specific and does not support any subset, $A \subseteq \Omega$, since \emptyset supports A and $\Omega \setminus A$ simultaneously. Furthermore, the positive mass allocated to the empty set in the TBM has a different interpretation within the dynamic level.

Coarsening and refinement

Lets have Ω and Φ two frames of discernment. A mapping ρ from the power set 2^Ω to the power set 2^Φ , ($\rho: 2^\Omega \rightarrow 2^\Phi$), is called a refining if it verifies following properties:

$$\{\rho(A) \mid A \subseteq \Omega\} \text{ is a partition of } \Phi$$

$$\rho(A \cap B) = \rho(A) \cap \rho(B)$$

The universe Φ is called coarsening of Ω and Ω is the refinement of Φ . The bba m^Φ on Φ can be transformed into bba on the refinement Ω relying on vacuous extension as follows (Delmotte and Smets, 2001; Démotier et al., 2006):

$$m_{12}(\emptyset) = \sum_{X \cap Y = \emptyset} m_1(X) m_2(Y)$$

Dynamic component

Smets has his own conjunctive rule of combination that we can apply at the credal stage to aggregate the bba's we acquire from independent sources. Smets's conjunctive rule aggregates bba's as follows:

Let m_1 and m_2 , bba's defined on the same frame Ω :

$$m_{12}(A) = \sum_{\substack{X \cap Y = A \\ X, Y \subseteq \Omega}} m_1(X) m_2(Y)$$

We are talking about the empty set that absorbs any possible conflicts detected between the two bba's. We assume that the sources say the full truth and there will be hence no need for normalization. The combined mass allocated to the empty set, $m_{12}(\emptyset)$ is needed as in a non-normalized Dempster combination rule. We can relate the two products, Normalized and Non-normalized belief masses as follows (Smets, 2000, 2004): :

$$m_{12}(A) = \frac{m_{12}(A)}{1 - m_{12}(\emptyset)}$$

The pignistic stage

As in (Smets, 1995, 2005; Smets et al., 1994), we can induce the following measures:

$$BetP(A) = \frac{|B \cap A|}{|B|} = \frac{m_{12}(A)}{1 - m_{12}(\emptyset)}$$

These probability measures are the betting probability functions Smets recommended for analyzing the decision solving situation.

The random selection process

We select N subsets D_i , $i=1,N$ of size d from random locations of the big data, in terms of physical locations and time locations. For every randomly selected subset D we induce probability measures in the way we explained above. Applying the conjunctive aggregation rule introduced above, we can produce probability measures for all the decision parameters involved in the decision situation on hand.

In this manner, we just have produced value in terms of decision support based on probability measures acquired on those decision parameters populated in the big data. We can show that the prescribed numbers of subsets randomly selected from the big data is optimal in the sense that more data on the decision parameters in question cannot significantly and feasibly change the values of the probability measures.

That is the probability measures produced cannot be feasibly improved given the current state of the big data. We can say that these probability measures are final for the current decision situation. The appropriate decision process and corresponding utility theory models can then be activated.

Actioning the big data

The big data can be stored or alive. Either way, it can be navigated physically in the data stores or throughout the online stream. The random data subsets can be populated either from the data stored in the big data or directly but randomly from the online stream. The probability measures are built on the data subsets individually then aggregated conjunctively.

As decision science is concerned, the big data has been translated, through the construction of probability measures, into the most valuable decision support that can be feasibly induced from the big data.

This framework of generating business value through the generation of decision support capabilities through the production of probability measures on the decision situation's decision parameters, is very much analog to the OLAP processes, in data warehousing, needed to generate the cubic data marts storing the data prepared for specific decision groups. There are however three main differences between processing a data warehouse and processing big data: the randomness of the generation of data cubes, the underlying probability measures on the dimensions of the cubes, and the feasibility of the cube generation process. This latter property is concerned with the fact that a change of the data in the data warehouse may require an update of the cubes whereas in the big data, the model we proposed assures that the change of data in the big data does not feasibly change the probability measures.

The same process may be generalized for all parameters of interest in the big data. Understanding the big data does not necessarily mean the generation of statistics about the data in the big data or any relations among them, but the reduction of uncertainty associated with data for the purpose of producing decision power. The decision power cannot be secured if the probability distributions on the decision parameters remain unknown.

This proposal studies how this decision power can be produced throughout the construction of pignistic probability measures on the big data in order to support decision processes. The paper is in progress.

THINKING THROUGH THE WRITE-OFF: ARGUMENTS FOR THE PECULIARITIES OF THE DEPRECIATION CHARGE

Gregory S. Kordecki, Clayton State University, gregkordecki@clayton.edu

INTRODUCTION

This paper surveys the relevant literature on the timing and nature of charges against income on long-lived assets. Within the framework of accounting, the spectrum ranges from complete, immediate write-off justified under income tax law expensing to financial reporting to external financial statement users where the rule calls for a systematic and rational approach. And then internal managerial accounting may provide a third set of propositions and results. While national income accounting and pundits for U.S. federal income tax reform may voice their arguments for rapid, if not immediate expensing, that distraction is not studied in the paper. Rather, the concern is for what is, or perhaps should be, appropriate under generally accepted accounting principles for external financial reporting on the one hand, and for internal managerial use under an entity's accounting policies and procedures. The paper also includes suggestions teaching faculty may use with depreciation write-off situations to illustrate related conceptual issues in accounting such as periodicity, matching, and cost versus market.

BASIC ISSUES

Acquisition of long-lived assets is a necessary process in all productive entities. Some authorities suggest that the recognition, allocation, and derecognition of the associated costs create complex theoretical issues in view of the treatment alternatives (Wright, 2006; Grinyer, 1994; and Sigidov, Rybyantseva, Adomako & Yarushkina, 2016). Business modelling, taxation policy, financial statement strength, and management strategy all rely heavily on the "fixed asset" cycle. When, and how much, to write-off the original historical cost of the acquisition has compounding problems, as time considerations go long and the materiality becomes greater.

The timing and amount of derecognition of the original cost becomes even more complex as the broad alternatives and methodologies for financial and managerial use are considered. While income tax policy *per se* is not included in this paper, the result of the temporary differences between financial reporting and income tax accounting must be explored. In addition, analysis of cash flows by managers is critical in that information provided on a full accrual basis be adjusted for an add-back of depreciation, amortization and depletion charges during the period. The classic cost accounting dilemma of product versus period cost can also be a complicating factor as to the decision for when and how much depreciation to include as operating expense, or on the other hand, overhead to calculate gross margin.

GENERAL EFFECTS OF WRITE-OFFS AND THE DEPRECIATION CHARGE

Analysis of cases during the late 1920s and early 1930s illustrate some of the reporting difficulties during a time of disruptive markets. Historically, the rational support for careful treatment of long-lived assets and cost allocation policies has not been as intense as developed in the 21st century. During the early 20th century, most American entities used the same depreciation method for both financial books and their tax return, as income tax law required the straight-line method.

Diamond Match Co. applied liberal write-offs to generate conservative financial statements—with timber and woods nearly fully depreciated and patents, trademarks, and goodwill not capitalized (Diamond Match..., 1929). The Gillette Safety Razor Co. proposed a major corporate restructuring writing down machinery by \$3.5 million, land and buildings by \$3.8 billion, and intangible assets by \$6.2 million (The Recapitalization..., 1931). Beech (1933) shows that the oil industry engaged in a practice of "concealed"

earning power through inflating depreciation charges. While the accounting profession and government regulators attempted to ameliorate the problem of secret reserves over economically depressed periods through quasi-reorganization and a broader menu of acceptable GAAP with disclosure, other problems emerge with inflation and international developments.

RECOGNITION EXPENDITURE, ALLOCATION, AND DISPOSAL DERECOGNITION

Setting aside issues of business combinations and improvements, betterments, and repair issues, it is helpful to view the cycle for long-lived assets as a three-stage process: (1) acquisition or recognition, (2) write-off, or allocation, and (3) disposal or derecognition. Blake (1974) illustrates how difficult it is to analyze asset-disposal decisions as the seller has to have assumptions on return rates, profit recovery through other assets, effect on cash flow and income, possible future offers, and the effect on employee morale.

The capital expenditure versus revenue expenditure classification is especially important to the factors of recognition and derecognition. The general textbook treatment of “capital expenditure” is to apply this expression as a company’s acquisition of non-monetary resources to expand and generate future earnings, whereas the revenue expenditure refers to the company’s ability to maintain current operations. The capital expenditure, then, is one where a productive asset acquisition occurs and the result is a long-lived asset appearing on the entity’s balance sheet. On the other hand, the revenue expenditure represents amounts immediately expensed, and as such, reporting appears on the income statement. Brush, Bromiley, and Hendrickx (2000) indicate that gray areas can lead to misleading financial statements and ratio analysis.

CHOICE OF DEPRECIATION BASE AND METHOD

Wright (1960) demonstrates the importance of managerial concepts of return on investment (ROI), residual income, and net present value in the study of depreciation theory. If discounted cash flow techniques of net present value and internal rate of return are considered to be among the best in capital budgeting, then the argument would follow that depreciation as a component in the time value of money equation should be extended to return on asset measures, and the more precise the manager is on net book values rather than using gross book values, the more useful the results of the ratio.

While Sigidov and colleagues point to the economic characterization of depreciation as the monetary formation of the fixed capital reproduction financing source, they also suggest practitioners as well as academic scholars characterize depreciation as a gradual transfer of plant and equipment subject to usage, wear and tear, and associated with other costs of the period (Sigidov, 2016). Grinyer (1994) argues for matching cost outlay with cash inflows, and as such in accounting for long-lived assets, even though allocation methods can be arbitrary, the bases do not have to be arbitrary.

For economic efficiency, Cummins Engine successfully uses a modified units-of production method (Hall & Lambert, 1996). Raby (1950) advocates a square root method which further improves upon sum of the years’ digits and the use of trigonometric sines. The advantage to the Raby method is with square roots the schedule begins less harsh and ends with a heavier charge, supporting the argument that the underlying fixed asset’s deterioration curve is not physically as drastic as the more accelerated methods suggest.

Elaborate schemes for depreciation have been postulated. Howe (2004) advocates use of a condition-based depreciation (CBD) method, entailing the calculation of an annuity based on management plans, and dividing the total cost over the intended service life. Inglis (1949) pointed out the distinct advantage of using activity basis for depreciation in that it accomplishes the purpose of legitimately increasing depreciation charges in those years of life of an asset when the productivity and earnings are the greatest.

FINANCIAL REPORTING—FOR AND NOT-FOR-PROFIT ENTITIES

Statement No. 93 of the Financial Accounting Standards Board, “Recognition of Depreciation by Not-for-Profit Organizations,” was a turning point for some key not-for-profit entities, with universities as well as hospitals required to report depreciation charges to external users of their financial statements. This improvement also helps analysis of an entity’s cash flow as depreciation add backs are clearly seen (SFAS 93..., 1988). The application of financial statements without adequate provision for depreciation continued for the most part with government sponsored not-for-profits where groups of accounts were segregated for long-lived plant and equipment.

Critics argue that information on an entity’s deferred maintenance, age, and condition may be more useful than depreciation information (Recognition of Depreciation, 1987). Brown (1998) illustrates that the depreciation standard for not-for-profits has been a boon in both the internal budgeting sense as well as the external financial reporting sense. Brown asserts that the academic industry is faced with spiraling operating expenses on decreased volume of student revenue. Colleges and universities should be encouraged to accept depreciation accounting because it provides for incentives in curtailing cash operating expenses, and serves as a mechanism for the Institution to use major capital renovation and expansion plans. For similar reasons, hospitals benefit from the depreciation information, and it was recognized as early as the 1960s that outside assistance from various sources would become limited and economic efficiency would need be established (Howell, 1966).

MANAGEMENT PERFORMANCE

To measure internal performance, management has generally taken seriously the importance of budgeting. Colgan (1928) believed it was critical that management prepared budgets void of depreciation and other write-offs, entering those amounts only after the entire budget is prepared and clearly identified as a projected profit and loss statement. Some research shows that it may be optimal to base a division manager’s compensation on residual income as a performance measure but using specified depreciation and capital charge rates (Dutta & Reichelstein, 2002).

Combined with eroding profit margins and inflation, when depreciation is inadequate, business is unable to replace existing plant and equipment, and expansion plans are halted (ROI and Inflation, 1979). Results of analysis using net present value may vary widely depending upon the depreciation assumptions employed in the calculations. Allen & Idlebird (2014) illustrate the possible concerns and misunderstandings that can be generated by using far-fetched capital recover tax shields in calculations. With standard costing, variance analysis leads to further improvement in evaluating performance.

PECULIARTIES AND CONUNDRUMS

Walkowiak (2014) found that depreciation and amortization regulations based on national laws in major European countries as reported in their entities’ IFRS financial statements have extremely close alignment between legal, tax, and financial reporting. Accordingly, companies following U.S. GAAP are less comparable, and where the write-off differences are significant the objective of global harmonization of accounting standards is not met.

The risk of inflation and price level changes could again affect companies as it did in the 1970s and 1980s. Resource consumption accounting (RCA) developed in Germany has been cited as an economically efficient mechanism for depreciation using current replacement cost, net realizable value, and net present value future cash flows (MacArthur, 2008). McAnly (1958) had previously studied income analysis where depreciation can be an expense bearing little resemblance over future periods to what it should be as a write-off in view of price level changes. Accordingly, McAnly favors basing depreciation on a purchasing power

index. The Cost Accounting Standards Board (CASB) had proposed price level indexing for depreciation, whereby depreciation would be applied to a deflator based on the then measurement of Gross National Product (GNP), upon which the FASB had also experimented (Data Sheet, 1976). With inflation concerns less severe in the early 21st century, these kinds of adjustments for depreciation are no longer hot topics.

Is cash flow king or is accrual net income king? Bridwell (1960) analyzed 30 large corporations and found that EPS is better than cash flow per share in general. More recently, Chan and Lui (2011) demonstrate certain benefits of cash flow analysis, particularly if free cash flow is separated from capital expenditures and where depreciation and noncash items are appropriately considered in net present value calculations.

With consideration of the product cost versus period cost dilemma and reporting cash flow from operations under the indirect method, or in the direct method's supporting reconciliation schedule, depreciation "incurred" versus depreciation "expensed" becomes significant with changes in inventories and other manufacturing costs. Nurnberg (1989) addresses this peculiarity and illustrates its importance when depreciation is a large fixed manufacturing cost and the work-in-process inventory is large.

CONCLUDING REMARKS AND SUGGESTIONS FOR FURTHER RESEARCH

Littrell (1986) spoofs at the options available to companies for depreciation and suggests they might as well use "just-in-time" depreciation to make remarkably precise forecasts of earnings. Income smoothing was also part of the American Telephone & Telegraph Co. case of 1935 where the cost of equipment and depreciation write-offs were examined in the context of relationships between a quasi-holding company, a manufacturing company that supplied equipment, and operating companies that provided a service (Colt, 1935).

Questionable reporting practices involving intangible assets and inconsistent display of fixed assets in Standard Brands, Inc. financial statements helped create timing differences that distorted net income significantly (Standard Brands..., 1930). The \$49 million reduction in net income was planned to be only a temporary hit against profits, with the company believing it would be beneficial in the long run. Therefore, another abuse of conservatism is shown.

Other abuses include classifying expenses as abnormal or extraordinary items even though they were part of normal operations (McCahey, 1999). The problem areas occurred in an "interperiod" as well as an "intra-period" context. With the exception of war years, until 1954 the Internal Revenue Code required entities to depreciate applying the straight-line method (Bridwell, 1960). Temporary differences between financial and income tax reporting may possibly generate a huge deferred tax liability. The general use of accelerated depreciation for income tax accounting, but the straight-line method for the financials, is now generally presumed and accepted.

Martin (1959) pointed out that a managerial approach to depreciation and deferred income taxes is needed, and that specific differences should be enumerated in communicating financial policy.

Dey, Grinyer, Sinclair, and El-Habashy (2009) studied depreciation choice by Egyptian companies and found that there was no relationship to simplicity of calculation, but that relationships existed on the basis of suitability for class of asset and conformity to industrial norms. Bishop (1955) argues for the concept of "matching" to be used. That argument likely continues to stand strong.

Further research in this area might include the following concepts:

- Survey college accounting instructors for their approaches to teaching the accounting for long-lived assets, including examples used in the classroom;
- Compare publicly traded entities on their policies regarding long-lived assets through disclosures in annual reports and other documents;

- Evaluate the progress in the standard-setting process made by regulatory authorities and professional bodies in accounting and auditing the elements associated with long-lived assets.

REFERENCES

- Allen, D. E., & Idlebird, J. L. (2014). Depreciation's effect on capital budgeting metrics needs more educator focus. *American Journal of Business Research*, 7(1), 45-60. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/1691068478?accountid=10139>
- Beech, L. (1933, January 16). Scaling down oil-company depreciation reserves. *Barron's*, 13(3), 20. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:3322/docview/350260767?accountid=10139>
- Bishop, J. W. (1955). Accounting for fixed assets by cost elements. *National Association of Cost Accountants. NACA Bulletin*, 36(5), 689-701. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/199126549?accountid=10139>
- Blake, A. B. (1974, October). The asset disposal decision. *Management Accounting*, 56(4), 47-51.
- Bridwell, R. W. (1960, October 3). Cash flow or profits? *Barron's National Business and Financial Weekly*, 40(40), 9,21. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/350428118?accountid=10139>
- Brown, K. W. (1998). How colleges can profit through depreciation. *Management Accounting*, 79(7), 18-22.
- Brush, T. H., Bromiley, P., & Hendrickx, M. (2000). The free cash flow hypothesis for sales growth and firm performance. *Strategic Management Journal*, 21(4), 455-472. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/225004329?accountid=10139>
- Chan, R. W., & Lui, B. C. (2011, 12). Discounted cash flow: A more accurate tool. *Better Investing*, 61(4), 29-30. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/906279660?accountid=10139>
- Colgan, C. Y. (1928). Understanding budget preparation and control. *Journal of Accountancy*, 46(2), 106-112. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:3322/docview/198283221?accountid=10139>
- Colt, C. C. (1935, May 6). The pending telephone probe: Washington to investigate the greatest of holding companies. *Barron's*, 15(18), 8,16. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:3322/docview/350236326?accountid=10139>

Data sheet. (1976, January). CASB considers standard on adjustment of depreciation costs for inflation. *Management Accounting*, 57(7), 12.

Dey, C., Grinyer, J., Sinclair, D., & El-Habashy, H. (2009). An exploration of managers' reasons for depreciation method choice in Egyptian companies. *Journal of Applied Accounting Research*, 10(1), 20-32. Retrieved from doi:<http://ezproxy.clayton.edu:2090/10.1108/09675420910963379>

Diamond match write-offs liberal. (1929, January 21). *Barron's*, 9(3), 11. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:3322/docview/350139190?accountid=10139>

Dutta, S., & Reichelstein, S. (2002). Controlling investment decisions: Depreciation- and capital charges. *Review of Accounting Studies*, 7(2-3), 253-281. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/208519116?accountid=10139>

Grinyer, J. R. (1994). (Review of) Depreciation: The time for change (by Anthony Carey). *Accounting and Business Research*, 24(96), 351. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/198159583?accountid=10139>

Hall, L., & Lambert, J. (1996). Cummins Engine changes its depreciation. *Management Accounting*, 78(1), 30-36.

Howe, S. (2004). Condition-based depreciation—The engineering perspective. *Australian Accounting Review*, 14(3), 48-55. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/217555039?accountid=10139>

Howell, C. D. (1966). Hospital depreciation funding. *National Association of Accountants. NAA Management Accounting*, 47(6), 48-50. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/199453999?accountid=10139>

Inglis, J. B. (1949). Corporate financial reporting—Selective study of annual statements for 1948. *National Association of Cost Accountants. NACA Bulletin*, 31(1), 253-268. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/199019924?accountid=10139>

Littrell, E. K. (1986). Shadows and mirrors: Just-in-time depreciation approved by SASB. *Management Accounting*, 68(4), 63.

MacArthur, J. B. (2008, January). Practical guidelines for replacement cost depreciation in RCA. *Cost Management*, 22(1), 29-34. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/209699746?accountid=10139>

Martin, S. A. (1959). A managerial approach to depreciation and deferred income taxes. *Business Quarterly*, 24(1), 28-35. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/224685670?accountid=10139>

- McAnly, H. T. (1958). Recognizing the deficiency of depreciation provisions based upon historical costs. *National Association of Accountants. NAA Bulletin* 39(6), 5-15. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/198868996?accountid=10139>
- McCahey, J. (1999). Company reporting: Improving, but more care needed. *Australian CPA*, 69(7), 28-29. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/211312047?accountid=10139>
- Nurnberg, H. (1989). Depreciation in the cash flow statement of manufacturing firms: Amount incurred or amount expensed? *Accounting Horizons*, 3(1), 95-101.
- Raby, W. L. (1950). Some further methods of calculating depreciation to relate annual charges more closely to usefulness of the asset. *Journal of Accountancy*, 89(6), 14. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/198248419?accountid=10139>
- The recapitalization of Gillette safety razor. (1931, November 30). *Barron's*, 11(48), 10. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:3322/docview/350214962?accountid=10139>
- Recognition of depreciation by not-for profit organizations - GASB-FASB friction. (1987). *The CPA Journal*, 57(10), 9-10.
- ROI and inflation: U.S. steel president speaks out. (1979). *Management Accounting*, 60(8), 12-16,28.
- SFAS 93 requires all not-for-profits to record depreciation. (1988). *The CPA Journal*, 58(6), 64-68.
- Sigidov, Y. I., Rybyantseva, M. S., Adamenko, A. A., & Yarushkina, E. A. (2016). Methodological aspects of depreciation as an economic category. *International Journal of Economics and Financial Issues*, 6(1), 88-95. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/1796269610?accountid=10139>
- Standard Brands pays as it goes: Policy of charging extraordinary expenses to earnings holds down net. (1930, May 26). *Barron's*, 10(21), 28. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:3322/docview/350155981?accountid=10139>
- Walkowiak, M. P. (2014). Vestiges of British, German and Polish tax depreciation and amortization regulations in IFRS financial statements. *The Poznan University of Economics Review*, 14(2), 63-79. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/1551392377?accountid=10139>
- Wright, F. K. (2006). Depreciation theory in the 1960s. *Accounting History*, 11(1), 85-95. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/214910293?accountid=10139>

DIVERGENCE IN THE PUBLIC COMPANY ANNUAL REPORT DISCLOSURE: WHAT DO HOLY LAND PRINCIPLES AND SUSTAINABILITY ISSUES SUGGEST ABOUT CORPORATE PERFORMANCE?

Gregory S. Kordecki, Clayton State University, gregkordecki@clayton.edu

INTRODUCTION

This paper reviews shareholder proxy proposals of selected publicly-held companies in the U.S. for possible association between specific social policy human rights implementation and the entity's performance measured by stock market price. The purpose includes examination for any correlation between the consideration of Holy Land Principles and positive growth in the company compared to the results of other major companies. The paper also recommends items for future research on disclosure information which can help financial statement users discriminate between companies on overall performance.

Advances that have been achieved on sustainability in Europe through the Global Reporting Initiative (GRI) and the International Integrated Reporting Council (IIRC), are now becoming more apparent in the United States, especially with the evolution of the Sustainability Accounting Standards Board (SASB). Wider implementation of positive environmental, social, and governance (ESG) practices will likely be seen as corporate generic boilerplate language disclosure is replaced with sound metrics (Cohn, 2017). The movement on ESG, and especially, human rights issues, captures views on both the side of no action versus of intervention in these aspects of the labor market. This paper offers optimism that at least the corporate awareness of shareholder concerns may be a positive for corporate performance.

RELEVANT DEVELOPMENTS IN HUMAN CAPITAL REPORTING

Human rights social policy inclusion in publicly held companies is accelerating in interest with the global professional organizations devoted to sustainability and integrated report. In the United States, these efforts have been slower, but may take on more interest as the Securities and Exchange Commission (SEC), corporate issuers and auditors of financial statements, and other regulators assess the international climate for competition. Principles of human rights have been proposed as part of corporate reporting over several decades with Sullivan Principles, MacBride Principles, Ruggie Principles, and most recently Holy Land Principles.

Developed by retired Philadelphia minister and social activist, Reverend Leon Sullivan established a code which may have been instrumental in ending apartheid in South Africa (Chevron Chairman, 1999). The Sullivan Principles came into existence in 1977 with the announcement of their adoption by twelve large U.S. companies, forming a code of conduct on treatment of non-white workers by companies doing business in South Africa (McMillan, 1996). With approximately 200 of 275 American companies operating in South Africa and following the Sullivan Principles, Harrison and Lewellyn (2004) cite the global Sullivan Principles as fundamental, basic human rights and instrumental in developing a theoretical underpinning for corporate social reporting.

Brown (2004) suggests that the MacBride Principles, job discrimination against Catholics in Northern Ireland, were modelled loosely on the Sullivan Principles. Father Sean McManus, an Irish born Catholic priest working in the United States, announced the MacBride Principles in 1984 as a corporate code of conduct for American companies doing business in Northern Ireland, and with such principles not calling for disinvestment, divestment, or reverse discrimination—the MacBride Principles was signed into U.S. law by President Bill Clinton in 1998. (McManus, 2014). Brown (2004) states that while there is little evidence of the MacBride Principles impacted investment decisions in Northern Ireland, companies may

have been dissuaded from doing business in Northern Ireland merely due to the existence of the MacBride Principles.

In 2011, Guiding Principles on Business and Human Rights (the Ruggie Principles) guidelines emerged from the United Nations, with the general goal of achieving a common ground between state obligations and corporate responsibilities (Hackett & Moffett, 2016). Based on report by John Ruggie, special representative of the secretary-general of the United Nations on the issue of human rights and transnational corporations and other business enterprises, the document offers general guidelines on issues involving multinational corporations and human rights (Ruggie Principles, 2011).

Sean McManus, pleased with the fact that 116 companies had signed into the MacBride Principles, argues that his proposal for the Holy Land Principles is totally consistent with the Ruggie Principles (SEC Rules, 2015; Holy Land Principles, 2016). He is frustrated with the lack of progress so far on his current mission, but notes that it took five years to obtain the first signature on the MacBride Principles. McManus views the Holy Land Principles as pro-Jewish, pro-Palestinian, and pro-company, with a win for all (Holy Land Principles, 2015). Figure 1 lists the eight guidelines of the Holy Land Principles.

Figure 1. Holy Land Principles: Set of Equal Opportunity Employment Principles to Serve as Guidelines for Corporations in Israel/Palestine

1.	Adhere to equal and fair employment practices in hiring, compensation, training, professional education, advancement and governance without discrimination based on national, racial, ethnic, or religious identity.
2.	Identify underrepresented employee groups and initiate active recruitment efforts to increase the number of underrepresented employees.
3.	Develop training programs that will prepare substantial numbers of current minority employees for skilled jobs, including the expansion of existing programs and the creation of new programs to train, upgrade, and improve the skills of minority employees.
4.	Maintain a work environment that is respectful of all national, racial, ethnic and religious groups.
5.	Ensure that layoff, recall and termination procedures do not favor a particular national, racial, ethnic or religious group.
6.	Not make military service a precondition or qualification for employment for any position, other than those positions that specifically require such experience, for the fulfillment of an employee's particular responsibilities.
7.	Not accept subsidies, tax incentives or other benefits that lead to the direct advantage of one national, racial, ethnic or religious group over another.
8.	Appoint staff to monitor, oversee, set timetables, and publicly report on their progress in implementing the Holy Land Principles.

Source: Drawn from the Shareholder Proposal—Implement Holy Land Principles (Item 8) of the *Boeing Company 2017 Notice of Annual Meeting of Shareholders*, p. 60.

The Boeing Company shareholder proposal as shown in Figure 1 is same for the other companies discussed below. In each case the board of directors unanimously recommends a vote against the proposal. Common reasons cited include overall expense, duplication of work already performed, company preferring to implement policies within its own structure rather than have a mandated one, and creation of conflicts with the sets of policies necessary to work in other parts of the world.

PROXIES ON DOW 30 COMPANIES

Figure 2 contains all the Dow 30 stocks. For the purposes of this paper, “Dow 30” will be the expression used to designate the components of the Dow Jones Industrial Average (DJIA) and is separate from the transportation and financial indices. The Dow 30 stocks were selected because they are among the most popular as solid, “blue chip,” and widely held stocks in the world, and offer reasonable boundaries of an informal study on Holy Land Principles. Dividend rates are also shown in Figure 2 as some analysts consider this measure as an important contribution to overall growth in a corporation’s stock price.

Figure 2. Dow 30 Stocks by Dividend Rate and Stock Market Price September 30, 2017

AAPL	Apple Inc.	1.64%	\$154.12
AXP	American Express	1.55%	\$90.46
BA	Boeing Co.	2.23%	\$254.21
CAT	Caterpillar Inc.	2.50%	\$124.71
CSCO	Cisco Systems	3.45%	\$33.63
CVX	Chevron Corp	3.68%	\$117.50
DIS	The Walt Disney Company	1.58%	\$98.57
DWDP	DowDuPont Inc.	0.00%	\$69.23
GE	General Electric	3.97%	\$24.18
GS	Goldman Sachs	1.26%	\$237.19
HD	Home Depot	2.18%	\$163.56
IBM	IBM Corp	4.14%	\$145.08
INTC	Intel Corp	2.86%	\$38.08
JNJ	Johnson & Johnson	2.58%	\$130.01
JPM	JP Morgan Chase	2.35%	\$95.51
KO	Coca-Cola Co.	3.29%	\$45.01
MCD	McDonald's	2.58%	\$156.68
MMM	3M	2.24%	\$209.90
MRK	Merck	2.94%	\$64.03
MSFT	Microsoft	2.26%	\$74.49
NKE	Nike Inc.	1.39%	\$51.85
PFE	Pfizer	3.59%	\$35.70

PG	Procter & Gamble	3.03%	\$90.98
TRV	Travelers Co.	2.35%	\$122.52
UNH	UnitedHealth Group	1.53%	\$195.85
UTX	United Technologies	2.41%	\$116.08
V	Visa	0.63%	\$105.24
VZ	Verizon	4.77%	\$49.49
WMT	Wal-Mart Stores	2.61%	\$78.14
XOM	Exxon Mobil	3.76%	\$81.98

Source: *Dividend.com* -- Available from <http://www.dividend.com/dividend-stocks/dow-30-dividend-stocks.php>

Figure 3 illustrates the activity on the Dow 30 stocks over the three-year period, 2015 to 2017 for any shareholder proposal dealing with social policy human rights. This *Proxy Monitor* data becomes available as the SEC requires companies to comply with SEC Rule 14a-8, which permits properly filed timely proposals to be included for proxy votes by even minority stockholders. Boerner (2012) comments that the percentage of social policy resolutions from 2009 to 2010 increased from 29% to 37% as measured by shareholder proxy proposal submissions.

Figure 3. Stockholder Proposals on Social Policy Human Rights 2015-2017

Company Name	Year	Title	Proponent	Votes For %
Apple Inc. AAPL	2016	Human Rights Risk	The National Center for Public Policy Research	1.76
Boeing Co BA	2016	Report on Arms Sale to Israel	Richard Berg	5.08
Boeing Co BA	2017	Arms Sale to Israel	N/A - Undisclosed	3.82
Caterpillar Inc. CAT	2015	Review of	Mercy Investment Program	5.1
Caterpillar Inc. CAT	2015	Review of Human Rights Policies	The National Center for Public Policy Research	17.32
Cisco Systems, Inc. CSCO	2015	Implement Holy Land Principles	Holy Land Principles, Inc.	2.79
Coca-Cola Co KO	2017	Human Rights Review	The National Center for Public Policy Research	1.76
Merck & Co., Inc. MRK	2017	Conflict-Affected Areas	Heartland Initiative, Inc.	23.58
Procter & Gamble Co PG	2017	Conflict Affected Areas	Heartland Initiative, Inc.	0

Source: *Proxy Monitor*. Available at <http://www.proxymonitor.org/Results.aspx>

Figure 3 only shows the proxy proposals for social policy human rights for the years 2015 through 2017 as accumulated by Proxy Monitor. There are other proposals that could have been studied, such as non-GAAP measurers, and directors' policies, but those matters are outside the scope of the paper. Also, beyond the boundaries of this study is the interesting area of climate control and other ESG issues.

Likely due to classification differences, only one Holy Land Principles proponent is shown in the list. While the list shows Boeing Co, 2017, Arms Sale to Israel as N/A-Undisclosed, actual examination of that company's annual report and proxy filing shows Holy Land Principles. This list by Proxy Monitor is revealing especially in the "Votes For %", with only two of the social policy human rights results for the three-year period in double digits, and then very low at approximately 17% and 24% for Caterpillar and Merck, respectively. In addition, the *Proxy Monitor* list does not capture all the recent activity. Figure 4 shows the actual proxy list of companies for implementing Holy Land Principles in their 2017 proxy materials.

Approximately 550 major US companies do businesses in Israel and Palestine. Holy Land Principles, Inc. has entered proxy requests on the major companies doing business where there are questions of employment practices in areas governed by both Israel and Palestinian Authority. Figure 4 lists the Dow 30 companies where Holy Land Principles proxy proposals were made for 2017.

Figure 4. Dow 30 Companies with a Holy Land Principles Proposal 2017

Symbol	Company
BA	The Boeing Company
MCD	McDonald's Corporation
MMM	3M
MRK	Merck & Co., Inc.
PFE	Pfizer
PG	The Procter & Gamble Company

Source: Constructed by the author from examination of each individual company's 2017 proxy material.

The combined company results from figures 3 and 4 generate the following larger list (to include Cisco systems, Inc.), shown below as figure 5. For the remainder of this paper, the designation "**HLP**" is used to refer to these seven companies with a Holy Land Principles proposal over the three-year period 2015 to 2017, and "**non-HLP**" to the other 23 companies in the Dow 30.

Figure 5. HLP Composition of the Dow 30

Symbol	Company
BA	The Boeing Company
CSCO	Cisco Systems, Inc.
MCD	McDonald's Corporation
MMM	3M
MRK	Merck & Co., Inc.
PFE	Pfizer
PG	The Procter & Gamble Company

These seven companies then can be considered as a block of the 30 Dow companies where there has been a solid shareholder proposal addressing the Holy Land Principles during the three-year period, 2015-2017, and the financial gains as measured by stock market price can be compared to the remaining Dow 30 companies.

FINANCIAL RESULTS

Figure 6. HLP Companies Stock Market Price December 31, 2014-September 30, 2017

Symbol	Company	December 31, 2014	September 30, 2017	Difference	% Change
BA	The Boeing Company	119.93	254.21	134.28	112.0
CSCO	Cisco Systems, Inc.	25.40	33.63	8.23	32.4
MCD	McDonald's Corporation	86.17	156.68	70.51	81.8
MMM	3M	153.12	209.90	56.78	37.1
MRK	Merck & Co., Inc.	52.09	64.03	11.94	22.9
PFE	Pfizer	28.20	35.70	7.50	26.6
PG	Procter & Gamble Company	83.43	90.98	7.55	9.0
	SIMPLE AVERAGE				46.0%

Figure 7. Non-HLP Companies Stock Market Price December 31, 2014-September 30, 2017

Symbol	Company	December 31, 2014	September 30, 2017	Difference	% Change
AAPL	Apple, Inc.	104.86	154.12	49.26	47.0
AXP	American Express, Co.	88.93	90.46	1.53	1.7
CAT	Caterpillar, Inc.	82.74	124.71	41.97	50.7
CVX	Chevron Corporation	99.74	117.50	17.76	17.8
DIS	The Walt Disney Company	90.99	98.57	7.58	8.3
DWDP	DowDuPont, Inc.	44.10	69.23	25.13	57.0
GE	General Electric	23.07	24.18	11.10	4.8
GS	Goldman Sachs	186.62	237.19	50.57	27.1
HD	Home Depot	98.98	163.56	64.58	65.2
IBM	IBM Corporation	145.52	145.08	-.44	-0.3
INTC	Intel Corporation	33.36	38.08	4.72	14.1
JNJ	Johnson & Johnson	96.86	130.01	33.15	34.2
JPM	JP Morgan Chase	58.20	95.51	37.31	64.1
KO	Coca-Cola Co.	38.60	45.01	6.41	16.6
MSFT	Microsoft	43.27	74.47	31.20	72.1
NKE	Nike, Inc.	46.28	51.85	5.57	12.0
TRV	Travelers Co.	99.37	122.52	23.15	23.3
UNH	United Health Group	99.64	195.85	96.21	96.6
UTX	United Technologies	107.49	116.08	8.59	7.99
V	Visa	63.78	105.24	41.46	65.0
VZ	Verizon	41.19	49.49	8.30	20.2
WMT	Wal-Mart Stores	79.57	78.14	-1.43	-1.8
XOM	Exxon Mobil	83.94	81.98	-1.96	-2.4
	SIMPLE AVERAGE				33.6%

It is interesting to note that the percentage growth averages of 46.0% for HLP and 33.6% for non-HLP become less pronounced, when considering the larger field of “human rights”. As Figure 7 above shows Apple, Caterpillar, and Coca-Cola all carried non-Holy Land Principles, but other Human Rights proposals were submitted in their proxy materials since 2015. In addition, the author identified from 2017 proxy material three additional Dow 30 companies, Chevron, Travelers, and Verizon, where stockholder proposals are consistent with Ruggie and other social human rights policies. When isolating these six additional companies, Figure 8 still shows favorable stock market gains correlating to these companies.

Figure 8. Social Policy Human Rights, but Non-HLP Stock Market Prices

Symbol	Company	December 31, 2014	September 30, 2017	Difference	% Change
AAPL	Apple, Inc.	104.86	154.12	49.26	47.0
CAT	Caterpillar, Inc.	82.74	124.71	41.97	50.7
CVX	Chevron Corporation	99.74	117.50	17.76	17.8
KO	Coca-Cola	38.60	45.01	6.41	16.6
TRV	Travelers Co.	99.37	122.52	23.15	23.3
VZ	Verizon	41.19	49.49	8.30	20.2
	SIMPLE AVERAGE				29.3%

However, the sample field is not as strong as those companies with proposals emphasizing the Holy Land Principles. Curiously, the average of 29.3%, being less than the 33.6% in Figure 7 above might suggest that non-Holy Land Principles social policy human rights requests work in the opposite direction of financial market gains.

CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

Cause and effect is many times difficult to determine, and correlation should not be confused with causation. The positive stock market gains by the Holy Land Principles companies might be due to a whole range of factors and may only by co-incidence carry high correlation with the financial strength. Some reasons may include . . .

- Companies on which the stockholder put forth proposals may have done well in Israel and hence more obvious targets,
- Some Dow 30 companies may not be doing business in Israel.
- Companies selected by Holy Land Principles, Inc. may have been based upon prior economic strength, giving those entities a priority for their selection.

The practice of allowing minority stockholder proposals in the proxy materials has been questioned. The House Financial Services Subcommittee (2016) expressed concern that it is only a small group of stockholders dominating the process of shareholder proposals, and using Holy Land Principles, Inc has placed its proposals on significant companies when their ownership in some cases is as low as 55 shares. The Subcommittee further summarized that that in the decade 2006 to 2015 only 1% of shareholder proposals involved investors without a labor affiliation, or a social, or religious focus. Accordingly, bias is recognized, but still may be healthy and worthy of further study. Francis (2017), corporate secretary and chief governance officer at Chevron Corporation also argues that requiring companies to resolve social issues place by shareholders detracts greatly from the work of the companies with frequently little to do on enhancing shareholder value.

From a scan of dividend rates in Figure 2, it does not appear there is a significant difference between Holy Land Principles proposed companies versus the other companies in the Dow 30. However, future research might bear this out. Book value statistics in addition to the market value of stock market price may provide for fruitful research. Revenue and earnings trends might be studied to see whether there is change along with social constructs proposed or implemented.

Is the proxy the best mechanism for addressing ESG matters? It does not appear to be efficient, nor effective in the short run from the proponent's viewpoint. Research might delve into what may be other means to advance ESG goals. The results of this study offer some hope as compared to an earlier study by McMillan (1996) where he found that the application of the Sullivan Principles actually had a negative effect on stock market price of the participating companies.

This informal study should not be viewed as conclusive until additional data are obtained. With more data points over more years of time, and with more active stockholders included along with other companies, willing to propose disclosures, studies can be conducted which may have an influence on standard-setters beyond sustainability bodies. The SEC, PCAOB, FASB, and AICPA may take more active interest in such disclosure and the effect may even bear out in accounting and auditing pronouncements.

REFERENCES

The Boeing Company (2017). *2016 Annual Report and 2017 Annual Meeting of Shareholders*. Chicago, IL.

Boerner, H. (2012). Corporate beauty contests: What is the rank/score for your company? *Corporate Finance Review*, 16(6), 35-39. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/1431036086?accountid=10139>

Brown, J. M. (2004, May 07). Quest for fairness may have tipped balance: Legislators are under pressure to look closely at the factors behind growing dissatisfaction among protestants, writes john murray brown. *Financial Times*. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/249580776?accountid=1013>

Chevron chairman ken derr lauds rev. leon sullivan for the introduction of the global sullivan principles at the united nations. (1999, Nov 03). *PR Newswire* Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/449478813?accountid=10139>

Cohn, M. (2017). Companies struggle to go beyond boilerplate in sustainability disclosure. *Accounting Today*. Available at <https://accountingtoday.com/news/companies-struggle-to-go-beyond-boilerplate-in-sustainability-disclosures>

Dividend.com (2017). Available from <http://www.dividend.com/dividend-stocks/dow-30-dividend-stocks.php>

Francis, M. A. (2017). Why it's time for shareholder proposal reform. *Directorship*, 43(2), 64-65. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/1903812626?accountid=10139>

Hackett, C., & Moffett, L. (2016). Mapping the public/private-law divide: A hybrid approach to corporate accountability. *International Journal of Law in Context*, 12(3), 312-336.
doi:<http://ezproxy.clayton.edu:2090/10.1017/S1744552316000239>

Harrison, D. S., & Lewellyn, P. G. (2004). Russian management training programs: Do corporate responsibility topics have a place? *Management Accounting Quarterly*, 5(4), 25-36. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/222802457?accountid=10139>

Holy land principles gave GE second chance. (2016, May 03). *U.S.Newswire*. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/1786231100?accountid=10139>

Holy land principles: American principles following American investments. (2015, Feb 24). *U.S.Newswire*. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/1657613189?accountid=10139>

House financial services subcommittee on capital markets and government sponsored enterprises hearing. (2016). Lanham: Federal Information & News Dispatch, Inc. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/1822399512?accountid=10139>

McMillan, G. S. (1996). Corporate social investments: Do they pay? *Journal of Business Ethics*, 15(3), 309-314. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/198103241?accountid=10139>

McManus, S. (2014). My American struggle for justice in Northern Ireland...and the holy land. *The Washington Report on Middle East Affairs*, 33(1), 20-21. Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/1504678671?accountid=10139>

Proxy Monitor (2017). Available at <http://www.proxymonitor.org/Results.aspx>

Ruggie Principles (2011). *UN Guiding Principles and Human Rights*. Available at <http://www.ohchr.org/documents/issues/business/A.HRC.17.31.pdf>

SEC rules in favor of holy land principles in 3 cases. (2015). *Health & Beauty Close - Up*, Retrieved from <http://ezproxy.clayton.edu:2048/login?url=https://ezproxy.clayton.edu:2230/docview/1655940655?accountid=10139>

Principles versus Rules and Revenue Recognition Differences Exacerbating U.S. GAAP and

IFRS Convergence

Regan W. Garey, DBA, CPA

Lock Haven University

U.S. Generally Accepted Accounting Principles' (GAAP) reliance upon rules and the International Financial Reporting Standards' (IFRS) tendency to focus more on principles has been and continues to be a highly debated subject. Some accounting experts would argue that this categorization is far too simplistic. "To suggest that significant pieces of U.S. GAAP are just rules with no underlying principles is an insult to the Financial Accounting Standards Board and the other groups that have contributed to U.S. GAAP over the years."(Taub, 2014).

Although this is a multi-faceted, continuing, contentious debate this paper primarily focuses on the role of revenue recognition and the implicit role of conservatism. The timing of revenue recognition is one of the top theoretical differences between financial reporting in the U.S. vs. in the approximate 120 countries using IFRS. With the imminent convergence of US GAAP and IFRS, one could argue that this possible outcome should be examined further since, as many would agree, IFRS takes a more aggressive, albeit less conservative view on revenue recognition. International convergence and conservatism are interrelated concepts in that auditors have an interest in conservatism and investor fidelity (Bratton, 2003).

Many believe that IFRS' reliance upon principles more than rules requires a substantial level of judgment on the part of both accountants and auditors. Although neither system is entirely either rules-based or principles-based, regulators need to decide which system will dominate (Phillips, 2010). In 2005, the European Union began the transition to IFRS. According to a UK research group conducted in 2006, principles are not specific enough to provide sufficient guidance in a global context given a myriad of different cultures using principles-based IFRS. In the Institute of Chartered Accountants of Scotland's study they found that use of a principles-based system involved the following steps: identifying the principle in broad terms, i.e. defining the specifics and then discussing the exceptions. This second step entails finding and using words in the standard accurately reflecting the identified principles. This exhaustive process most likely will have to be done with a principles vs. rules based system since specific

guidance unfolds eventually versus being spelled out at the beginning as is the case with rules-based systems.

Rules provide specific guidelines for accounting treatments and focus on the form vs. the substance of the transactions. On the other hand, principles are more broad interpretations and are characterized as being more flexible than rules. As trained accountants know, “the goal of GAAP – ‘in accordance with GAAP’, while the goal of IFRS is to give a ‘fair view’ of a company’s financial position.” (Agrawal, 2008). IFRS by its nature relies even more on assumptions, estimates and use of judgment than does US GAAP. Principles can also be described as tough, broad based rules (Bratton, 2003).

In this paper we focus on some of the general perspective differences between US GAAP and United Kingdom (UK) GAAP as they relate to the reliance upon principles vs. rules. The UK currently is and remains not immune to accounting scandals such as the Polly Peck, Maxwell and BCCI scandals. But since these scandals pre-dated some of those in the U.S. such as Enron, is there the possibility that the UK shifted its focus on accounting rules and enhanced corporate governance? (Kershaw, 2005). Although the entire argument is beyond the scope of this article, this question warrants pause. “It argues that the identification of principles-based regulation as an important factor in the UK’s comparative success has molded the posture, the force and the scope of the UK’s post-Enron regulatory review” (Kershaw, p. 595).

Kershaw (2005) also asks the fundamental question that many researchers have asked over the years, namely “when does the use of rules in regulation render a regulatory system rules-based?” (p. 596) According to Cunningham (2007) “While the concepts of rules and principles (or standards) are useful to classify individual provisions, they are not scalable to the level of complex regulatory systems”. (p. 1414) The areas researched by Cunningham (2007) include corporate law, securities regulation and accounting to reflect this issue. The question he poses is whether or not these labels “principles-based” and “rules-based” should be discontinued.

Kershaw (2005) questions when regulation using rules becomes rules-based. “The problem with specific rules is that even when carefully drafted they are invariably both under- and over-inclusive in relation to the original principle. In relation to rule-based prohibitions they are under-inclusive because the rule can only address a very limited number of circumstances in which the principle is implicated” (p. 605). This argument will be illustrated here with the discussion of revenue recognition differences between companies using US GAAP and IFRS.

We propose that there are numerous examples of varying levels of conservatism as a fundamental component of US GAAP and International Financial Reporting Standards (IFRS). Conservatism has long been a fundamental concept of Generally Accepted Accounting Principles (GAAP) in the U.S. We argue that in recent years, this attribute has become less important as the U.S. gravitates towards convergence with IFRS. IFRS’ foundation is more future-oriented, relying upon decision usefulness (IASB framework, IASB, 2006a). This is the case since the International Accounting Standards Board (IASB) and FASB state that prudence and conservatism are not desirable qualities of financial reporting (Hellman, 2008). Thus, the insidious de-emphasis on conservatism and ensuing emphasis on relevance equates to more focus on use of judgment and estimates.

The concept of comparability deserves mention since two primary goals of convergence with IFRS are increased global competition and comparability between companies’ financial reporting regardless of the country of origin. There is much ambiguity related to the concept of conservatism in both the FASB and IASB frameworks. Prudence is important in the IASB structure but there are numerous exceptions to its usefulness as part of the framework. Hellman (2008) states that part of the IASB framework is highly interpretative as it relates to the concept of prudence and conservatism.

“The preparers of financial statements do, however, have to contend with the uncertainties that inevitably surround many events and circumstances, such as the collectability of doubtful receivables, the probable useful life of plant and equipment and the number of warranty claims that may occur. Such uncertainties are recognized by the disclosure of their nature and extent and by the exercise of prudence in the preparation of the financial statements. Prudence is the inclusion of a degree of caution

in the exercise of the judgments needed in making the estimates required under conditions of uncertainty, such that assets or income are not overstated and liabilities and expenses are not understated. However, the exercise of prudence does not allow, for example, the creation of hidden reserves or excessive provisions, the deliberate understatement of liabilities or expenses, because the financial statements would not be neutral and therefore, not have the quality of reliability” (IASB Framework, paragraph 37)

Ball, Kothari and Robin (1997) studied conservatism in the U.S. as it differs from conservatism in the United Kingdom (UK). They argued that the US and United Kingdom had varying levels of strong incentives in timely recognition of bad news. According to the Ball et al, this was due to the United Kingdom’s less strict approach to accounting regulation and to lower expected litigation costs. The following statement is but one example of a difference between the US and the UK regarding financial transactions. “... the relatively permissive and ambiguous definition of extraordinary items under U.K. GAAP before 1993 created opportunities for firms to manage ordinary earnings by taking large transitory write-offs, consistent with conservative income recognition, through extraordinary items.” (Ball, Kothari and Robin, 1997)

The following excerpt from the IASB illustrates that the idea of prudence, i.e. conservatism is still worth continued dialogue.

“What is the role of conservatism (or prudence)? Does it conflict with neutrality? If not, why not? Why keep it?”

Answer: The IASB Framework lists prudence as a subquality of reliability, calling prudence “the inclusion of a degree of caution in the exercise of the judgments needed in making the estimates required under conditions of uncertainty, such that assets or income are not overstated and liabilities or expenses are not understated” (paragraph 37). FASB Concepts Statement 2 discusses *conservatism*—meaning *prudence*—at length in paragraphs 91–97, defining it as “a prudent reaction to uncertainty to try to ensure

that uncertainty and risks inherent in business situations are adequately considered,” but pointedly leaves it out of its table of qualitative characteristics. The IASB does go on to say that “the exercise of prudence does not allow, for example, the creation of hidden reserves or excessive provisions, the deliberate understatement of assets or income, or the deliberate overstatement of liabilities or expenses, because the financial statement would not be neutral and, therefore, not have the quality of reliability.”

The staff is reluctant to continue to include conservatism or prudence in a list of qualitative characteristics of accounting information right there next to neutrality. The clash of concepts is glaring. Remembering that the first objective of financial reporting [agreed upon by both Boards at last month’s joint meeting] is to provide information useful to present and potential investors and creditors, is it truly helping present investors to understate the net assets of an entity whose securities they now own, possibly inducing them to sell what they might better keep? Is it truly helping potential investors to understate the net income of an entity they might invest in, possibly discouraging them from an investment they might better make? It has been suggested that conservatism is a characteristic of accountants, a counterweight to the exuberance of other kinds of business.

The UK Statement of Principles discusses prudence in similar terms to the IASB, going further to say that under conditions of uncertainty, it requires more confirmatory evidence about the existence of, and a greater reliability of measurement for, assets and gains that is required for liabilities and losses; it does, however, echo the IASB’s rejection of hidden reserves, excessive provisions, and deliberate over- or people, rather than a necessary characteristic of accounting information” (http://www.ifrs.org/Current-Projects/IASB-Projects/Conceptual-Framework/Meeting-Summaries-and-Observer-Notes/Documents/May050505ob07_b.pdf)

Revenue Recognition

Revenue recognition guidance under both frameworks needed improvement. US GAAP comprised wide-ranging revenue recognition concepts and requirements for particular industries or transactions that could result in different accounting for economically similar transactions. The guidance was criticized for being fragmented, voluminous, and complex. While IFRS had less guidance, preparers found the standards sometimes difficult to apply as there was limited guidance on certain important and

challenging topics. The disclosures required by US GAAP and IFRS often did not provide the level of detail investors and other users needed to understand an entity's revenue-generating activities.

The boards subsequently issued multiple amendments to the new revenue standard in 2015 and 2016 as a result of feedback from stakeholders, primarily related to: □ Deferral of the effective date of the revenue standard by one year (see RR 13.2) □ Collectibility (see RR 2.6.1.5) □ Identification of performance obligations (see RR 3.3) □ Noncash consideration (see RR 4.5) □ Licenses of intellectual property (see RR 9) □ Principal versus agent guidance (see RR 10) □ Practical expedients at transition (see RR 13.3.2)

As mentioned, revenue recognition criterion differences remain one of the more contentious areas between US GAAP and IFRS. It is germane in this paper since many researchers and accountants view IFRS as being less conservative and as being in fact, more aggressive in the area of revenue recognition.

Revenue recognition — general

The Securities and Exchange Committee (SEC) has taken an active role in deciphering accounting conceptual discussions related to revenue recognition. Broad conceptual discussions have occurred in addition to the development of industry-specific guidelines (SEC.gov)

As explained by the SEC, if there is a void in authoritative direction regarding a particular industry, “the staff will consider the existing authoritative accounting standards as well as the broad revenue recognition criteria specified in the FASB’s conceptual framework that contain basic guidelines for revenue recognition.” (SEC.gov)

Accountants trained in US GAAP are familiar with the concept that revenue should not be recognized until it is realized or realizable and earned. This is discussed in Concepts Statement 5, *Recognition and Measurement in Financial Statements of Business Enterprises*, in paragraph 83(b)

which states that “an entity’s revenue-earning activities involve delivering or producing goods, rendering services, or other activities that constitute its ongoing major or central operations, and revenues are considered to have been earned when the entity has substantially accomplished what it must do to be entitled to the benefits represented by the revenues” [footnote reference omitted]. This discussion continues in Paragraph 84(a) as “the two conditions (being realized or realizable and being earned) are usually met by the time product or merchandise is delivered or services are rendered to customers, and revenues from manufacturing and selling activities and gains and losses from sales of other assets are commonly recognized at time of sale (usually meaning delivery)” [footnote reference omitted]. Lastly, paragraph 84(d) discusses the circumstances in which items such as interest or rent can be reliably measured when contractual prices are pre-established and readily available, in which case revenue is recognized as time passes.

According to the SEC, “revenue generally is realized or realizable and earned when all of the following criteria are met: persuasive evidence of an arrangement exists, delivery has occurred or services have been rendered, the seller’s price to the buyer is fixed or determinable, and collectibility is reasonably assured.” <http://www.sec.gov/interps/account/sabcodet13.htm#A.1>

A Different Perspective on Conservatism Differences between US GAAP and IFRS

Another interpretation is discussed below by Philippe DANJOU, (Board Member, of the International Accounting Standards Board) regarding his view that IFRS is not less conservative and somewhat less prudent than US GAAP. This discussion is an important underlying aspect of the revenue recognition differences in approach between US GAAP and IFRS. This discussion took place February 1, 2013 and the main argument was about accounting prudence with the IFRS framework.

“An effective altimeter shall be calibrated in a neutral manner, and should not include inertia mechanisms hiding altitude variations. Similarly, as regards financial information reporting, transactions and economic events shall be recorded in the statements in an unbiased manner, without emphasizing a

“principle of prudence” which would actually consist in introducing a systematic negative bias of measurement and in setting up hidden reserves.

Understating the assets or overstating the liabilities during an accounting period often leads to a distortion in the actual business performance, not only over the related period, but also in a future period: this is inconsistent with an unbiased reporting objective and with the principle of fair and equal treatment of the present and future shareholders. This has been strongly condemned by the stock exchange authorities in many countries, and furthermore, I believe this is contrary to the true and fair view principle as stated in the 4th and the 7th European Union Directives.

The IFRS Conceptual Framework, a guide adopted and followed by the standard setter when drafting new standards, has therefore deleted the explicit reference to prudence as a fundamental principle, since the IASB determined, as did its predecessor the IASC, that the use of this principle could result in abusive accounting practices.

The IASB has made the assumption that the users of the financial information are sufficiently knowledgeable on economic issues to respond in a rational way to expansion or contraction phases, without the need to implement for them a “prudential filter”, generally and for the financial statements of all entities. However, the prudential regulators of financial intermediaries (mainly banks and insurance companies), while using the financial information reported to them, may wish to implement supplemental “prudential filters”, in addition to setting liquidity and capital ratios, in order to influence the behaviour of the banks or the insurance companies and to ensure a sufficient level of equity capital to withstand economic depressions. These intermediaries do carry on their balance sheets some risks “on behalf of third-parties” requiring specific supervision and some special precautions. This should not be a strictly accounting concern.

The role of IFRSs is not to act as an economic control instrument, beyond ensuring financial transparency, which is a condition for the proper operation of markets and a key component of financial

stability. However, prudence remains very significantly incorporated into the various IFRS.” (An Update on International Financial Reporting Standards (IFRSs))

Although beyond the scope of this paper, the interconnection between fraudulent reporting and aggressive reporting should be mentioned. Despite the fact that parties not convinced that the US should converge with IFRS may like to make that correlation between the propensity to fraudulently report financial transactions and IFRS’ presumed more aggressive approach, this would require further study.

One could argue that since there is more guidance on financial transactions’ reporting under US GAAP than there is under IFRS it means that it is easier to prove a misstatement under US GAAP. Violations are more apparent in financial reporting under a rules-based system, i.e. under US GAAP (Phillips, 2010). US GAAP tends toward conservative reporting of revenue and when revenue is not reported accurately and fairly, this situation is more apparent than it would be under IFRS. “Conversely, companies charged with violating IFRS can argue that the violation is merely a product of the innocent exercise of discretion given to them under that system” (Phillips, 2010, p 627).

There is considerably less guidance for reporting transactions under US GAAP than may have been the case had IFRS been the accounting system, as reflected in the Coca-Cola Company case in which Coke transferred large amounts of concentrate to their affiliates that did not want these deliveries (Phillips, 2010). This aggressive, unsubstantiated revenue recognition scheme led to eight years of litigation and a class action settlement that cost Coke \$137.5 million. The intriguing question remains: would the outcome have been different if Coke had been following IFRS vs. US GAAP?

Revenue Recognition Recent Developments

In July of 2013, the FASB and IASB formed a joint transition resource group to further analyze revenue recognition issues. The two governing bodies are in the final stages of agreeing upon a converged revenue recognition standard. As is the common practice during these ‘negotiations’, this group will be

tasked with soliciting, analyzing and discussing applicable stakeholder issues commonly seen in accounting practice.

The group will not offer advice but will provide information to the Boards that will help them solidify an agreement before the standard takes effect in 2017. Accordingly, both FASB's Chairman and IASB's Chairman were asked to comment as follows:

Russell G. Golden, Chairman of the FASB commented:

“Effective implementation of the revenue recognition standard is critical to its success in providing financial statement users with the information they need to make the right decisions about how to allocate their capital. The Boards are committed to ensuring a smooth transition to the new standard, and the transition resource group is an important tool for determining any areas that will need additional guidance before the standard becomes effective in 2017.”

Hans Hoogervorst, Chairman of the IASB commented:

“Revenue is a key performance indicator and is important to every business. Our joint transition group will help to ensure that stakeholders are reading the words in the new revenue standard in the way that we intend that they be read.”

Conclusion

There remains a continuous debate over the reliance and interpretation of principles versus rules and the importance of conservatism as an accounting fundamental. Accounting scandals and fraudulent reporting issues have left such an indelible mark on the accounting profession that researchers are investing much time and effort in analyzing both the role of principles versus rules as well as the successes and failures of other systems in preventing such financial reporting abuses. In this article we focused, in part, on the differences and similarities between US GAAP's and the UK's reliance on IFRS.

Conservatism's role as an often overlooked aspect of both of these accounting systems was debated from both a US GAAP and an IFRS perspective. The progression towards a joint agreement between the FASB and IASB on revenue recognition was used as a pivotal aspect of the discussion on principles versus rules based systems. This progress towards a more consistent approach is especially critical given the accounting scandals that affect the capital markets in our global economy.

Sources Cited

- Agrawal, N. (2008) *The Impact of IFRS on Corporate Governance*, livemint.com, Oct 2, 2008
- Ball, R., Kothari, S.P., & Robin, A. (1997) *The Effect of International Institutional Factors on Properties of Accounting Earnings*, Journal of Accounting and Economics, Vol, 29, No. 1, pp 1-51
- Bratton, W.W. (2003) *Enron, Sarbanes-Oxley, and Accounting; Rules versus Principles versus Rents*
- Cunningham, L.A. (2007) *A Prescription to Retire the Rhetoric of 'Principles-Based Systems' in Corporate Law, Securities Regulation, and Accounting*, Vanderbilt Law Review, Vol. 60:5, 1411
- Hellman, Nicolas (2008) *Accounting Conservatism under IFRS*. Accounting in Europe, Vol. 5, No. 2, p. 71-100.
- IASB, International Accounting Standards Board (2006a). *Preliminary Views on an improved Conceptual Framework for Financial Reporting: The Objective of Financial Reporting and Qualitative Characteristics of Decision-useful Financial Reporting Information*: Discussion Paper, July, 2006. (London: International Accounting Standards Committee Foundation)
- IFRS.org http://www.ifrs.org/Current-Projects/IASB-Projects/Conceptual-Framework/Meeting-Summaries-and-Observer-Notes/Documents/May050505ob07_b.pdf
- Kershaw, D. (2005) *Evading Enron: Taking Principles Too Seriously In Accounting Regulation*, The Modern Law Review Limited
- Phillips, L. (2010) *The Implications of IFRS on the Functioning of the Securities Antifraud Regime in the United States*. Michigan Law Review, Vol. 108, Issue 4, p 603-631.
- SEC.gov <http://www.sec.gov/interps/account/sabcodet13.htm#A.1>
- Taub, S. (2014) *Busting some myths about IFRS and GAAP*, ifrs.org.

The Need for Consistency and Reproducibility in Financial Market Research

By:

Jerry K. Bilbrey, Jr.
Lander University
jbilbrey@lander.edu

Michael Shurden
Lander University
mshurden@lander.edu

Introduction

The basis of scholarly research is to provide a new base for building the body of knowledge. However, in the field of financial modeling, there has been less advancement due to the lack of sufficient modeling details. These details would allow true advancement of previous work. There is a technical aspect to the modeling of financial systems. This includes quantifying and testing various hypotheses. However, the literature has failed to require that sufficient details be disclosed for the modeling process. This is necessary for the advancement of the field. Without both the methodology and details of the models used for testing, reproducing and advancing the field of financial modeling becomes unachievable. The goal of scholarly research is to provide a base upon which it is to be built. Without a solid base, the field of scholarly research is unnecessarily held back as reproducing methods (and subsequently adding to or improving the methods in some manner) becomes impossible to achieve. The objective of this work is to demonstrate the need for more explicit documentation for models in the field of finance.

Purpose of this work

Without enough information to replicate a given method, it cannot be compared to other methods in an apples-to-apples comparison. For instance, virtually all research uses different data sets or different date ranges for their input data. It is critical to be able to compare methods using the same data along with the same parameters chosen for the reported research. Furthermore, it is always possible for mistakes to be made during the modeling process that would otherwise never be discovered if a method cannot be reasonably reproduced.

Another aspect of comparisons is that of bull and bear markets. Some algorithms may work well on one type of data or another but may, in fact, produce less than desirable results on a market other than it was designed for. Also, an algorithm may perform so much less than desired on a given data set that no one would be interested in utilizing the algorithm for fear that the market could change – as it clearly does from time to time.

The sheer possibilities for accumulating wealth make this field of research both fascinating, plausible and intriguing to the general public. Standards are needed for comparisons to be performed. There are necessary and sufficient conditions for scholarly research. The work must perform reasonably well for a method to have minimum desirability (necessary condition). However, the work needs to be reproducible to be compared with other methods (sufficient condition). Without apples-to-apples comparisons, a method may not perform well enough to be seriously considered by industry.

In the end, bullish and bearish markets cannot be predicted with certainty. However, any method should be directly comparable with another method for a given time frame. These types of comparisons are critical to the advancement of the literature. Whether risk, liquidity or any other parameter is being investigated, a given method should produce results. Many scholars will argue that poor results are important for direction so that further work in a given direction will not be pursued. However, industry is not so inclined to put value on work that does not produce positive results.

Study of the literature

For the introduction of generic standards, the parameters necessary to be reported need to be determined. This can reasonably be done through the examination of past work. Certainly, it is not reasonable for a given set of data or timeline to be prescribed as the data and behaviors are almost certainly going to change over time. Also, many different assumptions can be made and factors investigated accordingly. However, quantitative methods should be reasonably compared over a static time frame that can be replicated.

Efficient markets

There is much work that has been performed on the efficient market hypothesis which states that an efficient market effectively prices any public information into the price of a given asset. For instance, Dow and Gorton, 1993, investigate market response to new information. Similarly, in another paper, they (1994) investigate the effects of arbitrage chains based on private information and the effects of the markets as the information become reflected into the price of an asset. For the interested reader, Dimson and Mussavian, 1990, and Fama, 1965, give a discussions of the efficient market hypothesis and its implications. About the same time as Fama, Samuelson, 1965, presented work that prices fluctuate randomly. Balvers et al., 1990, use the efficient market hypothesis as a framework for predicting stock returns.

Psychologies

Due to the possible gains from stock price changes, there has been a plethora of work done on risk due to various psychological factors. One of these factors is noise trading while others mostly focus on quantification of risk factors.

Noise Trading and Risk

There is a some work that has studied the effects of noise trading and ways of quantifying the risk effects. A noise trader is someone who trades on either poor information or no real information at all. This is basically a form of speculation that a security is either priced too high or low based on intuition rather than information. Some early work in this area was done in 1953 by Friedman. A more recent reference to this type of work was preformed by DeLong et al. (1990). They concluded that noise traders do not have a great effect on asset pricing overall.

Quantitative Examples

Cichocki et al., 2005, studied variable selection in predicting a stock index. Gençay, 1998, looked at the optimization of technical trading strategies and their profitability. Leung et al., 2000, also look at forecasting stock indices by comparing classification and level estimation methods. In 1990, Schwert looked at stock returns over an entire century.

Artificial Intelligence methods have drawn an immense amount of interest due to the methods' abilities to look at non-linearity. Lendasse et al., 2000, and Bilbrey et al., 2009, discuss the evidence for non-linear behavior in the stock markets. An artificial intelligence (AI) example is given by Hill et al., 1996. They use neural networks to forecast stock pricing. Another neural network example is given by Enke and Thawornwong, 2005, where they also make an attempt at predicting stock market returns. Jasic and Wood, 2004, also present a case study where they test neural network predictions on the stock market. Yet another AI example was presented by Olson and Mossman, 2003. They utilize neural networks for making predictions on the Canadien stock market. Thawornwong et al., 2003, looked at using neural networks for decision rules and their potential for predicting stock prices. There was so much activity using AI techniques for technical trading that Vellido et al., 1999, created a survey of the techniques and results.

Summary

There has been evidence provided of much interest in the field of predicting financial markets. However, there is one common denominator in the field. That is the lack of consistency which would enable the methods to be directly compared. Although the problem can be defined as an NP-Complete problem due to its endless possibilities, a standard is needed for the advancement of the field as a whole. Without consistent and methodological approaches, advancement in the field will be slow, at best and unproductive at worst.

References

- Balvers, R., T. Cosimano and B. McDonald (1990). "Predicting Stock Returns in an Efficient Market." *Journal of Finance*, 55 (4), pp. 1177-1189.
- Jerry K. Bilbrey, Jr., Neil F. Riley, and Winnie A. Riley (2009) "A Test of Market Efficiency using a Probabilistic Neural Network," *Journal of Business and Behavioral Sciences*, 20(1), spring.
- Cichocki, A., S. Stansell, Z. Leonowicz, and J. Buck (2005). "Independent Variable Selection: Application of Independent Component Analysis to Forecasting a Stock Index." *Journal of Asset Management*, 6 (4), pp. 248-259.
- Dimson, Elroy and Massoud Mussavian (1998). "A Brief History of Market Efficiency." *European Financial Management*, 4 (1), pp. 91-193.
- Dow, James and Gary Gorton (1993). "Trading, communication and the response of price to new information," *The Economic Journal*, 103, pp. 639-646.
- Dow, James and Gary Gorton (1994). "Arbitrage chains," *Journal of Finance*, 49, pp. 819-849.
- Enke, D. and S. Thawornwong (2005). "The Use of Data Mining and Neural Networks for Forecasting Stock Market Returns." *Expert Systems with Applications*, 29 (4), pp. 927-940.
- Fama, Eugene, (1965), "The behavior of stock market prices," *Journal of Business*, 38, pp. 341-05.
- Gençay, R. (1998). "Optimization of Technical Trading Strategies and the Profitability in Security Markets." *Economics Letters*, 59 (2), pp. 249-254.
- Hill, T., M. C'Connor and W. Remus (1996). "Neural Network Models for Time Series Forecasts." *Management Science*, 42 (7), pp. 1082-1092.
- Jasic, T. and D. Wood (2004). "The Profitability of Daily Stock Market Indices Trades Based on Neural Network Predictions: Case Study for the S&P 500, the DAX, the TOPIX, and the FTSE in the Period 1965-1999." *Applied Financial Economics*, 14, pp. 285-297.
- Lendasse, A., E. De Bodt, V. Wertz, and M. Verleysen (2000). "Non-linear Financial Time Series Forecasting – Application to the Bel 20 Stock Market Index." *European Journal of Economic and Social Systems*, 14 (1), pp. 81-91.
- Leung, M., H. Daouk and A. Chen (2000). "Forecasting Stock Indices: A Comparison of Classification and Level Estimation Models." *International Journal of Forecasting*, Volume 16, Number 2, pp. 173-190.
- Olson, D. and C. Mossman (2003). "Neural Network Forecasts of Canadian Stock Returns using Accounting Ratios." *International Journal of Forecasting*, 19 (3), pp. 453-467.
- Samuelson, Paul (1965). "Proof That Properly Anticipated Prices Fluctuate Randomly." *Industrial Management Review*, 6, pp. 41-49.

Schwert, W. (1990). "Stock Returns and Real Activity: A Century of Evidence." *Journal of Finance*, 45, pp. 1237-1257.

Thawornwong, S., D. Enke, and C. Dagli (2003). "Neural Networks as a Decision Maker for Stock Trading: A Technical Analysis Approach." *International Journal of Smart Engineering System Design*, 5 (4), pp. 313-325.

Vellido, A., P. Lisboa and J. Vaughan (1999). "Neural Networks in Business: A Survey of Application (1992-1998)." *Expert Systems with Applications*, 17 (1), pp. 51-70.

Data Monetization as a Growing Business Revenue Stream: Issues and Challenges

Uma Gupta, State University of New York at Buffalo State College

Abstract

The idea that data is an asset is decades old. Today, many companies are cognizant of the critical importance and revenue potential of the data that they generate, process, and analyze. Data is a means to gain deeper insights and dominance in the marketplace and thereby increase revenues, decrease costs, and grow and engage customers. With Big Data emerging as a powerful competitive tool, organizations are harnessing their abilities and capacities not only to leverage data to enhance organizational performance, but also to monetize huge troves of data through meaning-making of such data to external constituents and partners. Data monetization is a rising tide and organizations that ride this wave will achieve a significant competitive edge in the marketplace. This paper explores the fundamentals of data monetization, its potential and challenges, and identifies steps for success for early adopters.

Introduction:

The role and value of data has shifted from that of an asset that is primarily deployed to strengthen and grow internal assets, such as products, services, business processes and talent, make better internal and external decisions, strengthen the efficiency of business processes, increase profits, decrease costs, deliver higher value to customers, and achieve market dominance to becoming an invaluable asset in its own right. Data has now become *a stand-alone* asset, product or service that in its own capacity and right can deliver innovation, trigger the development of new products or add value to existing products and services, and capture insights of great value to customers. Data is now a steady and reliable primary source of revenue to forward-thinking and innovative organizations. Since data as a product or service can be monetized it now competes directly with other products and services for limited resources. The ability to monetize data is a strategic issue because of its direct impact and potential on the profits, growth, market power and dominance of an organization.

Data monetization is not a technology issue; it is a business issue. In other words, it is true that technology and technological skill sets, infrastructure, and capabilities are at the heart of data monetization. However, the vision and strategy to leverage technology in an efficient, timely and innovative way to generate sustainable revenues and market competencies is a strategic issue that deserves the full attention of the Csuite. Senior executives are responsible for carefully defining, establishing and communicating the benefits of monetizing data to the entire organization and to key stakeholders. Monetizing data demands an integrated, well-coordinated, organizationalwide strategy and execution framework and is the foundation for long-term success.

Data as an Ecosystem

Data must also be viewed as a living organism within the enterprise. The entire ecosystem of data within the organization should be carefully and frequently studied and monitored for its shelf life, external value, strengths, weaknesses and revenue potential. Every data-driven interaction, both within and outside the organization, including the interactions among external entities that directly or indirectly influences or impacts the data (for example, two suppliers interacting and collaborating to meet a particular need for the organization), deserve care, attention and thoughtful analysis in order to make a preliminary go or no-go decision as to whether such data has the potential to become a revenue source for the organization. This is because although all organizations generate large volumes of data, not all data is useful enough to create monetary value. These preliminary decisions about the monetary value of a given piece of data are not permanent decisions, but highly dynamic that changes with the shifting needs of the marketplace. Data appreciates and depreciates in value and is time-dependent. Data that is valuable and rare today can easily become trite and copiously available tomorrow.

By viewing data as a living ecosystem that is constantly changing wherein some elements will generate more value than others over time creates a paradigm shift. Data is no longer viewed as just a byproduct or a resource to craft decisions, but instead as a dynamic revenue source and platform for adding strategic value to customers to help them achieve their business objectives as well as for the larger social good. In other words, organizations must frequently and faithfully ask and answer the question, “What value, if any, is this data to anyone, internal or external, to the organization? This approach to data is well summarized as follows: *“An enterprise that does not effectively utilize its data assets can be compared to a living entity with a broken nervous and sensory system. A living enterprise that suffers from compromised abilities to hear, feel, see, and smell the dangers and opportunities around is vulnerable and disabled (KPMG – Framing a winning DM strategy)*

Although the idea is simple, execution is an enormous challenge that digs into the very core of an organization’s core competencies. The success of data monetization depends on one’s ability to deliver value that the customer thinks is worth paying for over the long-term. In order for data acquisition and monetization efforts to have a positive impact on the bottom line, it must be backed by thoughtful strategies and sound business models that are not cast in stone, but that are incipient and emerging. In other words, data monetization strategies are core to long-term organizational success, the absence of which can result in leaders becoming blind to opportunities or pursuing dead-ends that are not in alignment with the nucleus capacities of their organization. Data monetization should therefore, be an essential part of an organization’s strategy and execution framework and senior leaders must make it a fundamental part of all investments and discussions relating to data.

What is data monetization?

The MIT Center for Information Systems Research (MIT CISR) defines data monetization (DM) as “the act of exchanging information-based offerings for legal tender or something of perceived equivalent value.” (B.H. Wixom, “Cashing In on Your Data,” *MIT Sloan CISR Research Briefing, Vol. XIV, No. 8, August 2014.*) Data, within the context of monetization, is viewed as an

economic good and the data sharing activity an economic transaction. (Bataineh). The Wikipedia defines data monetization as “instituting the discovery, capture, storage, analysis, dissemination, and use of data.” Such data may be created or aggregated in a multitude of ways from internal or external data sources, or as the result of merging internal data with proprietary data sources, or data is streamed or generate from sensors and mobile devices, or any other means. When raw data is used as input to generate timely knowledge and insights about business functions, processes, customer preferences, industry trends and market dynamics in the form of data-derived products and services it is referred to as data monetization. In other words, anything that generates enough value and utility that an external entity is willing to pay for it falls under the umbrella of data monetization.

Why the sudden interest in data monetization? Today, thanks to the extraordinary and highly affordable computing power at one’s fingertips, data storage, information processing, and knowledge management have become affordable and within the reach for more organizations than at any other time in human history. A specific category of information systems and applications that can leverage the advances in computing power and sophisticated analytical software to help organizations achieve a competitive edge in the marketplace is Big Data (McGuire, Manyika, & Chui, 2012). With the increasing prominence and push for “Big Data” as a must-have competitive tool (Bell, 2013) (Datskovsky, 2013) (Bhadani & Kotkar, 2015) (Davenport, 2014) (E. Prescott, 2014) it becomes essential for the entire organization and its associated business units to examine, analyze, and determine the role of Big Data in achieving competitive advantage. Big Data holds the potential to “transform the entire business process” (Wamba, Akter, Edwards, & Chopin, 2015) by changing the way companies innovate, compete, sell, grow, and survive. The effective and timely application of Big Data holds the power to alter and enhance “corporate ecosystems” (Maniyka, 2011), solve complex problems that hitherto may have been beyond reach (Yadav & Kumar, 2015), and deliver exponential value and growth (Brown, Court, & Willmott, 2013). In other words, what is evident from the emerging strengths of Big Data as a competitive weapon is that no business, regardless of its size, location or industry, can any longer afford to ignore Big Data. This is not to say that existing technology resources are no longer of value and must be replaced with Big Data technologies and techniques. Quite to the contrary, the greatest bang for Big Data may come from aligning Big Data technologies effectively with existing technologies and then carefully identifying where the valuable “stretch” opportunities may be hidden. In addition, the exponential increase in the number of mobile devices and sensors within the larger context of the Internet of Things has highlighted the potential for data as a revenue generator.

Those that play in the data monetization arena may be data generators, aggregators, consumers or all of the above, with the sole intent to cut costs and/or generate revenue by selling or exchanging data or both. The opportunity to leverage data commercialization is abundant across industries. While financial and credit card companies surface to the top, it is hard to name an industry that does not consume, generate, or aggregate some data that is worthy of monetization. An organization may choose to go broad or deep or both in terms of how it leverages its ability to monetize data. In other words, an organization may do a deep dive in one specific or specialized area, such as supply chain, social media, financial fraud, attracting technical talent, or it may deploy its resources and capacity broadly across a range of processes, functions and decision-

making within a given industry or even across industries. This choice of approaches to data monetization is referred to as the *information offerings consumption path* (Buff *et.al*) to reflect the gamut of choices that faces an organization as it enters the data monetization market.

A few critical strategic questions that help to shape preliminary discussions as to whether an organization should enter the data monetization domain include the following:

- What data does my enterprise own, generate or process that can be useful to my customers, supply chain partners, and other touch points in my industry or related industries?
- What is the detailed profile of my potential customers, both in my industry and outside, that can benefit from this data?
- Why is this data valuable and how does it align with the business objectives and goals of my customers, present and future?
- What is the nature of the data that can be monetized including its shelf life, complexity, timeliness, direct impact, strategic nature, and deep insights?
- Is my data an independent, stand-alone product or service or can it be embedded into our current products and services to strengthen brand loyalty and upselling?
- What processes, resources and talent does the organization need in the short run and in the long run to sustain the monetization stream? What internal competencies exist to achieve these goals?
- Who are my potential competitors now and in the future?
- What is my business model(s)? How does it compare with that of my competitors?
- Who are potential partners that can strengthen my existing or emerging data monetization capabilities and if so, how?

These are a few preliminary questions an organization must explore before it makes the decision to embark on monetizing its data.

Pathways to Monetization

There are three important paths to make money, according to CISR

- Improve internal processes and generate more profits: UPS gives drivers critical geo information; hospitals that reduce infections; increase sales and strengthen customer satisfaction. Evidence-based organizations – change habits and mindsets – reward what is valued – mandate the use of data – strengthen performance evaluations -
- Wrapping – word coined by CISR – to show information *about* a product or service can help the customer – eg. FedEx tracking of packages; customers can log into their health data – tracking and monitoring health issues over a period of time. In isolation, it may not add value – but it increases customer loyalty, brings down the pain threshold, perceived value of product goes up – the customers insights increases – Oh! I did not know that!
- Sell data – solve other people’s problems with data that you own and have. This requires deep domain expertise, strong customer engagement, a wish list, clarity around pain points that customers have –

The Consumption Path is made up of three focus areas:

Data (Raw or Processed)

Data raw or processed requires several steps: acquiring, cleaning, sorting, managing etc. This requires heavy investments in databases, data acquisitions strategies and cleaning and updating the data. Even if a company is focusing on raw or processed data, which is input to a customer's operational or insight-seeking processes, it is essential for the company to have a clear understanding of how the customer will use the data. The nature and availability of raw data determines the profit margins. Is the data readily available? Is it clean or unclear? Is it from public or proprietary databases?

If a company is in the business of monetizing data by converting it from raw to processed, then it needs to understand what the customer needs and get as close to meeting that need as possible. This involves data conversion processes "which often draw upon deep domain expertise to develop taxonomies, dictionaries and business rules, which increase in accuracy, effectiveness and value over time."

Insights (Reporting or Analytics)

Reports and analytics form the basis of insights. This implies that the monetization process offers knowledge and information that exceeds standard run-of-the-mill reporting. In other words, the company has to deliver value that exceeds what the customer can do on his or her own. Reporting is built on sophisticated data packing technologies. "visualization and dashboard technologies, graphic and interface design expertise, and user training and customer service" are all services that can generate value. "Subscription and self-service pricing models are common for insights offerings." Analytics is different from reporting because it is predictive and prescriptive.

Action (Process Design or Process Execution)

You have the insights. Now what? What actions should you take? How does one go about identifying the steps to be taken? The services that fall in this area where data and insights are leveraged to action and thereby revenue include consulting, strengthening of processes, outsourcing processes, market analysis to find blue ocean space, leadership development, building internal data science centers and think tanks, and so on.

Sections on revenue generation and implementation challenges will be added if the abstract is accepted.

Thank you!

Keynes' Unscientific Theory of Consumption Function and its False Policy Implication for the Multiplier Effect: A Review of Disaggregated Evidence

Nozar Hashemzadeh, Radford University

Abstract

The assumption that the marginal propensity to consume [MPC] and the resulting multiplier are fairly stable at the aggregate level irrespective of the time frame, commonly articulated in some post-Keynesian literature and introductory macroeconomic texts and universally used as the building block of fiscal policy decisions, are false concepts. In this enquiry, we examine the robustness of this proposition using disaggregated disposable income to demonstrate that neo-Keynesians' generalization that consumers in different income brackets would react similarly to a change in income is refuted by the weight of historical evidence. We derive estimates of the MPC in the short-run and the long-run using recent data from the US Bureau of Economic Analysis [BEA]. We show that the whole is not the sum of its parts when it comes to the MPC. This insight should give teachers a more accurate description of short-run consumption behavior. Our objective is to extend students' understanding of the complexity of the economy and reveal that there are many intricate mysteries that are yet to be expounded.¹

Key Words: MPC, Multiplier, Keynes' General Theory

JEL Codes: E21 E27, E60

Introduction

John M. Keynes' impact on macroeconomic theory and practice has been omnipresent since the publication of the General Theory in late 1930s. While Keynes' analysis of consumption behavior and conception of the consumption function have been integrated into much of the macroeconomic literature, the Keynesian introspective methodology has not gone unchallenged. Early on, A.C. Pigou, a contemporary colleague of Keynes noted "Mr. Keynes... contrives to be clear-headed without making muddleheaded people hate him" (Skidelsky, 1983, p.123). Other skeptics of Keynesians' methodology have pointed out that in economics, as in in other social sciences, the outcome of 'thought experiments' is not foreseeable since we have no foreknowledge of how individuals or groups will behave in the context of an ever changing environment. It is therefore not surprising that philosophers and social scientists who rely on objectivity and the scientific method have questioned the Keynesian introspective methodology and its relevance to macroeconomic decision-making. Among many others, Angus Deaton who merited the Nobel Prize in 2015, has been raising serious questions about the relationship between income and consumption in many of his presentations and published works (Deaton 2010, 2011). Deaton's pioneering empirical work has shifted the emphasis away from the behavior of macro aggregates to the decision-making process at the individual and household levels. We can now agree that a fixed aggregate MPC tells us nothing about economic behavior

¹ The authors wish to extend their gratitude to the editor and the reviewers for their valued comments. Disclaimer: - A rudimentary version of this article without much of the empirical work and advanced econometrics scrutiny was published on line in 2016.

since the impulsive and perhaps random actions of millions of individual agents may ‘add up’ in such a way that the aggregate MPC appears constant.

Overview of the Literature

Empirically, if the Keynesian paradigm was subjected to the more exacting versions of the scientific methodology, as articulated by some classical philosophers (Hume, et al, 1888), his hypothesis would have been rejected at the outset. Soon after the publication of the *General Theory*, Machlup (1939, 1943) attempted to qualify Keynes’ *multiplier theory* as a gradual process rather than being as an instantaneous episode as conjectured by Keynes. He attempted to lend some credibility to Keynes’ consumption theory and make it more convincing by suggesting that other variables such as time lags, unpredictable propensities to consume and random events should be taken into consideration.

In contemporary times, Keynes’ hypothesis would fail to meet scientific standards as vigorously defined by such eminent philosophers as Karl Popper, Dennis Phillips and other epistemologists. For instance, in Popper’s view, empirical theories such as conjectures about the trajectory of the MPC can only be tested and falsified, but never logically verified. Factually and from the beginning, Keynes’ intuitive proposition has been *falsified* through extensive empirical tests and credible corroborations. Therefore, we are inclined to reject Keynes’ consumption theory as a scientific paradigm.

The falsity of Keynes’ speculation that “if the consumption psychology of the community is such that they will choose to consume, e.g. nine-tenths of an increment of income, then the multiplier k is 10; and the total employment caused by (e.g.) increased public works will be ten times the primary employment provided by the public works themselves” (Hazlitt, 1992, pp. 116-117) is manifestly obvious. Mathematically speaking, if one assumes that MPC is one or near one, then the size of the multiplier approaches infinity—which is an incongruous corollary. Herbener (1992) pointed out there is no ‘accounting principle’ to justify that the MPC is bounded between zero and one. He used US income and consumption data from 1939 through 1960 to show that the MPC ranged from -1.38 in 1945 to 45.33 in 1949.

The notion of a stable MPC, which is founded on inductive methodology, is at best a speculative proposition. Nearly two hundred years before the publication of Keynes’ influential work, David Hume (1888) had cautioned that the problem of inductive logic is that “instances, of which we have had no experience, must resemble those of which we have had experience, and that the course of nature continues always uniformly the same.” (Selby- Bigge, 1986, p. 104). Therefore, limited evidence of a stable MPC in short instances at one level (aggregate) cannot logically be worked into a universal theory. In an evolving economy, we should hesitate to presume anything is ‘fixed’; a constant MPC evident in today’s data does not necessarily imply it will remain so indefinitely.

Recently, the irregular behavior of the MPC by income class, regional and country differences and the phase of economic development are being robustly and progressively questioned in the more insightful approaches that have used more reliable microeconomic data in testing the Keynes’ theory and its implications. This research also has had important implications for the shape and behavior of the utility function, since the value of the MPC emerging from the utilitymaximization exercise depends in part on the exact formulation of the utility function. This outcome has contributed to academic debates in the context of the Permanent Income

Hypothesis. Nevertheless, the simplicity and established popularity of the theory has served to divert objective and impartial analysis of typical consumption behavior by households. Sadly, the intransigent fascination with Keynes' simplistic model by many well-known contemporary authors of introductory principles of economics texts continue to severely obstruct academic literacy, modelling innovations and policy design. In an intensive reappraisal of the Keynesian multiplier theory and the related literature, Ahiakpor (2001, p.768) categorically rejects Keynes' multiplier theory (based on a stable MPC). He correctly argues that Keynesian theory seems "plausible only because both its proponents and previous critics have failed to ask the pertinent questions to help unmask its fundamental misconception of the economic process, especially the concurrent nature of production and subsequent exchange rather than a unidirectional one."

In this reevaluation article, we review the robustness of the 'constant MPC' hypothesis. We began by reviewing selected insights from recent research findings. In the following segments, we extend the discussion by exploring current data on consumption and disposable income for the US. We provide a simple empirical framework which demonstrably falsifies Keynes assessment of the MPC. We end the article with implications and recommendations for future research.

The Factual Causality between Consumption and Income

While a significant causal relationship between income and consumption seems theoretically and empirically reasonable, there is no scientific foundation to support the notion that changes in the level of income changes consumption spending by a predictable amount at every stage. The failure of Keynes hypothesis in explaining the post-war consumption and saving behavior in the United States and elsewhere in Europe prompted much debate soon after the publication of the *General Theory*. In a treatise published in 1947, A.C. Pigou criticized Keynes for ignoring the 'wealth effect' in the consumption function. Pigou submitted that in due time, as a result of a falling price level, the wealth effect would stimulate consumption as well the MPC. Nobel Prize laureate, Paul Samuelsson (1943) questioned the stability of the Keynesian consumption function and proposed a 'ratchet model' with the implication that during an economic recession household are reluctant to abandon their consumption habits in response to declining levels of spendable income. Soon after, other economists including Brady and Friedman (1947), Duesenberry (1948) Modigliani (1949) and Katona and Mueller (1953, 1956), offered competing hypotheses about consumers' consumption behavior during the postwar era. Friedman's Permanent Income Hypothesis, which initially gained considerable support in the macroeconomic literature, conjectures that it is the permanent income that drives consumption behavior rather than current income.

All the same, consumption theories that use permanent income or life-cycle income as a determinant of consumption have proved inadequate in explaining the behavior of the MPC over the short horizon. These theories often subsume a world of certainty in which individuals have perfect information about their future income, the direction of interest rates, and the availability of credits, life expectancy and so on. Tobin (1958), a celebrated Keynesian and a Nobel Laureate, questioned aspects of Keynes' consumption theory as it related to large expenditures on consumer durables such as cars, boats, etc. and developed a sophisticated model famously known as the 'Tobit Regression' to better explain the relation between income and consumption. Empirical estimates of the MPC by Watts (1958) and Bodkin (1959) did not support a predictable and stable MPC. In fact, Watts' statistical study (1958) indicated that the

behavior of the MPC was asymmetrical depending on whether changes in income were perceived to be positive or negative. Watts' research is consistent with further evidence reported by Jonathan Parker (1999) and Nicholas S. Souleles (1999). These authors demonstrated that consumers' spending behavior was particularly sensitive to the timing of changes in income.

In a re-evaluation of these theories, Robert Hall (1976) used the Euler equation² to argue that the consumption function, as it related to data from the United States, could be modelled as a random walk. He proposed that consumers attempt to maximize their intertemporal utility when the real interest rate is assumed to remain constant. Recall that in the context of a random walk model, the best predictor of consumption in the next period is the change in consumption in the previous period. Despite its simple construct, tests of Hall's hypothesis have been statistically intractable (see Yuan Mei, 2012).

In a more formative study, Princeton economist Hseih (2003, pp. 397-405) showed that changes in household spending in response to changes in income was only predictable when income changes were "large and transparent."

More recently, Carrol, Slecalek and Tokuoka (2014) demonstrate that in developing countries with skewed distribution of wealth, the consumption function is concave which evidently implies that low wealth families have a higher MPC when compared to wealthier cohorts. Furthermore, they report that the "aggregate MPC is considerably lower than the estimates reported in the empirical literature" (p.2). These authors suggest that the aggregate MPC does not vary over the business cycle. Furthermore, they report that "neither the mean value of MPC nor the distribution of MPC changes much when the economy switches from one state to another" (p.5).

Recent Evidence from Federal Reserve and CES Data

We now seek to evaluate the recent dynamics of the MPC using both the conventional consumption function model as well as our own construct. We first look at data from the US Bureau of Economic Analysis [BEA] (via the Federal Reserve Bank of St. Louis FRED database) for an extensive period (1930 – 2015) This dataset contains aggregate real personal consumption expenditure (C_t), at annual frequency, in billions of chained 2009 dollars. The dataset also contains aggregate real disposable personal income (Y_t), at annual frequency, in billions of chained 2009 dollars.³

² Euler's equation is based on the assumption that consumers typically attempt to equalize the marginal rate of substitution between consumption in the current year and the present value of consumption in the coming year.

³ US Bureau of Economic Analysis, Real Personal Consumption Expenditures [PCECCA], retrieved from FRED, Federal Reserve Bank of St. Louis <https://research.stlouisfed.org/fred2/series/PCECCA> US Bureau of Economic Analysis, June 10, 2016. Real disposable personal income [A067RX1A020NBEA], retrieved from FRED, Federal Reserve Bank of St. Louis <https://research.stlouisfed.org/fred2/series/A067RX1A020NBEA>, June 10, 2016.

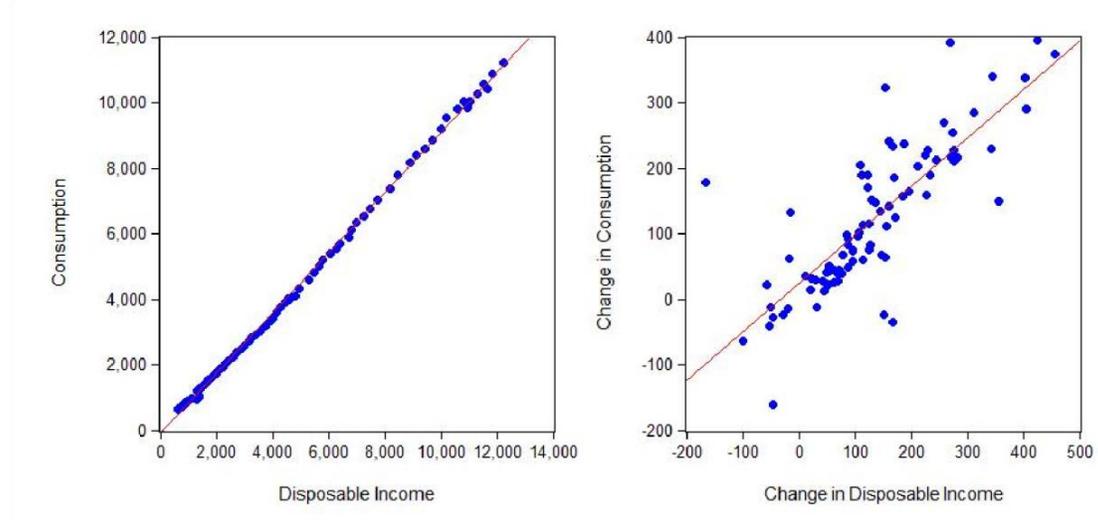
"Chained 2009 dollars" are dollar figures adjusted for inflation using 2009 as the base year.

We also consider annual data from the US Consumer Expenditure Survey [CES] for a much shorter time period (1985 – 2014). This data is available from the Bureau of Labor Statistics [BLS] website. Two particular series are relied upon: average disposable income (income after taxes) and average total consumer expenditure. This data is appropriate to our query because the CES measures spending habits, income levels and several characteristics of US households. The BLS data retrieval tool allows us to sort the surveyed households into different categories before extracting their average disposable income (income net of taxes) and spending levels. We choose to group the households by pre-tax income ranges with an additional group consisting of all the households. It is therefore possible to evaluate the ‘stable MPC hypothesis’ for each income subgroup (at a more ‘micro’ level). We explore properties of this data set for the 1985 – 2014 period, but choose to pay particular attention to the 2001 – 2014 time period where more comprehensive data is available.

Methodology

We first consider the longer aggregate dataset (1930 – 2015) from the BEA (see Figure 1).

Figure 1: Aggregate Consumption Spending and Disposable Income, 1929-2015, \$Billions, 2009 Chained Dollars



Source: Federal Reserve Bank of St. Louis (2016).

We begin by testing the input data for stationarity by evaluating the Augmented Dickey-Fuller [ADF] statistic (which tests for the presence of a unit root). Observing that the ADF statistic for both the income and the consumption series are greater than the test critical values, we fail to reject the null hypotheses that a unit root is present and conclude that the level data is nonstationary. We also test the data for stationarity in first differences.⁴ For both income and consumption, the null hypothesis of a unit root is rejected at 99% level. Similar results are observed when the data consists of first differences of income and consumption with the trend component included. Likewise, natural logarithmic (ln) transformation of the data in levels are non-stationary but stationary in first-differences. Based on these results, we fit an error

⁴ First difference (year-to-year change) is used to generate a stationarity time series data with a stable mean and variance remain over time.

correction model (ECM) to the aggregate data to evaluate the aggregate MPC from 1930 through 2015:

$$\Delta \ln(C_t) = c_0 + c_1 \Delta \ln(Y_t) + c_2 \text{Gap}(-1) + e_t \quad (1)$$

$\Delta \ln(C_t)$ is the first difference of $\ln(C_t)$, which approximately equals the growth rate of consumption spending. $\Delta \ln(Y_t)$ is the first difference of $\ln(Y_t)$, which is approximately the growth rate of disposable income. $\text{Gap}(-1) = \ln(Y_{t-1}) - \ln(C_{t-1})$ is the difference between log disposable income and log consumption last period. The ECM model provides estimates of both the short-run and the long-run effects of changes in disposable income on consumption expenditures. In this formulation, the coefficient of $\Delta \ln(Y)$ in the right-hand-side of equation (1) should approximate the short-run MPC, while the coefficient of $\text{Gap}(-1)$ indicates the speediness to which consumption and income and consumption converge to their long-run equilibrium levels. The error term (e_t) represents shock events that are likely to impact consumption behavior. The estimated results shown in the following table from the error correction model yield estimates for both the short-run MPC (0.509) and the speediness of convergence of consumption and income in the long-run (0.13)

Table 1: The MPC Estimate from the Error Correction Model for US: [1930-2015]

Variable	Coefficient	Std. Error	t-statistic	Prob.
Constant	-0.001147	0.005922	-0.193632	0.8469
$\Delta \ln(Y_t)$	0.518417	0.058650	8.839172	0.0000
$\text{Gap}(-1)$	0.130655	0.041667	3.135678	0.0024

R-squared 0.509363 Mean dependent var 0.030980 Adjusted R-squared 0.497541 S.D. dependent var 0.029465 S.E. of regression 0.020886 Akaike info criterion 4.865209 Sum squared residuals 0.036207 Schwarz criterion 4.779592 Log likelihood 212.2040 Hannan-Quinn criterion 4.830752 F-statistic 43.08395 Durbin-Watson statistic 1.216851
 Prob(F-statistic) 0.000000 ⁵

From these results, we can also compute a ‘factor of proportionality’ = $\exp[(\text{coefficient on constant} / \text{coefficient on Gap}(-1))] = 0.991$. This estimate suggests that we can expect US consumers to spend approximately 99.1% of their income in the long-run. When compared to the long-run estimate of the MPC in a simple regression of spending on income (shown below), the approximate MPC from the error correction model is approximately 20% higher. Note that

⁵ Akaike information criterion (AIC) and Schwarz criterion (SC) are used to discover if the addition of a new independent variable improves the accuracy of the designated model. Both methods have been found useful in dealing with time-series data that are contaminated with statistical noise and measurement errors. Factor of proportionality demonstrates the ratio between consumption and income which are assumed to be proportional.

this data set contains some extreme economic shocks (recessions and high inflation periods) which may impact the numerical findings. Exploring more consistent data ranges using an error-correction model is left for another study. Nonetheless, this result is more revealing of the proper relationship between changes in income and changes in consumption at a disaggregated level at different income brackets.

We now consider the shorter dataset from the CES. Here, we take a simpler approach and focus on OLS models to extract estimates of the MPC. Two models are considered:

$$C_t = c_0 + MPC_{LR} \times Y_t + e_t \quad (2)$$

C_t represents average consumption spending, c_0 represents an autonomous level of consumption, MPC_{LR} is the long-run marginal propensity to consume and Y_t represents average disposable income. We note that equation (2) is representative of the formulation of the relationship between income and consumption in much of the undergraduate textbooks. To correct for spurious results (stemming from trended data) we also estimated the parameters of equation (3) below which is based on first differences of income and consumption.

$$\Delta C_t = a_0 + MPC_{SR} \times \Delta Y_t + e_t \quad (3)$$

In this equation, a_0 is a constant parameter, MPC_{SR} is the marginal propensity to consume over the short run and ΔY_t is the yearly changes in disposable income. These two formulations differ in that the first equation assumes a fixed level of autonomous consumption (c_0) while the second equation accommodates persistent movements in autonomous consumption within the parameter a_0 . Speculation about shifts in autonomous consumption was first raised by Peter Temin's *Did Monetary Forces Cause the Great Depression?* (1976) who posited that shifts in the consumption function was central in the intensification of the contraction from 1929 to 1933. In a paper published by the National Bureau of Economic Research, Robert Hall (1986, pp. 237-266) produced results similar to Taman's work. He showed that significant shifts in the consumption/GNP relation played a decisive role in setting off the Great depression. Previously, Temin's critics, Thomas Mayer (1978) and Barry Anderson and James Butkiewicz (1980), had demonstrated that consumption functions of various types had important negative residuals in 1930.

We might think of equation (2) as representing aggregate consumption over the longer term which is used in Keynesian economic models. We might think of equation (3) as that reflecting consumer behavior and how spending patterns change in response to immediate income shifts. As such, they produce different estimates of the MPC, with the estimate from equation (2) sometimes called the 'long-run MPC' (MPC_{LR}) and the estimate from equation (3) called the 'short-run MPC' (MPC_{SR}). If the MPC is constant, we would expect data points for spending and disposable income to fall on a straight line for at least one of the two linear functions. To visually identify this trend, we generated simple scatter plots (with linear trend lines) and used simple OLS to produce estimates of the MPC.

Early data (1985 – 2000) covering all income groups shows a strong linear relationship between consumption spending and disposable income. It appears that equation (2) fits the data quite well during this period. The OLS estimate for the long-run MPC for this period is 0.793 and is highly significant (see Table 2). As expected, a lesser linear relationship appears to exist

between changes in spending and changes in disposable income. We would hesitate to immediately assume that equation (3) is an appropriate model during this period. It is highly plausible that a potentially-omitted factor, such as a measure of income distribution that influences consumption changes needs to be incorporated. Moreover, stochastic spending/income shocks are quite strong which consistently impact the short-run MPC. Despite the additional variation, our enquiry produces a significant OLS estimate of the short-run MPC of 0.48. These numbers are consistent with the overall expectations of a significant MPC value between 0 and 1 and in-line with the estimates obtained from the ECM model reported in Table 1.

Table 2: OLS Estimates of the MPC: 1985-2000 and 2001-2014

	Levels [Equation (2)]			Differences [Equation (3)]		
	OLS Estimate of Long-run MPC	Std. Error	Significance	OLS Estimate of Short-run MPC	Std. Error	Significance
1985 - 2000:						
All	0.793	0.016	***	0.484	0.140	***
2001 - 2014:						
Income Group						
All	0.662	0.093	***	0.325	0.104	***
< \$5K	-0.459	0.341		-0.085	0.400	
\$5K - \$10K	7.196	1.486		1.113	2.522	
\$10K - \$15K	1.923	0.756	**	0.275	1.266	
\$15K - \$20K	2.065	0.763	**	0.836	1.470	
\$20K - \$30K	1.368	0.384	***	-0.255	0.562	
\$30K - \$40K	0.733	0.525		-0.500	0.582	
\$40K - \$50K	-0.616	0.465		-0.393	0.556	
\$50K - \$70K	-0.333	0.201		-0.103	0.281	
\$70K - \$80K	-0.143	0.181		0.120	0.250	
\$80K - \$100K	-0.165	0.145		0.080	0.234	
\$100K - \$120K	-0.190	0.107		-0.091	0.145	
\$120K - \$150K	-0.133	0.121		-0.010	0.205	
> \$150K	-0.018	0.070		0.089	0.058	

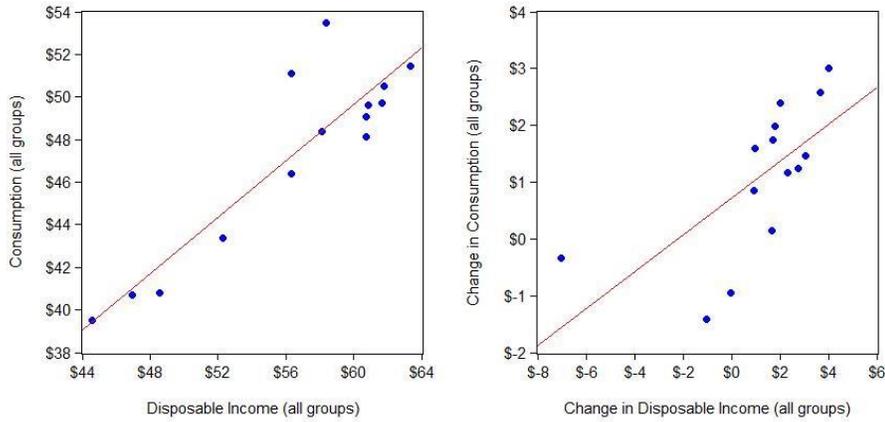
*** = Significant at 1% level, ** = Significant at 5% level, * = Significant at 10% level.

When we focus only on the most recent period (2001 – 2014), a somewhat different picture emerges. Visual inspection of the data again shows a strong relationship between consumption and disposable income described by equation (1), but there is much more additional variation in consumption to explain, with particularly extreme movements in 2009 – 2010 and 2013 –

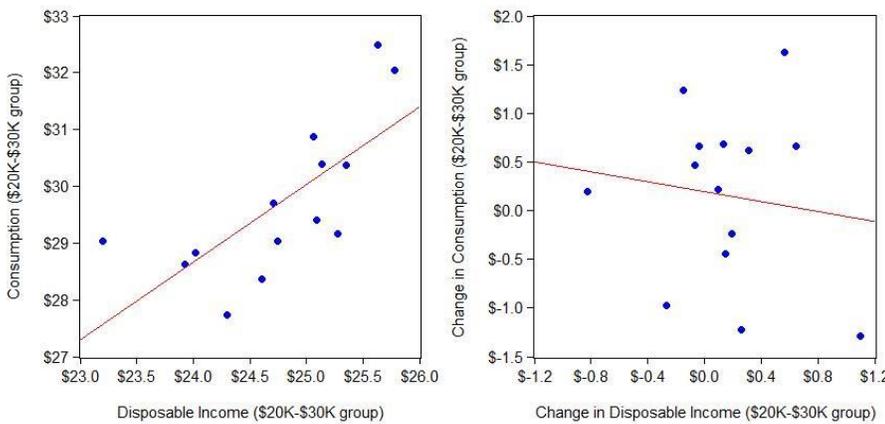
2014 (see Figure 2a, left graph). At first glance, we might hesitate to adopt equation (2) for this period without further testing. Results for changes in consumption and changes in disposable income are similar to those for the early period. Because of too much variation in the data, it is implausible that equation (3) captures the real but unobserved relationship between the two variables (see Figure 2a, right graph). Estimates of the long-run and short-run MPCs (covering all households) during the 2001 – 2014 period are 0.66 and 0.33 respectively (see Table 2). Although, both estimates are statistically significant, they are lower than those from the 1985 – 2000 period. This finding suggests that the MPC has drifted in the latter period. A simple ttest that the long-run MPC estimate from this latter period equals that from the earlier period can be rejected at the 5% level (but not at the 10% level). For the short-run MPC, we can reject the hypothesis that the latter period estimate equals the earlier period estimate at the 1% level (but not at the 5% level). These different estimates contradict the hypothesis that the MPC is fixed.

Figure 2: Aggregate Consumption Spending and Disposable Income by Income Group, 2001-2014, \$Thousands

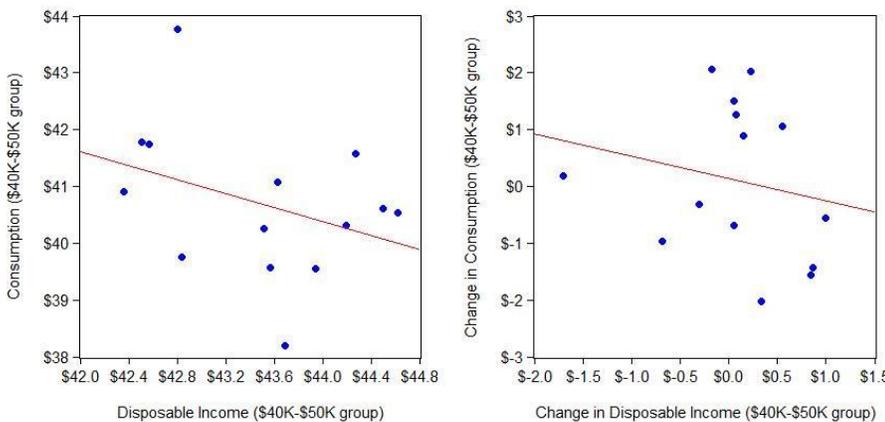
(a) All Income Groups



(b) \$20K-\$30K Income Group



(c) \$40K-\$50K Income Group



Source: Bureau of Labor Statistics (2016)

When we evaluate equation (2) and equation (3) for separate income groups during the 2001-2014 period, we fail to achieve consistent and, in many cases, significant estimates of the longrun and short-run MPCs. Figure 2b and 2c show the spending and disposable income data for the \$20K-\$30K and the \$40K-\$50K income groups as examples to illustrate how different data for these groups can be (figures for the other income groups are available upon request).

Table 2 reports the OLS estimates for this dataset. Notably, estimates of the long-run MPC generally decline with income level. Significant, positive estimates are found only for low income levels (\$10,000 - \$30,000 in pre-tax income). These MPC estimates all exceed 1 (likely due to the role of credit for low-income households). For income levels greater than \$30,000, estimates of the long-run MPC are not statistically different from zero. As shown in Table 2, the MPC for higher income groups have turned negative in recent years.

Note that estimates for the short-run MPC are never statistically different from zero for all income brackets. Once again, either there are other explanatory variables to consider, or there exist exceptionally volatile stochastic shocks to consumption/income which distort the estimates. However, a more likely scenario is that the MPC is just not constant. Therefore, we would not immediately accept equation (1) or equation (2) at a more ‘micro’ level without further analysis. This exercise also shows that the relationship between spending and disposable income evident at more ‘micro’ levels (outside the 0-1 range) tends to be statistically insignificant in many cases. By contrast, estimates of the MPC at more ‘macro’ levels (within the 0-1 range) turn out to be highly significant. Once again, it is apparent from our investigation that modeling the behavior of the whole fails to provide an objective understanding of the behavior of the constituting parts.

Conclusion

John M. Keynes’ consumption theory and the multiplier effect has gained much traction in much of macroeconomics literature due to his convincing observation that when a fraction of marginal income is spent by consumers, it creates long-lasting streams of marginal revenues for vendors and producers who provide the products and services. However, Keynes’ proposition is far from being a universal certainty. Much of the empirical research and our investigation strongly contradicts the prevalent view that the MPC can be assumed to remain fixed either in the short-run or the long-run. Decades after the publication of the *General Theory*, macroeconomic theorists and practitioners appear to have reached some consensus that there is a critical need for a paradigm shift in macroeconomic theory and application of policy. We submit that Keynes multiplier effect makes sense only if it targets a closed economy where the initial spending stimulus could sprout into subsequent rounds of income and subsequent expenditures. As Professor Deaton (2010) has put it, there is no assurance that a fiscal and monetary experiment that worked once will produce the same results if tried again.

The evidence presented in our paper questions the validity of some fundamental aspects of the Keynesian consumption theory. Several noted economists, among them the former Governor of the Federal Reserve System, questioned the soundness of massive debt financing and subsequent spending to expand home ownership. In his testimony before the US Senate Banking Committee, he admitted that “we were wrong”. Alan Greenspan, was uncharacteristically candid when he stated that “an ideology is a conceptual framework with the way people deal with reality. Everyone has one. You have to — to exist, you need an ideology. The question is whether it is accurate or not. And what I’m saying to you is, yes, I found a flaw. I don’t know how significant or permanent it is, but I’ve been very distressed by that fact.”

As stated at the outset, we have affirmatively discovered that the Keynesian ideology is empirically flawed at the disaggregated level. Since the crash of 2008, governments and central

banks in the United States, the European Union, China, Japan and elsewhere, have been using unprecedented fiscal and monetary stimulus to revive their respective economies. Although marginally effective, these interventions do not seem to have turned the corner. The recession that began in late 2007 has resulted in massive income and wealth redistribution from the lower and middle brackets with high MPC to high income earners who have been reluctant to put their newly gained fortune to work. As a result, there has been little progress in revitalizing consumption, formation of high-wage jobs and real economic growth. What is worse, these policies have produced more uncertainty, fear, and loss of confidence in government policy decisions.

As models with a constant MPC are taught to undergraduate students, the limitations of the hypothesis should be clearly explained so that the next generation of economists do not repeat our mistakes. Describing the recent shifts in the data and referring to Hume's 'problem of induction' is an opportunity for educators to highlight the importance of the Philosophy of Science to economic models. Showing that 'the whole is not the sum of its parts' when it comes to the MPC gives teachers the chance to extend students' understanding of the complexity of the economy and provide some evidence them that there are still mysteries in the economy which are yet to be explained.

References

Ahiakpor, J. C. W (2001). On the Mythology of the Keynesian Multiplier: Unmasking the Myth and the Inadequacies of Some Earlier Criticisms. *American Journal of Economics and Sociology*, 60(4), 745-773.

Akaike, H. (1985), Prediction and entropy, in Atkinson, A.C.; Fienberg, S.E., A Celebration of Statistics, Springer, pp. 1-24

Anderson, B. L. & Butkiewicz, J. L. (1980). Money, Spending, and the Great Depression. *Southern Economic Journal* 47: 388-403.

Bodkin, R. (1959). Windfall Income and Consumption. *The American Economic Review*, Vol. 49, No. 4, pp, 602-614.

Bureau of Labor Statistics [BLS] (2015). *Consumer Expenditure Survey*. Available at www.bls.gov/cex.

Carroll, C., Slacalek, J., & Tokuodka, K. (2014). The Distribution of Wealth and the Marginal Propensity to Consume. Working paper, No. 1655, European Central Bank.

Deaton, A. (2010). Instruments, Randomization, and Learning about Development. *Journal of Economic Literature*, 48(2), 424-455.

Deaton, A. (2010). Understanding the Mechanisms of Economic Development. *Journal of Economic Perspectives*, 24(3), 3-16.

- Deaton, A. & Laroque, G. (1992). On the Behavior of Commodity Prices. *Review of Economic Studies* 59(1), 1-23.
- Duesenberry, J. (1949). Income, Saving and the Theory of Consumer Behavior. *Harvard Economic Studies*, Vol. 87. Cambridge: Harvard Univ. Press.
- Engle, Robert F.; Granger, Clive W. J. (1987). Co-integration and error correction: Representation, estimation and testing". *Econometrica*. 55 (2): 251–276. JSTOR 1913236.
- Farhat, Dan. & Hashemzadeh, N. (2016). The Fable of a Stable Marginal Propensity to Consume (MPC), *British Journal of Economics, Finance and Management Sciences*, March 2016, Vol. 11 (1).
- Friedman, M. (1957). A Theory of the Consumption Function. National Bureau of Economic Research, General Series, No. 63. Princeton: Princeton Univ. Press.
- Friedman, M. (1957). *A Theory of Consumption Function*. Princeton: Princeton Univ. Press.
- Greenspan, A. (2008). Cited in <http://www.distressedvolatility.com/2008/10/dissecting-alangreenspans-testimony.html>
- Hall, R. E. (1978). Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence. *Journal of Political Economy*, 86 (6), 971–987.
- Hall, R. E. (1986). The Role of Consumption in Economic Fluctuations. In *The American Business Cycle: Continuity and Change*. Chicago: Univ. of Chicago Press, pp. 237-266.
- Hazlitt, H. (1959). *The Failure of the "New Economics": An Analysis of the Keynesian Fallacies*. Princeton: D. Van Nostrand, 1959, reprinted by the Foundation for Economic Education in 1995.
- Herbener, J. M. (1992). The Myths of the Multiplier and the Accelerator. In M. Skousen (ed.), *Dissent on Keynes: A Critical Appraisal of Keynesian Economics*. New York: Praeger Publishers, pp. 73-88.
- Hsieh, C. (2003). Do Consumers React to Anticipated Income Changes? Evidence from the Alaska Permanent Fund. *The American Economic Review*, 93(1), 397-405.
- Hume, D. (1888). *Treatise of Human Nature*. L. A. Selby Bigge (ed.), Oxford: Clarendon Press (1986), p. 104.
- Katona, G. & Mueller, E. (1953). Consumer Attitudes and Demand, 1950–1952. Survey Research Center, Ann Arbor: Univ. of Michigan.
- Katona, G. & Mueller, E. (1956). Consumer Expectations 1953–1956. Survey Research Center, Ann Arbor: Univ. of Michigan.

- Keynes, J. M. (1936). *The General Theory of Employment, Interest and Money*. London: Macmillan.
- Laroque, G. (1992). On the Behavior of Commodity Prices. *Review of Economic Studies*, 59(1), 1-23.
- Machlup, F. (1939). Period Analysis and Multiplier Theory. *Quarterly Journal of Economics*, 54: 1-27.
- Machlup, F. (1943). *International Trade and the National Income Multiplier*. New York: August M. Kelley.
- Mayer, T. (1978). Consumption in the Great Depression. *Journal of Political Economy*, 86(1), 139-45.
- Mei Y. (2012). U. S. Consumption Function: An Empirical Test of the Life-Cycle Hypothesis. Senior Thesis, Trinity College, Hartford, CT.
- Modigliani, F. (1949). Fluctuations in the Saving-income Ratio: A Problem in Economic Forecasting. In *Studies in Income and Wealth* (pp. 369-444). National Bureau of Economic Research.
- Office of Management and Budget (1983). *Federal Government/Finances: 1984 budget data*. Washington, D.C.: Office of Management and Budget.
- Parker, J. (1999). The Reaction of Households Consumption to Predictable Changes in Social Security. *American Economic Review*, 89(4), 959-73.
- Phillips, D. C. (2000). *The Expanded Social Scientist's Bestiary: A Guide to Fabled Threats to, and Defenses of, Naturalistic Social Science*. Rowman & Littlefield Publishers.
- Pigou, A. C. (1947). Economic Progress in a Stable Environment. *Economica*, 14(55), 180-188.
- Popper, K. (2002). *The Logic of Scientific Discovery*. London: Routledge.
- Rosenberg, A. (2000). *Philosophy of Science A Contemporary Introduction*. New York: Routledge.
- Samuelson, P. (1943). Full Employment after the War. In S. E. Harris (ed.), *Postwar Economic Problems*. New York: McGraw-Hill, pp. 27-53.
- Skousen, Mark. (1992). *Dissent on Keynes: A Critical Appraisal of Keynesian Economics*. Greenwood Publishing Group, p. 78
- Souleles, N. S. (1999). The Household of Household Consumption to Income Tax Refunds. *American Economic Review*, 89(4), 947-958.

Skidelsky, Robert, A. (1983): *John Maynard Keynes: A Biography Hopes Betrayed, 1883-1920*, vol. 1, Macmillan, London.

Temin, P. (1976). *Did Monetary Forces Cause the Great Depression?* New York: Norton.

Tobin, J. (1951). Relative Income, Absolute Income, and Saving. In E. C. Simmons (ed.), *Money, Trade, and Economic Growth: Essays in Honor of John Williams*. New York: Macmillan.

Watts, H. (1958). *Long-run Income Expectations and Consumer Saving*. Cowles Foundation for Research in Economics at Yale University.

Fast-and-Frugal Decision Trees: A Review

Reza Kheirandish*, College of Business, Clayton State University, Morrow, Georgia

Shabnam Mousavi*, Carey School of Business, Johns Hopkins University, Baltimore, Maryland

* Center for Adaptive Behavior and Cognition, Max Planck Institute for Human Development,
Berlin, Germany

Abstract

A fast-and-frugal tree (FFT) is a tree that allows for classification at each level (node) of the tree. This means that a tree with K binary cues (attributes) will have K nodes and $K+1$ exits (end nodes or leaves). This makes fast-and-frugal trees much simpler than the complete trees with 2^K exits. Indeed, due to the exponential increase of the exits with number of cues, complete trees quickly become computationally intractable for large number of cues, and this makes FFTs operationally attractive and more robust. In an FFT, cues are usually ordered according to one-reason decision-making and one-reason stopping rules (Gigerenzer, 2004, and Gigerenzer & Gaissmaier, 2011). There are a variety of applications where FFTs have shown to perform exceptionally well compared to competing models. This paper, reviews a selection of such FFTs in the fields of Medicine, Psychology, Law, Finance, Banking, and Military Stability Operations and shows how they work in action. Laun, Schooler, and Gigerenzer (2011) in their seminal paper perform a signal-detection analysis of the FFTs and show that (i) the choice of exit structure in the FFTs corresponds to the setting of the subjective decision criterion in signal-detection theory, (ii) order of cues searched, the mean and variance of cues' individual sensitivities, inter-cue correlation, and the number of cues are related to the sensitivity of an FFT, and (iii) FFTs are very frugal, robust, and well adapted to the payoff structure of a given task compared to other models. We will revisit the FFTs introduced by (a) Green & Mehr (1997), who showed their tree could help emergency doctors detect acute ischemic heart disease, (b) Dhami (2003), who developed a tree that captures magistrates ruling at a London court to bail a defender or take a punitive action, (c) Super (1984), who designed the Simple Triage and Rapid Treatment (START) procedure, (d) Keller and Katsikopoulos (2016), who showed application of an FFT in reducing civilian casualties in military stability operations, where FFT is used to classify the incoming traffic as hostile or non-hostile, (e) Aikman et al. (2014), where an intuitive (judgement-based) FFT for assessing bank vulnerability is discussed, and (f) Jenny et al. (2013), where an FFT is introduced to detect the depressed mood of an individual and the results are compared with the unit-weight, the regression model, and naive maximization. Our review shows that under certain conditions and in the presence of uncertainty, the FFTs could perform superior compared to the other, usually more complex, models. This, in turn, illustrates a counter intuitive phenomenon: The solution to a complex problem need not be a complex model; a simple model can just be the right effective tool, especially in the presence of a high level of uncertainty.

References

- Aikman, D., Galesic, M., Gigerenzer, G., Kapadia, S., Katsikopoulos, K., Kothiyal, A., Murphy, E. & Neumann, T. (2014). Taking uncertainty seriously: simplicity versus complexity in financial regulation. *Bank of England Financial Stability Paper No. 28 – May 2014*, 1-25.
- Dhami, M. K. (2003). Psychological models of professional decision-making, *Psychological Science*, 14, 175-180.
- Gigerenzer, G. (2004). Fast-and-frugal heuristics: The tools of bounded rationality. In D. Koeler & N. Harvey (Eds.). *Blackwell handbook of Judgement and decision making* (pp. 62-88). Oxford, UK: Blackwell.
- Gigerenzer, G., & Gaissmaier, W. (2011). Heuristic Decision Making. *Annual Review of Psychology*, 62, 451-482.
- Green, L. & Mehr, D. R. (1997). What alters physicians' decisions to admit to the coronary care unit? *The Journal of Family Practice*, 45, 219-226.
- Jenny, M. A., Pachur, T., Williams, S. L., Becker, E., Margraf, J. (2013). Simple rules for detecting depression. *Journal of Applied Research in Memory and Cognition*, 2(3), 149-157.
- Keller, N. & Katsikopoulos, K. (2016). On the role of psychological heuristics in operational research; and a demonstration in military stability operations, *European Journal of Operational Research*, 249, 1063-1073.
- Laun, S., Schooler, L. J., & Gigerenzer, G. (2011). A signal-detection analysis of fast-and-frugal trees. *Psychological Review*, 118(2), 316-338.
- Super, G. (1984). *START: A triage training module*. Newport Beach, CA: Hoag Memorial Hospital Presbyterian.

INVESTIGATING VULNERABILITIES AND CYBERSECURITY ISSUES IN CONNECTED CARS

Goktug Erkan, NU-PULSE, gee33366@marymount.edu
Xiang (Michelle) Liu, Marymount University, xliu@marymount.edu

ABSTRACT

According to a Gartner report there will be 50 billion Internet of Things (IoT) devices connected to the Internet by 2020. Connected cars, smart cars and Internet of Vehicles (IoV) are typical subdivisions of Internet of Things (IoT). This paper provides an overview of cybersecurity concerns regarding connected cars and shows how connected cars are vulnerable to attack since there are not enough information security products available. Additionally, the study explores current technologies and developments on connected cars with three case studies and examples on most popular connected car products in the market today. Further, the authors conducted penetration testing including detailed steps of footprinting, scanning, enumeration, exploitation and gaining access on systems of Tesla Software by Tesla Motors Inc., Harman Embedded Infotainment System, and QNX RTOS by Blackberry. The results are then summarized and discussed.

INTRODUCTION

Technological developments continue to influence everyday activities. Research and technological improvements have made it possible to achieve different levels of success that might have been difficult to imagine earlier. The emergence of technologies such as the Internet of things (IoT) has enabled different functions performed in an integrated and seamless manner by connecting devices to the Internet. The transport sector has not been left behind in this regard. From a humble beginning, automobiles today utilize more computing power than that of personal computers. Traditionally, information technology (IT) was used to optimize internal functions of a car. However, the ideas behind connected cars focus on creating cars that can connect with the outside world. Connectivity to the outside world is utilized to ensure that automotive drivers have better and enjoyable driving experiences. In essence, connectivity is made possible through the creation of technologies that can support the performance of the connected car. However, the technologies developed for such purpose often are vulnerable to human manipulation.

Today IoT has become an increasingly growing topic among manufacturers, consumers, researchers and practitioners in academia and industries, bringing new research and development areas into the horizon. The Internet of Vehicles (IoV), a typical subdivision of IoT, has been gaining special attentions due to its capability of interacting smart and connected cars with other vehicles and other physical environments through Vehicular Ad hoc Networks (VANETs) [9]. As a variety of elements such as medical devices, smart TVs, home appliances and many other devices in our daily lives are increasingly integrated into various networks, more attack surface is thus exposed without security design in mind, with little technical safeguard implemented, and/or without up-to-date law and

regulations enforced.

There are many key stakeholders in the market of automated and connected vehicles including automobile manufacturers, technology and software vendors, cybersecurity providers, wireless carriers, and advertisers. Most of the carmakers such as Acura, BMW, Ford, Toyota and Tesla and communication companies such as Verizon and AT&T have already entered the market. Technology companies are accelerating the industry's growth by providing software, mobile apps, and cybersecurity products. Some of the key players are Apple, Blackberry (QNX), Google, Spotify, Harman, and IBM.

As such, this paper seeks to investigate and report on security concerns and vulnerabilities of the most popular tools and software that have been used in the implementation of connected cars, followed by risk mitigation recommendations and conclusions. The authors will examine three forerunners in the IoV industry: Tesla, the most popular connected car currently in the U.S. market; Harman International, one of the top five automotive infotainment market vendors; and BlackBerry's QNX - the leading operating system in the connected car market.

SMART AND CONNECTED CARS: CURRENT TECHNOLOGIES AND DEVELOPMENTS

A connected car is defined as a car that is connected to the Internet and mostly within the wireless local area network [2]. With the access to the Internet and a variety of sensors, the connected cars can share its network with users and devices within and outside the vehicle and also interact with other vehicles or entities. The first connected car in the market was developed by General Motors in 1996 with the main aim being getting emergency help to the driver in time following an accident. The basis of the connected car was to save lives with regards to getting emergency help to the victims promptly. Since this period, there have been developments with regards to this technology as well as increased acceptance and adoption of connected cars by the market. With the increasing presence of connected cars in today's society, there is a need to consider information security management as an approach to mitigating risks linked to connected cars.

Automotive industry is moving from standalone and oil-fueled technology to being interconnected and fueled by a range of energy sources. Today, connected cars can provide smart driving assistant, connected car systems monitoring, automated emergency management, cloud-based infotainment solutions, enhances gesture control, biometric vehicle access, head-up display technology, personalized in-car marketing and more.

Automotive manufacturers are not software companies. Many of them do not have development capabilities, therefore, they mostly outsource software and tools used in their car models to third parties. There are a number of software and operating system solutions for connected cars. For instance, commercial Linux based, Open Source like Genivi, Windows Azure in some Ford models, Android applications or Real Time Operating Systems (RTOS) for connected embedded systems such as Nucleus RTOS by Mentor or QNX Neutrino RTOS by Blackberry. Moreover, some major companies provide cybersecurity solutions or frameworks for connected cars such as Harman and IBM. Although connected car software is still in its infancy, the sector has seen the emergence of

technologies that seek to have a direct influence on how connected vehicles are being implemented. Further, it is worth to note the emergence of both automakers and software manufacturing companies competing to control the market. Harman is one such company, offering solutions and trying to foster development in producing connected car software. Furthermore, Google has not been left behind either with the Android Auto.

SECURITY CONCERNS

Compromise in security of car systems can lead to accidents. Foster, Prudhomme, and Savage [4] point out that modern automobiles have virtually all functionalities ranging from acceleration to braking being mediated by computerized controls. Furthermore, the interconnected nature of the systems becomes a point of weakness that can be exploited. A popular aftermarket Telematics Control Unit (TCU) which is connected to a vehicle via the OBD-II port can be discovered and compromised by a remote attacker [4]. The study showed that vulnerability exploits in the TCU makes it easier for the whole car system to be compromised. The authors used a TCU device acquired from eBay to demonstrate the different types of attacks that malicious users can use on such a telematic system. It is evident that the attack can be local or remote considering the nature of the system. The authors further illuminated that measures such as the use of compromised SSH (Secure Shell) keys and the extraction of data from a NAND dump made it easier for any one with malicious intent to compromise the system.

Vallance [15] points out that a number of car infotainment systems continue to be vulnerable to attack. The author further acknowledges that Chris Valasek and Charlie Miller had proved to Wired magazine that it was possible to take control of a Jeep Cherokee. It was asserted that a Manchester based company had found a way to compromise a cars system by sending text from a mobile network to the system. It is evident that compromise from the system could result in an attacker taking control of the cars braking system and this is dangerous [15].

CASE STUDY: TESLA

Tesla is an electric and smart car manufacturer company that founded in 2003. Tesla Motors makes not only cars but also their own software, batteries and even solar roofs. Their research and development always bring new technologies to the industry of the smart and connected cars. In 2012, Tesla showed the power of innovation by creating truly connected cars with a number of APIs, which had functionalities that range from accessing the cars' data and offering OTA updates. The emergence of such technologies led to the development of the connected car market today.

The connected car prototype developed by Tesla has a distinguished characteristic derived from the company's over the air (OTA) updates system. Rob [14] reports that for many owners of a Tesla car, joy comes with experiencing new features and functionality that get rolled out over the air. Update time and frequency vary depending on the nature of the update. A number of factors influence an OTA update, a driver, therefore, has to ensure that they are aware of the version numbers, build numbers and release history first[14]. Software updates and releases are done following a particular pattern and over a given length of time. Although it is evident that OTA updates have revolutionized the way in which people interact with software in cars, the system is inherently vulnerable to various types of cyber attacks. The

same study also revealed that by gaining access to the car's system, a hacker was able to stop a Tesla car model. The ability of hackers to gain control and readily manipulate the activities of a car provides insight into the level of technology support and security measures for automobiles.

Penetration Testing

Tesla Motors provides free updates for the customers' cars with OTA and mobile applications, which helps to monitor and control their cars remotely such as keyless driving, climate control and GPS location. User should go to customer login platform (<https://my.teslamotors.com/user/login>) to install updates.

Because every Tesla customer must use the main website and customer portal website which are on the domain of teslamotors.com, the footprinting technique was used as one of the steps of hacking methodology to find any vulnerability. The first step was information gathering using one of the IP lookup websites. The authors used the website called ipinfo.io and successfully gathered whois details of the domain name teslamotors.com (Figure 1). We also found IP Address block of Tesla Motors, Inc: 209.133.79.0/24 (Figure 2)

The next step was DNS Interrogation, which helps to discover query on DNS servers. We used Kali's DnSENUM tool running the command: `dnsenum teslamotors.com`. This tool helps discover some information about Tesla's nameservers and Mail (MX) servers where they use Microsoft Outlook services (Figure 3).

Since Netblock range of Tesla Motors were gained already, we used the Armitage tool in Kali scanning all hosts of the IP Address block (Figure 4). 38 Open ports were found and then a couple of test attacks were performed without any result (Figure 5 and 6). These IP addresses and DNS information can be valuable for further researches.

CASE STUDY: HARMAN

Harman International Industries Inc., an American company, which provides solutions and services for connected cars, lifestyle audio equipment, enterprise automation products, and IoT devices. Harman has been leading the market for providing software management and cyber-security solutions for connected cars. The company has unique Defense in Depth approach with a comprehensive and multilayered cyber security framework, which they call 5+1 Cyber Security Framework [8]. The company started to give cybersecurity solutions for connected cars after the acquisition of an Israeli automotive cyber security company, TowerSec, in January 2016. The company, TowerSec, had two products, called ECUSHIELD and TCUSHIELD, which provide embedded automotive software security. Harman integrated these two products into Harman's 5+1 security architecture, which made more secure solutions.

Embedded Infotainment

The firm's approach to embedded infotainment is dedicated towards platform-based design, which uses a modular hardware structure enhanced for upgradability [6, 7]. The company offers solutions that include highly integrated infotainment systems that help deliver luxurious in-car experience. The company also offers a fully featured next-generation scalable infotainment platform which provides car

manufacturers the opportunity to choose from different operating systems and software ecosystems such as QNX, Genivi, Linux, Android, and HTML5 which accept downloadable applications and help ensure that the system developed by the company does not grow obsolete [7]. In addition, the software platform provided by the company accommodates both full internal and external connectivity, which are not limited to mirroring, Bluetooth, WiFi, and LTE [7].

The 5+1 multi-layer security framework developed by the company is equipped with OTA updating capabilities [8]. The capabilities help provide top-notch cybersecurity that guarantees the full connectivity benefits. Similarly, the robust design of the platform by Harman helps to support a multi-screen in-car environment, making it possible for the developed platform to have an influence not only on the navigation but instrumentation clusters and the rear-seat infotainment too [6]. The platform puts to use the latest multicore system-on-chip hardware, which makes it possible to utilize a flexible Linux OS framework and leverage smartphone experiences such as CarPlay and Android Auto by Google. The platform further supports Mirror Link integration for the familiar and simple use of popular mobile applications.

Security Concerns and Vulnerabilities

As explained above, the Embedded Infotainment system developed by Harman provides a number of advantages to its users. The system is supported across multiple platforms and cars. However, just like any other embedded system developed, the system has a number of underlying vulnerabilities. Connectivity is arrived at by pursuing means such as the use of WiFi networks and technologies. The functional flaws that are underlying within the operations of WiFi make it easier for hackers with adequate experience to gain access into a car system.

An incident-involving journalist Andy Greenberg shed light on the vulnerability that comes with the use of such kind of system [5]. While driving on at seventy miles per hour, he began to notice the car behaving weirdly. Two white hat hackers Charlie Miller and Chris Valasek had remotely taken control of the car Andy was driving and were able to manipulate controls in the car such as the radio, windshield wipers, the transmission of the car and even the car's climate control. The experience by Andy helps identify the flaws in the system utilized on the car he was driving. The system utilized by the Jeep Cherokee is similar to that developed by Harman as it is geared to offer a similar experience, therefore alluding to the security risk posed by the car's system.

CASE STUDY: QNX RTOS

QNX Operating System, owned by Blackberry, is the leading operating system in the connected car market. Currently, it has a market share of about 47% and Linux is the second while holding 20% market share [10]. More than 60 million connected cars run on QNX worldwide. Over 40 automakers such as Mercedes-Benz, BMW, Chrysler, General Motors, Toyota and Volkswagen rely on them. QNX OS includes almost everything such as navigation, infotainment, Internet browsing, and self-driving technologies etc. Blackberry's QNX Neutrino RTOS is an embedded operating system that handles time-sensitive tasks, such as driver assistance systems [1, 13]. Unlike Linux, Microsoft or Google's operating systems solutions for connected cars, QNX can process sensitive tasks in milliseconds, which is very important for self-driving technology that needs quick decisions and actions. Although the system has made the vehicles efficient, there are evident flaws in the implementation of the system that

make it vulnerable to outside manipulation [16], especially when considering that the vehicle can now connect to social media.

Vulnerabilities in Embedded Systems

The underlying ideas that enable the creation of connected cars make the systems utilized to achieve the objective relatively easy targets for manipulation from outside parties. Security threats are no longer only limited to software applications and general purpose digital systems. Once considered secure and out of reach for attackers, underlying hardware and hardware implementations of embedded systems can be exploited with the use of viruses and Trojan horses [3]. Embedded systems are confined to performing specific functions, therefore, attacks on an embedded system makes it difficult to deal with the effects of a security breach [3].

Incidentally, a number of vulnerabilities have been reported to Blackberry concerning its QNX real-time operating system [12]. Plaskett [12] points out that on the course of its lifetime, the operating system developed by Blackberry has not enjoyed good security reviews. For example, CVE-2014-2534-/sbin/pppoectl found in BlackBerry QNX Neutrino RTOS version 6.4.x and 6.5.x makes it possible for local users to attain critical information by evaluating "bad parameter" lines in error messages, as established by reading the root password hash in /etc/shadow [12]. Similarly, CVE-2014-2533-/sbin/ifwatchd in BlackBerry QNX Neutrino RTOS 6.4.x and 6.5.x permits local users to obtain privileges by providing an random program name as a command-line argument [12]. The errors highlighted above make the operating system vulnerable to attacks in the course of its everyday use.

Penetration Testing

One of the most important things for Cybersecurity professionals is comprehensive knowledge of the target system. In vulnerability analysis, if professionals are not familiar with the systems, they mostly follow up existing security researches. More complex and unknown systems require more thorough analyses in order to understand the infrastructure.

In the CVE security vulnerability database, there are four security vulnerabilities submitted in 2014 and 2015. The vulnerabilities CVE-2014-2534, CVE-2014-2533, CVE-2013-2688, and CVE-2013-2687 were exploited mostly on the version QNX RTOS 6.4.1. due to the DoS Exec Code Overflow.

After reading posts on the QNX Community Portal (openqnx.com) and running through articles in the news, more critical vulnerabilities have been revealed. In the Metasploit database, which contains updated exploits and scripts, QNX QCONN Remote Command Execution Vulnerability turns to be the most critical one. This security flaw in the QCONN component of QNX Neutrino causes the operating system trouble by allowing unauthenticated users to execute arbitrary commands remotely under the context of the 'root' user. Since QNX RTOS is Unix-like operating systems, its module name is exploit/unix/misc/qnx_qconn_exec in the database created by David Mor!p3r and Brendan Coles. In the following sections, this module will be used after finding security flaws.

First of all, anyone who registers QNX Software Development Platform can download 30-day-trial

version of QNX RTOS iso files with license keys. In this study QNX Neutrino v6.4.1 was run on VMWare Fusion. The first screen asks users to select a boot option (Figure 7). There are two options: Installing it to a small partition in hard drive or running on RAM like live CD without writing anything to hard drive. Live Run option (F2) is selected which is also preferred for testing purposes. After successfully installation, the login windows came up (Figure 8). The default login is root and there isn't any password to login. Its user interface is very simple and clean and most of the applications such as Firefox and utilities come default (Figure 9).

In the first exercise, with using Zenmap in Kali, the IP 192.168.136.128 of live environment was scanned and received 0 Open, 8 Filtered and 992 Closed Ports (Figure 10 and 11). Since there aren't any open ports, no further action occurred.

In QNX Developer Support manual, there is a program called pdebug in QNX, which helps to debug processes over TCP/IP and also provides to upload and download. This program doesn't run by default and users must launch it. QNX has also another program called qconn, which provides service support to remote IDE components. In order to upload or download anything remotely to connected cars, which run on QNX RTOS, QCONN must be launched. When launching it, it also starts the program pdebug on TCP port 8000.

In the second exercise, using the terminal in QNX, qconn was launched and then qconn prints the String "+ Done pdebug 8000" (Figure 12). At the second intense scan on Zenmap, we found 1 Open, 17 Filtered, and 982 closed ports (Figure 13,14 and 15). After seeing an open port, the next step was to open Metasploit and then Armitage tools in Kali.

The first step in Armitage is adding hosts with Nmap Intense Scan and the same open port was received, which was 8000 (qconn remote IDE support) (Figure 16). The next step is finding attacks from the database of Metasploit (Figure 17). After running previous attacks and vulnerabilities, it matched 4 attacks:

1. Splunk Search Remote Code Execution (HTTP) (Figure 18)
2. QNX QCONN Remote Command Execution Vulnerability (MISC) (Figure 20)
3. SAP SOAP RFC SXPG_CALL_SYSTEM Remote Command Execution (SAP) (Figure 22)
4. SAP SOAP RFC SXPG_COMMAND_EXECUTE Remote Command Execution (SAP) (Figure 23)

We tried all of them by selecting reverse connection every time (Figure 19 and Figure 21), which didn't generate any successful result. We also tried Hail Mary function, which launches a flood exploit at hosts and also sometimes causes crashing the systems (Figure 24). Hail Mary successfully provided one active session, (Shell Unix Type) (Figure 25). With this shell, we were able to interact with QNX RTOS operating system (Figure 26). This helps to execute any commands. Moreover, we were able to upload any type of files such as images or any linux tools. Also, we were able to perform pass session and post modules (Figure 27).

NetBSD is a free and open source Unix-like operating system, and on its database we found Netcat which is a Unix utility that reads and writes data across network connections, using TCP or UDP

protocol. Netcat was downloaded to Kali's local directory and then uploaded to QNX's platform under /tmp directory (Figure 28). Because of the active session, we were able to remote code execution on QNX RTOS through the port 8000. Therefore, we ran the Netcat under /tmp directory remotely and started to listen and received root shell.

Moreover, the other critical vulnerability is that the root user does not need any password to access the system at the beginning. FTP and rlogin services on QNX RTOS always require a password when connecting, the telnet services do not require. Therefore, anyone can telnet as root without a password if QNX's inetd utility is run. This vulnerability is alive for almost a year [11].

Conclusion

Advancement in technology has resulted in the development of underlying technologies that have made the emergence of connected cars possible. Companies such as Tesla, Harman and Blackberry have emerged as leaders in the creation of software products to support connectivity in motor vehicles. A striking characteristic of connected car technologies is their portability, which means they can readily be used from one model to another. The disadvantage of this approach of design is that vulnerability in the system is not confined to a single model, instead, the problem affects a wide range of automakers and customers. Connectivity primarily relies on the use of the Internet to aid in connectivity and as with the use of the Internet malicious attacks are imminent.

As the previous sections analyzed and demonstrated, the software and security solutions for connected cars have numerous vulnerabilities. For example, Tesla Software suffered series of attacks, which would lead to a compromise of critical company assets. The further research will be focused on vulnerability scanning on the open ports of their IP address block. In terms of QNX, the penetration testing has shown that the current version of QNX RTOS has very critical security vulnerabilities. With this security flaw, connected cars, which run on this operating system, can be hacked and controlled remotely. Thus, companies should invest in ensuring that the systems they develop are secure.

APPENDIX: Penetration Testing Figures Excerpts*

***Note: Due to the space limitation, only sample figures are included in this version of the paper.**

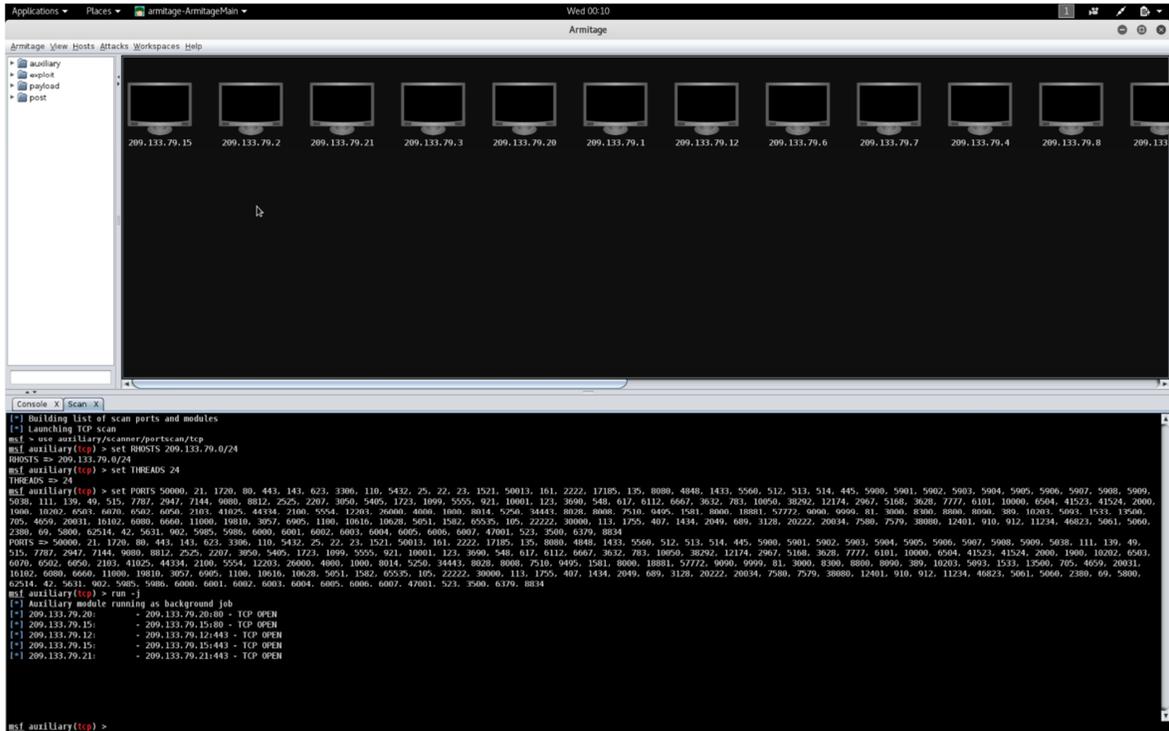


Figure 5

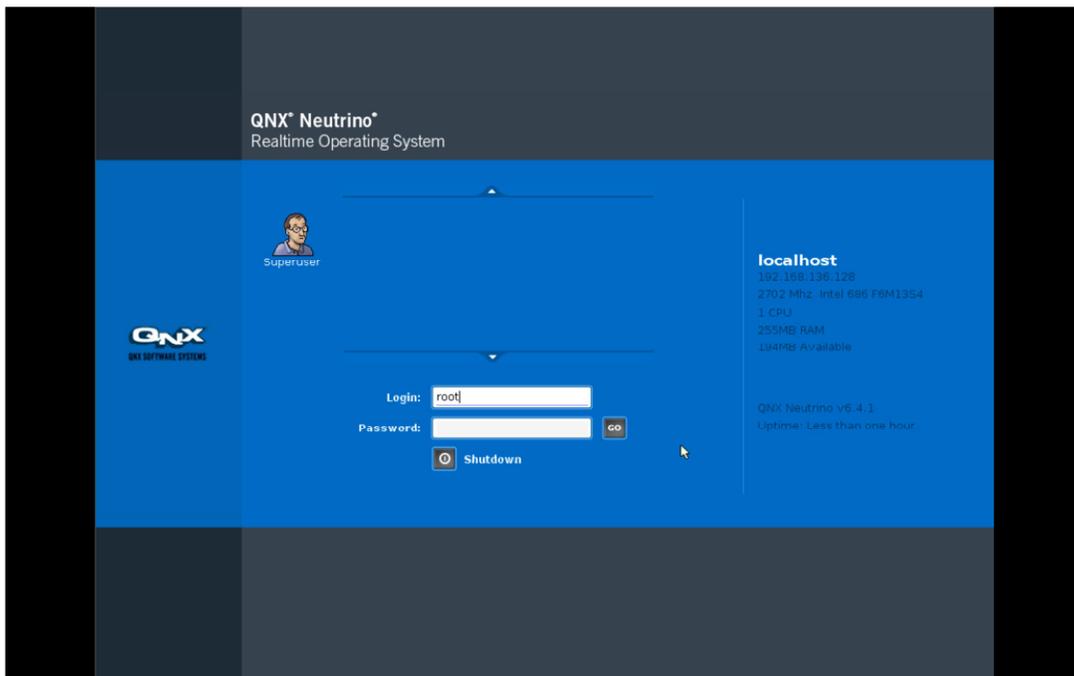


Figure 8

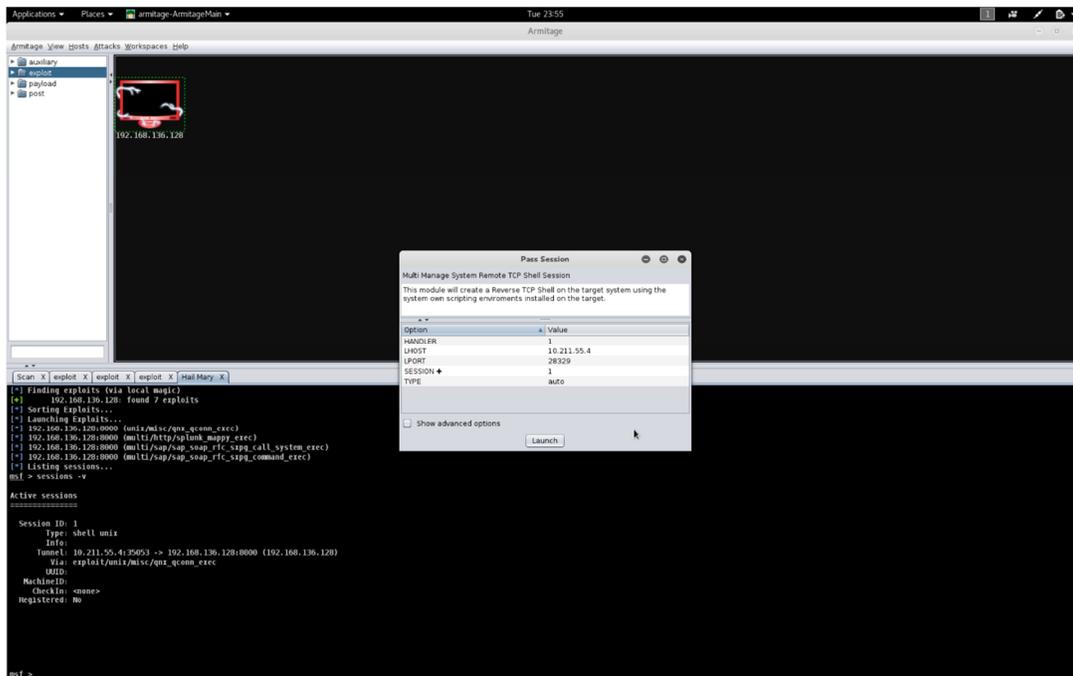


Figure 27

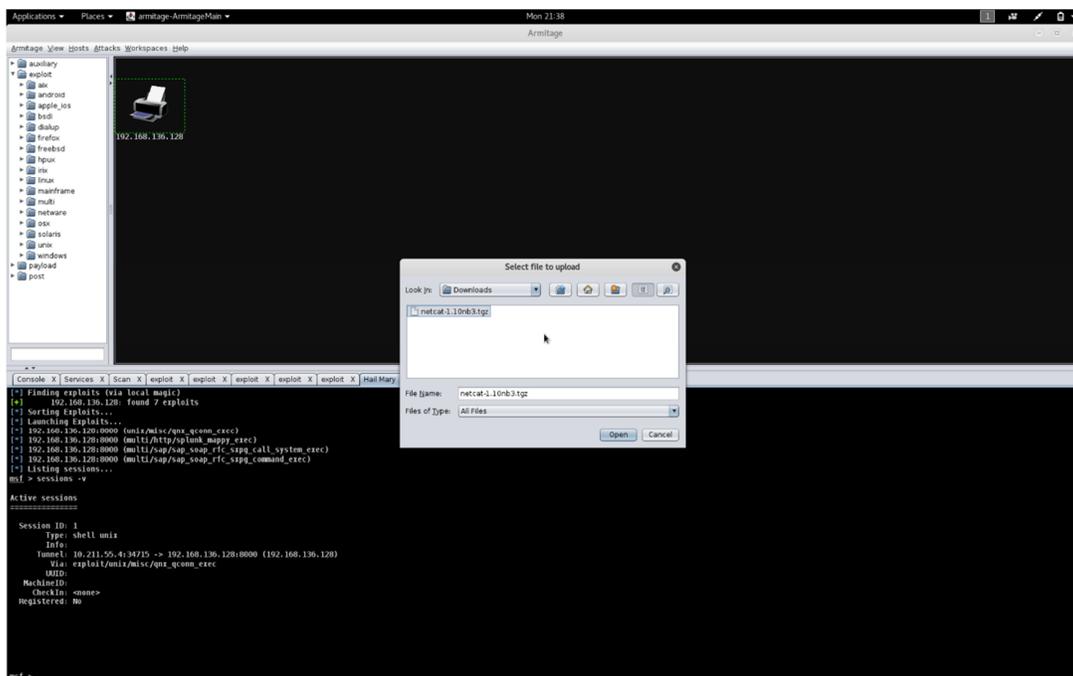


Figure 28

REFERENCE

- [1] Blackberry QNX. (2017). *QNX Operating Systems*. Available: <http://www.qnx.com/content/qnx/en/products/neutrino-rtos/index.html>
- [2] Chávez, M., Rosete, H., and Henríquez, R. , "Achieving Confidentiality Security Service for CAN," *Proceedings of the 15th International Conference on Electronics, Communications and Computers*, pp. 166–170, 2005.
- [3] Farooq-i-Azam, M., & Ayyaz, M. N. . (2016, Embedded Systems Security. *arXiv preprint arXiv:1610.00632*.
- [4] Foster, I., Prudhomme, A., & Savage, S. . (2015, Fast and Vulnerable: A Story of Telematic Failures. . Available: <http://www.autosec.org/pubs/woot-foster.pdf>
- [5] Greenberg, A. (2015, Hackers Remotely Kill a Jeep on the Highway—With Me in It. Available: <https://www.wired.com/2015/07/hackers-remotely-kill-jeep-highway/>
- [6] Harman. (2017, Platform Based Design. Available: <https://www.harman.com/platform-based-design>
- [7] Harman. (2017, Connected Car. Available: <https://www.harman.com/connected-car>
- [8] Harman Security. *HARMAN's unique 'Defense in Depth'* Available: <https://www.harman.com/security>
- [9] Kaiwartya, O., Abdullah, H., Cao, Y., Altameem, A., Prasad, M., Lin, C.-T., and Liu, X., *Internet of Vehicles: Motivation, Layered Architecture Network Model Challenges and Future Aspects* vol. 9, 2016.
- [10] Muoio, D. (2017, January 11, Blackberry is quietly trying to make a comeback - but not with phones. Available: <http://www.businessinsider.com/blackberry-pursues-self-driving-car-software-through-qnx-2017-1>
- [11] Ops, B. (2016, June 16, Hacking QNX systems over QCONN. Available: <https://www.blackmoreops.com/2016/06/02/hacking-qnx-systems-over-qconn/>
- [12] Plaskett, A. (2016, QNX Security Architecture: MWR Labs Whitepaper. Available: <https://labs.mwrinfosecurity.com/assets/BlogFiles/mwri-qnx-security-whitepaper-2016-03-14.pdf>
- [13] QNX Neutrino RTOS. Available: <http://www.qnx.com/products/neutrino-rtos/neutrino-rtos.html>
- [14] Rob, M. (2014, Everything you need to know about Tesla software updates. Available: <http://www.teslarati.com/everything-need-to-know-tesla-software-updates/>
- [15] Vallance, C. (2015, Car hack uses digital-radio broadcasts to seize control. Available: <http://www.bbc.com/news/technology-33622298>
- [16] Zheng, X., Pan, L., Chen, H., & Wang, P. , "Investigating Security Vulnerabilities in Modern Vehicle Systems," in *International Conference on Applications and Techniques in Information Security* Springer, Singapore, 2016, October, pp. 29-40.

Does Using IT As a Strategic Investment Improve Firms Performance? Work in Process

Rick Weible, Marshall University

Abstract

This paper investigates the effect of IT investment on firm performance. Many firms seem to view IT as a supporting utility, while others consider it a valuable tool in firm success. Do firms viewing IT as a tool for competitive advantage outperform firms that do not? How is a firm's IT investment measured? How is a firm's success measured? How is the firm's view of IT measured? This paper attempts to provide answers to these questions and suggestions for future research.

Introduction

Carr (2003) suggested that Information Technology (IT) doesn't matter. He posits, IT is ubiquitous, increasingly inexpensive, and accessible to all firms and therefore, cannot provide differential advantage to any firm. This of course, is in direct conflict with the view of most information technology academics. Carr based his argument partially on the resource-based view (RBV), postulating that it is scarcity not ubiquity that is a necessary condition for supernormal return generation. Academic researchers have positioned the issue in terms of IT capabilities and argue that such capabilities can and often do create uniqueness and therefore provide firms with a competitive advantage (Bhatt & Grover, 2005, Mata, Fuerst & Barney, 1995). In fact, these researchers often evoke RBV as the foundation for their support of IT's contribution to firm performance (Mata, Fuerst & Barney, 1995, Bharadwaj, 2000, Dehning & Stratopoulos, 2003, Santhanam & Hartono, 2003) by arguing that IT related organizational capabilities tend to be heterogeneously distributed among firms thus leading to differentiated business values to firms by improving organizational efficiencies, effectiveness, and uniqueness.

Beginning in the early 1980s research began focusing on the strategic impact of IT and its potential for creating firm competitive advantage (McFarlan, Jordan & Wurmfeld, 1984, Porter & Millar, 1985, Piccoli & Ives, 2005). Can IT lead to the creation of competitive advantage through efficiency and effectiveness improvements, differentiation, and channel domination as suggested by Sethi & King (1994)?

Literature Review

Do firms viewing IT as a tool for competitive advantage outperform firms that do not?

How is a firm's IT investment measured?

How is a firm's success measured?

How is the firm's view of IT measured?

In this study, competitive advantage means performing business activities better than the industry average. Differences in the performance of these activities or the activities actually chosen to perform serve as the basis of competitive advantage (Dehning & Stratopoulos, 2002).

Research Method

The following questions will be discussed in this section of the completed paper.

Identifying firms that use IT for a competitive advantage is a daunting task.

Do firms viewing IT as a tool for competitive advantage outperform firms that do not?

How is a firm's IT investment measured?

How is a firm's success measured?

How is the firm's view of IT measured?

Data Collection

Standard and Poor's Capital IQ will be the primary source of data for this paper. Data from on Industry will be compared using the answers developed to the above questions.

Conclusions

This section will be included in the final paper.

References

- Barber, B. M. & Lyon, J. D. 1996. Detecting abnormal operating performance: The empirical power and specification of test statistics* 1. *Journal of Financial Economics*, 41(3): 359-399.
- Barney, J. B. 1986. Strategic factor markets: expectations, luck, and business strategy. *Management science*, 32(10): 1231-1241.
- Bharadwaj, A. S. 2000. A Resource-Based Perspective on Information Technology Capability and Firm Performance: An Empirical Investigation. *MIS Quarterly*, 24(1): 169-196.
- Bhatt, G. D. & Grover, V. 2005. Types of Information Technology Capabilities and Their Role in Competitive Advantage: An Empirical Study. *Journal of Management Information Systems*, 22(2): 253-277.
- Brandenburger, A. M. & Stuart Jr, H. W. 1996. Value-based Business Strategy. *Journal of Economics & Management Strategy*, 5(1): 5-24.
- Brynjolfsson, E. 1991. Information technology and the 'new managerial work'.
- Brynjolfsson, E. & Hitt, L. 1996. Paradox lost? Firm-level evidence on the returns to information systems spending. *Management science*: 541-558.
- Brynjolfsson, E., Hitt, L. M. & Yang, S. 2002. Intangible assets: Computers and organizational capital. *Brookings papers on economic activity*, 2002(1): 137-181.
- Brynjolfsson, E. 1993. The productivity paradox of information technology. *Communications of the ACM*, 36(12): 77.
- Carr, N. 2003. IT doesn't matter. *Harvard Business Review*, 81(5): 41-49.
- Davis, L., Dehning, B. & Stratopoulos, T. 2003. Does the market recognize IT-enabled competitive advantage? *Information & Management*, 40(7): 705-716.
- Dehning, B. & Stratopoulos, T. 2003. Determinants of a sustainable competitive advantage due to an IT-enabled strategy. *The Journal of Strategic Information Systems*, 12(1): 7-28.
- Dehning, B. & Stratopoulos, T. 2002. DuPont analysis of an IT-enabled competitive advantage. *International Journal of Accounting Information Systems*, 3(3): 165-176.
- Dewan, S. & Kraemer, K. L. 2000. Information technology and productivity: evidence from country-level data. *Management Science*: 548-562.
- Eisenhardt, K. M. & Martin, J. A. 2000. Dynamic capabilities: what are they? *Strategic management Journal*, 21(10-11): 1105-1121.
- Harris, S. E. & Katz, J. L. 1991. Organizational Performance and Information Technology Investment Intensity in the Insurance Industry. *Organization Science*, 2(3): pp. 263-295.
- Hitt, L. & Brynjolfsson, E. 1996. Productivity, profit and consumer welfare: three different measures of information technology's value. *MIS quarterly*, 20(2): 121-142.
- Kohli, R. & Devaraj, S. 2003. Measuring information technology payoff: A meta-analysis of structural variables in firm-level empirical research. *Information systems research*, 14(2): 127.
- Mata, F. J., Fuerst, W. L. & Barney, J. B. 1995. Information Technology and Sustained Competitive Advantage: A Resource-Based Analysis. *MIS Quarterly*, 19(4): 487-505.
- McFarlan, F., Jordan, C. & Wurmfeld, C. 1984. Information technology changes the way you compete. *Harvard Business Review*, 62(3): 98-103.

- Piccoli, G. & Ives, B. 2005. Review: IT-Dependent Strategic Initiatives and Sustained Competitive Advantage: A Review and Synthesis of the Literature. *MIS Quarterly*, 29(4): 747-776.
- Porter, M. E. & Millar, V. E. 1985. How information gives you competitive advantage. *Harvard Business Review*, 63(4): 149-160.
- Ravinchandran, T. & Lertwongsatien, C. 2005. Effect of Information Systems Resources and Capabilities on Firm Performance: A Resource-Based Perspective. *Journal of Management Information Systems*, 21(4): 237-276.
- Ross, J., Beath, C. & Goodhue, D. 1996. Developing long-term competitiveness through information technology assets. *Sloan Management Review*, 38(1): 31-42.
- Santhanam, R. & Hartono, E. 2003. Issues in Linking Information Technology Capability to Firm Performance. *MIS Quarterly*, 27(1): 125-153.
- Sethi, V. & King, W. R. 1994. Development of measures to assess the extent to which an information technology application provides competitive advantage. *Management Science*, 40(12): 1601-1627.
- Teece, D. J., Pisano, G. & Shuen, A. 1997. Dynamic capabilities and strategic management. *Strategic management Journal*, 18(7): 509-533.
- Wernerfelt, B. 1984. A Resource-based View of the Firm. *Strategic Management Journal*, 5: 171-180.
- Yates, J. A. 1993. Co-evolution of information-processing technology and use: Interaction between the life insurance and tabulating industries. *The Business History Review*, 67(1): 151.
- Zahra, S. A. & Nielsen, A. P. 2002. Sources of Capabilities, Integration and Technology Commercialization. *Strategic Management Journal*, 23(5): 377.

Advances in Cybersecurity for Business and Management

Harry Katzan, Jr.,
Webster University
U.S.A.

Abstract

The value of modern computer systems and applications is generally conceived as being a function of five characteristics normally associated with cybersecurity: availability, accuracy, authenticity, confidentiality, and integrity. The concepts generally apply to government, business, education, and the ordinary lives of private individuals, and take place in an environment associated with the Internet. Maintaining a secure cyberspace is a multidimensional process involving personal identity, privacy, intellectual property, the critical infrastructure, and the sustainability of organizations. The threats inherent in a secure operating infrastructure are profound: cyber terrorism, cyber war, cyber espionage, and cyber crime, to which the technical community has responded with safeguards and procedures. This paper provides a contemporary view of security in the cyber domain with the ultimate objective of developing a science of cybersecurity. Two recent advances are covered: automated intrusion detection and application containers. Individuals and organizations involved with computer and information security should be aware of major developments in this important area.

KEYWORDS: Cybersecurity, critical infrastructure protection, application containers, intrusion detection.

Introduction

The Internet is the newest form of communication between organizations and people in modern society. Everyday commerce depends on it, and individuals use it for social interactions, as well as for reference and learning. To some, the Internet is a convenience for shopping, information retrieval, and entertainment. To others, such as large organizations, the Internet makes national and global expansion cost effective and allows disparate groups to profitably work together through reduced storage and communication costs. It gives government entities facilities for providing convenient service to constituents. The Internet is also efficient, because it usually can provide total service on a large variety of subjects in a few seconds, as compared to a much longer time for the same results that would have been required in earlier times (Katzan, 2012).

From a security perspective, the use of the term “cyber” generally means more than just the Internet, and usually refers to the use of electronics to communicate between entities. The subject of cybersecurity includes the Internet as the major data transportation element, but can also include wireless, fixed hard wires, and electromagnetic transference via satellites and other devices. Cyber elements incorporate networks, electrical and mechanical devices, individual computers, and a variety of smart devices, such as phones, tablets, pads, and electronic game and entertainment systems. The near future portends road vehicles that communicate and driverless automobiles. A reasonable view would be that cyber is the seamless fabric of the modern information technology infrastructure that enables organizations and private citizens to sustain most aspects of modern everyday life.

It is important to place cybersecurity in its proper operational domain. Cybersecurity resides in a domain named *cyberspace* that is distinct from the other established domains of land, sea, air, and space. Cyberspace uses the Internet as the transport mechanism that supports computers, tablets, smart phones, and control systems, and sustains communication of digital information including data, voice, video, and graphics. The variety of content and its extensive distribution is attractive to hackers, criminal elements, and nation with the objective is disrupting commercial, military, and social activities. Some of areas at risk in the cyberspace domain are commercial, industry, trade, finance, security, intellectual property technology, culture, policy, and diplomacy. The subject of cybersecurity is complicated because many cyber events, often classified as cyber attacks, are not deliberate and result from

everyday mistakes, poor training, and disgruntled employees. Cybersecurity metrics usually include non-serious and well as serious intrusions, so that the cybersecurity threat is commonly overstated.

Cyber supports the commercial, educational, governmental, and critical national infrastructure. Cyber facilities are pervasive and extend beyond national borders. As such, individuals, organizations, and nation-states can use cyber for productive and also destructive purposes. A single individual or a small group can use cyber for commercial gain or surreptitious invasion of assets. Activities in the latter category are usually classed as penetration and include attempts designed to compromise systems that contain vital information. In a similar vein, intrusion can also effect the day-to-day operation of critical resources, such as private utility companies.

Interconnectivity between elements is desirable and usually cost effective, so that a wide variety of dependencies have evolved in normal circumstances, and cyber intrusions have emerged. Thus, a small group of individuals can compromise a large organization or facility, which is commonly known as an *asymmetric* threat against which methodological protection is necessary. In many cases, a single computer with software obtained over the Internet can do untold damage to a business, utility, governmental structure, or personal information. Willful invasion of the property of other entities is illegal, regardless of the purpose or intent. However, the openness of the Internet often makes it difficult to identify and apprehend cyber criminals – especially when the subject’s illegal activities span international borders.

Cybersecurity Operations

Cybersecurity is a complicated and complex subject encompassing computer security, information assurance, comprehensive infrastructure protection, commercial integrity, and ubiquitous personal interactions. Most people look at the subject from a personal perspective. Is my computer and information secure from outside interference? Is the operation of my online business vulnerable to outside threats? Will I get the item I ordered? Are my utilities safe from international intrusion? Have I done enough to protect my personal privacy? Are my bank accounts and credit cards safe? How do we protect our websites and online information systems from hackers? Can my identity be stolen? The list of everyday concerns that people have over the modern system of communication could go on and on. Clearly, concerned citizens and organizations look to someone or something else, such as their Internet service provider or their company or the government, to solve the problem and just tell them what to do.

Cybersecurity hasn’t been a simple problem and probably never will be. Cyberspace is a virtual world synthesized from computer hardware and software, desktops and laptops, tablets and cell phones, and broadband and wireless signals that power our schools, businesses, hospitals, government, utilities, and personal lives through a sophisticated set of communication systems, available worldwide. However, the power to build also provides the power to disrupt and destroy. Many persons associate cybersecurity with cyber crime, since it costs persons, commercial organizations, and governments more than a \$1 trillion per year.¹ However, there is considerably more to cybersecurity than cyber crime, so it is necessary to start off with a few concepts and definitions.

The term *cybersecurity* refers to two things: the state of possessing a secure operational environment and also the process of achieving a secure operational environment.

Cyber Attacks

Cyber attacks can be divided into four distinct groups:² cyber terrorism, cyber war, cyber crime, and cyber espionage. It would seem that cyber crime and cyber espionage are the most pressing issues, but the others are just offstage.³ Here are some definitions:³

¹ Remarks by the U.S. President on Securing Our Nation’s Cyber Infrastructure, East Room, May 29, 2009. [1]

² Shackelford, Scott L., In Search of Cyber Peace: A Response to the Cybersecurity Act of 2012, Stanford Law Review, March 8, 2012, (<http://www.stanfordlawreview.org>). [20]

³ Lord, K.M. and T. Sharp (editors), America’s Cyber Future: Security and Prosperity in the Information Age (Volume I), Center for New American Security (June 2011), (<http://www.cnas.org>). [16]

Cyber crime is the use of computers or related systems to steal or compromise confidential information for criminal purposes, most often for financial gain.

Cyber espionage is the use of computers or related systems to collect intelligence or enable certain operations, whether in cyberspace or the real world.

Cyber terrorism is the use of computers or related systems to create fear or panic in a society and may result in physical destruction by cyber agitation.

Cyber war consists of military operations conducted within cyberspace to deny an adversary, whether a state or non-state actor, the effective use of information systems and weapons, or systems controlled by information technology, in order to achieve a political end.

As such, cybersecurity has been identified as one of the most serious economic and national security challenges facing the nation.⁴ There is also a personal component to cybersecurity. The necessity of having to protect one's identity and private information from outside intrusion is a nuisance resulting in the use of costly and inconvenient safeguards.

Cyber terrorism is and has been of particular to analysts in developed countries. In fact, cyber terrorism has engendered in an entire industry of consultants and other relevant services. The basic idea is that a terrorist event perpetrated via the Internet could disrupt one or more of the critical resources such as power, water, and transportation. Why a critical resource should be capable of being controlled through the Internet is an interesting question that cannot be easily answered. But, nevertheless, after years of warnings and discussion, to this date, it hasn't been done. (Weimann, 2006)

The Cyberspace Domain, its Elements and Actors

Cyberspace provides, through the Internet, the capability to create, transmit, manipulate, and use digital information.⁵ The digital information includes data, voice, video, and graphics transmitted over wired and wireless facilities between a wide range of devices that include computers, tablets, smart phones, and control systems. The Internet serves as the transport mechanism for cyberspace. The extensive variety of content is attractive to hackers, criminal elements, and nation states with the objective of disrupting commercial, military, and social activities. Many cyber events, classified as cyber attacks, are not deliberate and result from everyday mistakes and poor training. Others result from disgruntled employees. Unfortunately, security metrics include non-serious as well as serious intrusions, so that the cybersecurity threat appears to be overstated in some instances. This phenomenon requires that we concentrate on deliberate software attacks and how they are in fact related, since the object is to develop a conceptual model of the relationship between security countermeasures and vulnerabilities.

Many of the software threats can be perpetrated by individuals or small groups against major organizations and nation-states – referred to as *asymmetric attacks*, as mentioned previously. The threats are reasonably well known and are summarized in the following list: privilege escalation, virus, worm, Trojan horse, spyware, spam, hoax, adware, rootkit, botnet, and logic bomb. It's clear that effective countermeasures are both technical and procedural, in some instances, and must be linked to hardware and software resources on the defensive side. The security risks that involve computers and auxiliary equipment target low-end firmware or embedded software, USB devices, cell phones and tablets, and removable and network storage. Operating system risks encompass service packs, hotfixes, patches, and various configuration elements. Established counter measures, include intrusion detection and handling systems, hardware and software firewalls, and antivirus and anti-spam software.

⁴ National Security Council, The Comprehensive National Cybersecurity Initiative, The White House, (<http://www.whitehouse.gov/cybersecurity/comprehensive-national-cybersecurity-initiative>). [2]

⁵ McConnell, M., *Cyber Insecurities: The 21st Century Threatscape*, Chapter II in Lord, K.M. and T. Sharp (editors), *America's Cyber Future: Security and Prosperity in the Information Age (Volume II)*, Center for New American Security (June 2011), (<http://www.cnas.org>). [18]

The cybersecurity network infrastructure involves unique security threats and countermeasures. Most of the threats relate to the use of out-of-date network protocols, specific hacker techniques, such as packet sniffing, spoofing, phishing and spear phishing, man-in-the-middle attacks, denial-of-service procedures, and exploiting vulnerabilities related to domain name systems. Countermeasures include hardware, software, and protective procedures of various kinds. Hardware, software, and organizational resources customarily execute the security measures. There is much more to security threats and countermeasures, and the information presented here gives only a flavor to the subject.

There is an additional category of threats and countermeasures that primarily involves end-users and what they are permitted to do. In order for a threat agent to infiltrate a system, three elements are required: network presence, access control, and authorization. This subject is normally covered as the major features of information assurance and refers to the process of “getting on the system,” such as the Internet or a local-area network. A threat agent cannot address a system if the computer is not turned on or a network presence is not possible. Once an end user is connected to the computer system or network, then access control and authorization take over. It has been estimated that 80% of security violations originate at the end-user level.⁶ *Access control* concerns the identification of the entity requesting accessibility and whether that entity is permitted to use the system. *Authorization* refers to precisely what that entity is permitted to do, once permitted access. There is a high-degree of specificity to access-control and authorization procedures. For example, access control can be based on something the requestor knows, a physical artifact, or a biometric attribute. Similarly, authorization can be based on role, group membership, level in the organization, and so forth. Clearly, this category reflects considerations which the organizations has control over, and as such, constitutes security measures that are self-postulated.

Automated Intrusion Detection

Intrusion detection is the process of monitoring the events occurring in a computer system or network and analyzing them for signs of possible security [sec] incidents. Intrusion prevention is the process of performing intrusion detection and attempting to stop detected possible incidents. Intrusion detection and prevention systems (IDPS) are primarily focused on identifying possible incidents, logging information about them, attempting to stop them, and reporting them to security administrators. An intrusion detection system (IDS) is software that automates the intrusion detection process. (Scarfone and Mell, 2007, p. ES-1) This is definitely the way of the future in this regard, but for proprietary reasons, it is not possible to delineate detailed specifics.

Application Containers

An application container is an operating system in which each application can only see itself, thereby limiting intrusion by unwanted programs. The technology that underlies the use of application containers is based on the notion of a hypervisor, initially developed for large mainframe computer systems. (Katzan, 1986) An application-container is a minimalist operating system designed to run only containers with all other functionality disabled. The configuration is standard for a prescribed class of applications and the file-system is read only. Essentially, an application container is analogous to the operating system on a smartphone. The parent operating system, that is the hypervisor, is designed to run a set of distinct application containers. Thus, a set of application containers is a portable, reusable, and automatable way to package and run applications. (Souppaya, Morello, and Scarfone, 2017)

Distributed Security

The major characteristic of a cybersecurity system designed to prevent and mediate a cyber attack is that the totality of security elements in a particular domain are organized into a smart service system. This characteristic refers to the facility of cyber elements to communicate on a real-time basis in response to cyber threats. Currently, threat determination is largely manual and human-oriented. An intrusion detection system recognizes an intrusion and informs a security manager. That manager then contacts other managers via email, personal contact, or telephone to warn of the cyber threat. In a smart cybersecurity system, the intrusion detection software would isolate the cyber threat and automatically contact other elements in the domain to defend their system. Thus, the security service would handle intruders in a manner similar to the way biological systems handle analogous invasions: recognize the threat; attempt to neutralize it; and alert other similar elements.

⁶ Stewart, *op cit.*

In a definitive white paper on distributed security, McConnell (2011) recognizes the need for cyber devices to work together in near real-time to minimize cyber attacks and defend against them. This is a form of continuous monitoring and referred to as a *cyber ecosystem* in which relevant participants interact to provide security and maintain a persistent state of security. Clearly, a cyber ecosystem would establish a basis for cybersecurity through individually designed hierarchies of security elements, referred to as security devices. Ostensibly, security devices would be programmed to communicate in the event of a cyber attack. The conceptual building blocks of an ecosystem are automation, interoperability, and authentication. *Automation* refers to the notion of security devices being able to detect intrusion detection and respond to other security devices without human intervention. Thus, the security ecosystem could behave as a security service and provide speed and in the activation of automated prevention systems. *Interoperability* refers to the ability of the cyber ecosystem to incorporate differing assessments, hardware facilities, and organizations with strategically distinct policy structures. *Authentication* refers to the capability to extend the ecosystem across differing network technologies, devices, organizations, and participants.

Thus, the cyber ecosystem responds as a service system in requests for security service to participants that are members of the ecosystem, namely private firms, non-profit organizations, governments, individuals, processes, cyber devices comprised of computers, software, and communications equipment.

Monroe Doctrine for Cybersecurity

Internet governance refers to an attempt at the global level to legislate operations in cyberspace taking into consideration the economic, cultural, developmental, legal, political, and cultural interests of its stakeholders (Conway, 2007). A more specific definition would be the development and application by governments and the private sector of shared principles, norms, rules, decision-making, and programs that determine the evolution and use of the Internet (Conway, *op cit.*). Internet governance is a difficult process because it encompasses, web sites, Internet service providers, hackers, and activists, involving differing forms of content and operational intent ranging from pornography and terrorist information to intrusion and malicious content. Cybersecurity is a complex form of service that purports to protect against intrusion, invasion, and other forms of cyber terrorism, crime, espionage, and war. But, attacks can be carried out by anyone with an Internet connection and a little bit of knowledge of hacking techniques. NATO has addressed the subject of cyber defense with articles that state the members will consult together in the event of cyber attacks but are not duty bound to render aid (Cavelty, 2011). It would seem that deterrence, where one party is able to suggest to an adversary that it is capable and willing to use appropriate offensive measures, is perhaps a useful adjunct to cybersecurity service. However, successful attribution of cyber attacks is not a fail proof endeavor so that offensive behavior is not a total solution to the problem of deterrence.

Cybersecurity is a pervasive problem that deserves different approaches. Davidson (2009) has noted an interesting possibility, based on the volume of recent cyber attacks. The context is that we are in a cyber war and a war is not won on strictly defensive behavior. A “Monroe Doctrine in Cyberspace” is proposed, similar to the Monroe Doctrine of 1823 that states “here is our turf; stay out or face the consequences.”

Summary

The Internet is a seamless means of communication between organizations and people in modern society; it supports an infrastructure that permits cost effective commerce, social interaction, reference, and learning. The use of the term “cyber” means more than just the Internet and refers to the use of electronics in a wide variety of forms between disparate entities. Cyber facilities are pervasive and extend beyond national borders and can be used by individuals, organizations, and nation states for productive and destructive purposes. A single individual or small group can use cyber technology for surreptitious invasion of assets to obtain vital information or to cause the disruption of critical resources.

Cybersecurity is conceptualized as a unique kind of service in which providers and clients collaborate to supply service through shared responsibility, known as *collaborative security*. Cybersecurity is achieved through distributed security implemented as a smart system with three important attributes: automation, interoperability, and authentication. A Monroe Doctrine for Cybersecurity is proposed.

Two reasonably new classes of cybersecurity technology are automated intrusion detection and application containers.

References and Selected Bibliographic Material

- Remarks by the U.S. President on Securing Our Nation's Cyber Infrastructure (2009). East Room, May 29, 2009.
- National Security Presidential Directive 54/Homeland Security Presidential Directive 23 (NSPD-54/HSPD-23).
- The White House. National Security Council, *The Comprehensive National Cybersecurity Initiative*, (<http://www.whitehouse.gov/cybersecurity/comprehensive-national-cybersecurity-initiative>).
- The White House (2003). *The National Strategy to Secure Cyberspace*, February 2003.
- The Department of Homeland Security. *More About the Office of Infrastructure Protection*, (http://www.dhs.gov/xabout/structure/gc_1189775491423.shtm).
- The Department of Homeland Security (2009). *National Infrastructure Protection Plan: Partnering to enhance protection and resiliency*.
- Working Group on Internet Governance (2005). Report Document WSIS-II/PC-3/DOC/5-E, August 2005.
- Cavelty, M., (2011). *Cyber-Allies: Strengths and Weaknesses of NATO's Cyberdefense Posture*, IP-Global Edition, ETH Zurich, 3/2011.
- Conway, M. (2007). *Terrorism and Internet Governance: Core Issues*, Dublin: *Disarmament Forum 3*, 2007.
- Davidson, M. (2009). *The Monroe Doctrine in Cyberspace*, Testimony given to the Homeland Security Subcommittee on Emerging Threats, Cybersecurity, and Technology, March 10, 2009.
- Katzan, H. (2012). *Cybersecurity Service Model*, *Journal of Service Science*, 5(2): 71-78.
- Katzan, H. (1986). *Operating Systems: A Pragmatic Approach*, New York: Van Nostrand Reinhold.
- Lord, K.M. & T. Sharp (editors, 2011). *America's Cyber Future: Security and Prosperity in the Information Age* (Volume I), Center for New American Security (June 2011), (<http://www.cnas.org>).
- McConnell, B. & The Department of Homeland Security (2011). *Enabling Distributed Security in Cyberspace: Building a Healthy and Resilient Cyber Ecosystem with Automated Collective Action*, (<http://www.dhs.gov/xlibrary/assets/nppd-cyber-ecosystem-white-paper-03-23-2011.pdf>), 23 March 2011.
- Scarfone, K. and P. Mell (2007). *Guide to Intrusion and Prevention Systems (IDPS)*, Computer Security Division, Information Technology Laboratory, National Institute of Standards and Technology, Gaithersburg, MD, NIST Special Publication 800-94.
- Shackelford, S.L. (2012). *In Search of Cyber Peace: A Response to the Cybersecurity Act of 2012*, *Stanford Law Review*, March 8, 2012, (<http://www.stanfordlawreview.org>).
- Souppaya, M., Morello, J, and K. Scarfone, (2017). *Application Container Security Guide* Computer Security Division, Information Technology Laboratory, National Institute of Standards and Technology, Gaithersburg, MD, NIST Special Publication 800-190.
- Weimann, G. (2006), *Cyber Terrorism: How Real is the Threat?* United States Institute of Peace, (www.usip.org).

Author Information

Professor Harry Katzan, Jr. is the author of books and papers on computer science, service science, and security. He teaches cybersecurity in the graduate program at Webster University.

Branding Your Major: One MIS Program's Approach to Differentiation Work in Progress

Rick Weible, Marshall University

Abstract

MIS programs reach enrollment grew and fell with the dot.com bubble. In today's era of state governments cutting funding to higher education, it is more important than ever to attract more students. But how? This paper examines the approach developed at one Mid-Western University to grow its MIS program enrollment.

Introduction

MIS programs nationwide reported record enrollment heights shortly after the beginning of the new millennium. Then the dot.com bubble burst. Two years later, enrollment numbers began to fall. This happened even though the US Department of Labor report shortages and continued job creation in the IT field. It seems, the get rich quick gold rush appeal of IT lost its luster. This temporary enrollment bump was caused by the appeal of big salaries, big signing bonuses, fun job perks and stock options. Which quickly ended with the failure of many internet firms.

Enrollment in our MIS program dropped from a high of 100 to the mid 30's. MIS programs suffer from two major issues: Name Recognition and field definition (what is MIS anyway). Virtually, none of our student have heard of MIS prior to taking the first MIS course.

Porter suggests four generic strategies for any organization to follow for success: Low Cost Leadership, Differentiation, or Focus on these in a niche area.

Literature Review

A literature review will go here.

Discussion and Conclusions

This section will be included in the final paper.

“Using creative writing assignments to facilitate learning and curiosity”

Sharynn Tomlin, Ph.D.
Angelo State University

As a student pursuing a degree in business, or any other field for that matter, the importance of developing good written communication skills is critical to one’s success. Much has been written about how to best teach, translate and develop those skills in writing for business, but little evidence has used creative writing assignments as innovative means for teaching business concepts.

Concept-based instruction is driven by “big ideas” rather than subject-specific content. By leading students to consider the context in which they will use their understanding, concept-based learning brings “real world” meaning to content knowledge and skills. Students become critical thinkers which is essential to their ability to creatively solve problems in their future careers. By introducing students to universal themes and engaging them in active learning, concept-based instruction: creates connections to students’ prior experience, brings relevance to student learning, facilitates deeper understanding of content knowledge and acts as an impetus for students to respond to their learning with action (Erickson 2008).

Concept-based instruction, by placing the learning process in the “big picture” context of a transdisciplinary theme, leads students to think about content and facts “at a much deeper level” and “as a practitioner would in that discipline” (Schill & Howell 2011). Thus, concept-based instruction mandates more critical thinking at increasingly higher levels of Bloom’s taxonomy. (Erickson 2012).

Research has also shown that students will tend to read materials more in depth and strive to determine the meaning if it is engaging, motivating and in way some stimulates their curiosity. Curiosity stimulates intellectual achievement — it’s what drives us to keep learning, keep trying, keep pushing forward. But how does one encourage curiosity in students? George Loewenstein, a professor of economics and psychology at Carnegie Mellon University, proposed an answer in the classic 1994 paper, “The Psychology of Curiosity.”

Loewenstein wrote, “when attention becomes focused on a gap in one’s knowledge. Such information gaps produce the feeling of deprivation labeled curiosity. The curious individual is motivated to obtain the missing information to reduce or eliminate the feeling of deprivation.” Loewenstein’s theory helps explain why curiosity is such a potent motivator: it’s not only a mental state but also an emotion, a powerful feeling that impels us forward until we find the information that will fill in the gap in our knowledge.

As a professor of strategic business, it is a constant struggle to identify concept-based assignments that create the curiosity prerequisite in critical analysis of a business situation. Recently in a recurring study abroad program, the author identified a possible teaching assignment that might accomplish both goals: develop a fictitious short story built around their

study abroad program events whereby student creatively write the end of the story but using business concepts emphasized in materials covered in the class.

In a recent study abroad program directed by the author to the United Kingdom, the author noticed that in another classes' assignment the professor had assigned the students to read a novel that he felt best described British politics. The sensational novel was engaging and created a curiosity to finish the assignment in order to find the outcome. Using that idea, the author, who was teaching a course in international business practices and issues such as crisis management, was unable to find a suitable novel, but instead considered the possibility of writing one that would present various issues faced by businesses but in a creative narrative albeit factious format.

The program consisted of 19 advanced BBA students and 5 graduate students. Students traveled to Scotland, London and Dublin for about 4 weeks. As a part of the class, students were required to keep a daily journal and note such things as current events, cultural differences and any unusual occurrence or event. Additionally, students were required to read a collection of readings assembled by the professor after which the group would discuss their interpretation and give an example of how they would address the issue.

During the program the professor also kept a journal of their activities and would note interesting but not clearly identifiable events during the travels. For example, during an excursion to St. Andrews, which is near the Royal Air Force base, we noticed a series of aerial maneuvers and some interesting activates on the surrounding farms.

Our next stop being London, the professor had planned a number of visits to various historic sites, including Westminster Abbey, Parliament and 10 Downing Street. Now, the professor must assume some creative thinking and develop a story around these events. For example, create a series of events that would require the students to assume the role of having to write the end of the story, but based on what they had learned thus far in the course.

The outcome proved to be quite interesting, but both the professor and the students learned how to apply the knowledge acquired in the class that was driven by the curiosity of providing an ending to the story.

STUDENT ASSESSMENT IN A REAL-WORLD-PROJECTS CAPSTONE COURSE IN COMPUTING

Charles Tappert, Pace University; Jigar Jadav, Pace University

ABSTRACT

The capstone computing course at our university provides students with experience working on computing and information systems projects with real-world aspects, and the students have the opportunity to develop both the hard and soft skills that are sought after by industry. A unique peer evaluation system and various assessment tools have been developed recently to facilitate student assessment. This paper describes the student assessment techniques used in capstone courses at other universities and then describes the assessment techniques currently used in our capstone course in computing.

INTRODUCTION

The capstone computing course at our university has been offering masters-level students experience with the development of real-world computing projects for over fifteen years. The course has evolved from faceto-face delivery in the first five years to a web-assisted course involving dispersed teams today. With dispersed teams we needed to revisit the way we graded the performance of team members. It is well known that projects undertaken by groups lacking co-presence presuppose a higher level of organizational and process skills among their members [5].

A capstone course is a course offered as part of an academic major aiming to bring together major aspects of the academic disciplines related to the said major [7]. The aim of our capstone course in computing is to familiarize students with how their trade is plied in organizations, so that the program of study delivers "the practice" part of the promised "theory and practice." The projects are "real world" in every respect as they entail the development of an application desired by a real world customer. As in industry, applications are developed by a small, collaborative team which needs to communicate with the customer, coordinate its activity, attend to internal decision-making, and, as observed by [6], be sensitive to delivering value. The applications press into service current technology. This is technology with which the students are often unacquainted inasmuch as it may be specialized, new, or at least new to them. Students learn about realworld technology through their own group's experiences as well as through the reports from other groups. A soft skill of transcending importance, emphasized by activities throughout the capstone, is the ability to communicate on technical concepts and issues; orally, in written reports, and via Web media; to both peers and lay people. The soft skills acquired through a capstone course are perhaps one of the greatest rewards of this academic experience. These include problem solving, communication, and teamwork skills which are becoming essential for work in industry [8].

A 2015 paper [10] provided a fifteen-year review of our capstone course in computing¹. In the fifteen years (2001-2015) since the capstone course assumed its project-based form, the most significant change has been in its presentation. For the first five years the course spanned the fall and spring semesters and was faceto-face. In 2006 the course was condensed into a one semester offering. For projects, this meant accelerating requirements elicitation, system development, and testing. We responded with agile methodology. In 2006 the course delivery shifted from face-to-face to "hybrid", where students collaborate remotely except for three meetings – at the beginning of the semester for orientation, at the middle of the semester for midterm project status reports to the class, and at the end of the semester for final project presentations.

Our project teams are largely geographically dispersed. A geographically dispersed team (also known as a virtual team, distributed team, or remote team) is a group of individuals who work across time, space, and

¹ Some of the background material here comes from this earlier paper.

organizational boundaries with links strengthened by webs of communication technology [12]. These teams are similar to traditional teams but are geographically dispersed and rely heavily on virtual methods such as email and virtual conference applications. Instructors believe experience working on a virtual team prepares students for the growing business demand [9].

The focus of this paper is on student assessment where significant changes have been made over the last two years. The remaining sections of the paper cover the following material: section 2 surveys student assessment in capstone courses at other institutions; section 3 describes the current procedures for student assessment at our university; and conclusions are drawn in Section 4.

CAPSTONE PROJECT STUDENT ASSESSMENT AT OTHER INSTITUTIONS

An earlier study contacted 84 universities having capstone courses in computer science or engineering to get a sense of how various academic institutions implement their capstone course [2]. Of the 84 universities polled with a set of 16 questions, 34 responded, including CMU, U. California, U. Maryland, U.S. Air Force Academy, and U.S. Naval Academy. For schools that did not respond, information in some cases was obtained from the internet, resulting in appropriate information from up to 49 institutions, depending on the information. To put this work into context, the information from that study concerning student assessment is described here.

Most of the capstone instructors polled required some sort of progress report to be turned in regularly. The most common frequency was weekly at 48% since this coincides with a typical course schedule and is frequent enough to allow the instructor to track progress. Bi-weekly progress reports were required in 17% of the polled schools, and 9% allowed more than two week intervals between progress reports. Surprisingly, 26% of universities did not require progress reports, indicating that time management was the responsibility of the student team.

Capstone project grades are usually based in part on peer reviews designed to evaluate the performance of team members as seen through the eyes of team members. Peer reviews take into consideration the project goals, team communication, and division of labor. Geographically near teams have the opportunity to meet in person on a regular basis. Team members can take cues from one another through in-person interaction and the responsibility of each team member is clear. Mid-semester peer reviews assist the instructor in identifying contribution or issues among the team members that need to be addressed before the project can be impacted negatively.

The weekly time required of students varied greatly from two hours per week to forty hours per week. A majority (60%) of programs expected more than ten but less than twenty hours weekly.

CAPSTONE PROJECT STUDENT ASSESSMENT AT OUR UNIVERSITY

Student assessment is as follows: individual quizzes (20%), first quarter team project (10%), second quarter team project (20%), third quarter team project (20%), and fourth quarter team project (30%). Note that the project grades increase percentagewise as we get further into the semester – Q1=10%, Q2=20%, Q3=20%, Q4=30% – so students can more easily recover from poor early grades. Thus, 80% of a student's grade is based on their contribution to the project team effort with the quizzes, based primarily on the textbook material, providing the only direct individual assessment. The team has the ultimate responsibility for the project work and is graded accordingly. Grades on team events are determined by first assigning a team grade and then adjusting an individual student's grade up or down based on peer, customer, and instructor evaluations.

Assignment of Team Grades

A team grade is assigned to each team at each of the four quarterly checkpoints. The quarterly evaluations are based on the following:

- Weekly team submission of project activity report.
- Quarterly team submission of a project technical report that, by the end of the semester, grows into a technical paper that for most teams is published in an annual internal computing conference.
- Individual student responses to questions for the specific quarter time interval – the number of hours per week spent on project work, their specific contributions, their strengths and how they were used, their areas needing improvement, and what has enhanced and/or challenged their team’s performance.

A team grade is based on the quantity and quality of the team meetings, and an evaluation of the team’s project technical report. Each team submits their draft of the technical report on turnitin.com. To check for potential plagiarism, turnitin.com uses advanced machine learning technologies to generate similarity reports for the drafts submitted compared to texts available on the Internet [11]. If a team has a similarity score of greater than 25%, the team can resubmit their draft. All teams have the option of working with the university’s writing center before submitting their drafts. A special arrangement has been made with writing center coordinators to work with the teams on how to write a technical paper. Drafts are given a

letter grade based on their technical correctness, appropriate citations, how well the draft follows IEEE format, etc. For the first two drafts, each team is provided with extensive feedback on their drafts so they can improve on their writing in subsequent drafts.

Assignment of Individual Team Member Grades

Peer, customer, and instructor evaluations are used to assess the project contributions of each team member. The peer evaluation procedure is first described and then modified to include customer and instructor evaluations. Peer evaluations, although used earlier when the course was conducted in the classroom, are even more critical for distributed teams because some team members have minimal direct contact with the customer and instructor. Obtaining individual student grades on teamwork has been reported in the literature. For example, one system is somewhat similar to ours but uses more granular numerical input [3], another is an elaborate web-based system that records and tracks self and peer evaluations [4], and yet another uses survey instruments [13].

The students are required to provide peer evaluations four times during the semester, one at each of the quarterly checkpoints. Table 1 shows the recent two-year evolution of peer evaluation charts with associated grades for a four-member team. Each of the four evaluation columns shows the evaluation of a team member’s evaluation input. The summary (“Sum”) column shows the adjusted sum of each row of evaluations, and the grade column shows the student grades. Here, a team grade of 85% is first determined and then individual team member grades are adjusted relative to the team grade.

Team Member	Eval 1	Eval 2	Eval 3	Eval 4	Sum	Grade
1	+	=	--	++++	+++	91
2	=	=	-	----	----	77
3	-	=	++++	--	+	87
4	=	=	-	+	=	85
Average	=	=	=	=	=	85

Team Member	Eval 1	Eval 2	Eval 3	Eval 4	Sum	Grade
1		=	--	++++	++	89
2	+		+	---	-	83
3	--	=		-	---	79
4	+	=	+		++	89
Average	=	=	=	=	=	85

Team Member	Eval 1	Eval 2	Eval 3	Eval 4	Sum	Grade
1		4	2	8	4	89
2	5		4	0	-1	84
3	0	3		2	-5	80
4	5	3	4		2	87
Total	10	10	10	10	0	85

Table 1. Evolution of team peer evaluation charts:
prior to fall 2015 (top), fall 2015 (middle), and current (bottom).

In the top chart, used prior to the fall 2015 semester, each column must average "=", and student grades were adjusted up or down 2% for each "+" or "-" sign obtained in the summary row. The middle chart, used in the fall 2015 semester, varied slightly from the top chart with the difference being that the students could not evaluate themselves, and in this example the inputs (+, -, =) have been adjusted slightly from the top chart to average "=".

The top-chart method favors and thus encourages students to give themselves high evaluations. The middle chart corrects this problem and shows that the student who did not give himself/herself a high evaluation in the top chart now has a better grade. The bottom chart, first used in the spring 2016 semester, employs a numerical system where each team member allocates a total of 10 points among the other team members (again no self-evaluation) so that each evaluation column adds to 10. Each entry in the summary column is obtained by adding the row values and subtracting 10, so that the average of the summary column adds to zero. The summary value is then used to adjust the team grade for each team member. This numerical method simplifies the awkward accounting for the +, -, and = signs and is basically the one described by [1].

The student peer evaluations are obtained at each quarter over the Internet through a Google Form (Figure 1). In the Google form, students are required to select their team identification number, enter their name, and rate the team contribution of each of their fellow team members (peers). In rating their peers, a total of 10 points, using integer values, must be distributed among the other team members. Students can fill out the form more than once, but only the latest version of the peer evaluation is considered in the grading

process. After the submission deadline, a response sheet is generated by Google in the form of Google Sheets. This document is then downloaded in the form of Microsoft Excel spreadsheet. The data are initially sorted by name so that only the latest version of the peer evaluation is considered. After removing duplicates, data are again sorted by team identification number.

Peer Evaluation 4

This form is confidential and will only be seen by your instructor and graduate assistant. Only one response per student is allowed. Do not evaluate your customer and any non-enrolled students.

Step 1: Consider the following about the project contributions of your fellow team members:
 Technical work, organizational contributions, library/literature searches, planning, administration, writing, leadership, consultation, productivity, attitude, initiative, etc.

Step 2: Based on your assessment, allocate a total of 10 points among the members of your team, except yourself, for their contribution to the group effort. The greater a team member's contribution the more points allocated to that team member.

* Required

Team ID# *
 Choose ▾

Your name *
 First and last name
 Your answer

Team member 1 *
 First and last name
 Your answer

Team member 1 rating *

	0	1	2	3	4	5	6	7	8	9	10	
lowest	<input type="radio"/>	highest										

Figure 1. Peer Evaluation Google Form for Quarter 4.
 The rating input area for only one team member is shown here.

Occasionally, a student does not submit proper peer evaluations and this is handled as shown in Table 2. For comparison, the upper chart shows all team members evaluated equally, and decimal evaluations are necessary to do this. The lower chart shows how a student who does not submit peer evaluations or submits them in error (not using integer values, values not adding to 10, etc.) is evaluated. The student at fault, in this case team member #2, is assigned -3 points and the other team members assigned values so the total distributed adds to 10, and non-integer values can be used here.

Team Member	Eval 1	Eval 2	Eval 3	Eval 4	Sum	Grade
1		3.3	3.3	3.3	0	85
2	3.3		3.3	3.3	0	85
3	3.3	3.3		3.3	0	85
4	3.3	3.3	3.3		0	85
Total	10	10	10	10	0	85

Team Member	Eval 1	Eval 2	Eval 3	Eval 4	Sum	Grade
1		4.3	3.3	3.3	1	86
2	3.3	-3.0	3.3	3.3	-3	82
3	3.3	4.3		3.3	1	86
4	3.3	4.3	3.3		1	86
Total	10	10	10	10	0	85

Table 2. Handling a student who fails to submit a proper peer evaluation. The student in question, highlighted in yellow, receives -3 points and the remaining students receive points to yield a sum of 10 points.

Customer and instructor (and possibly graduate assistant) evaluations are similarly included as shown in Table 3. The instructor’s evaluation of a student’s contribution to the team effort can be influenced by the student’s responses to the general questions, such as the number of hours per week spent on project work, and additional input can be obtained by discussing team member contributions with the team leader. The top chart shows the evaluations without customer and instructor additions (from Table 1, bottom chart). The bottom chart shows the customer and instructor additions when they both agree team member #1 was best and #4 second best.

Team Member	Eval 1	Eval 2	Eval 3	Eval 4	Eval Cust	Eval Inst	Sum	Grade
1		4	2	8			4	89
2	5		4	0			-1	84
3	0	3		2			-5	80
4	5	3	4				2	87
Total	10	10	10	10			0	85

Team Member	Eval 1	Eval 2	Eval 3	Eval 4	Eval Cust	Eval Inst	Sum	Grade
1		4	2	8	5	5	9	94
2	5		4	0	1	1	-4	81
3	0	3		2	1	1	-8	77
4	5	3	4		3	3	3	88
Total	10	10	10	10	10	10	0	85

Table 3. Adding customer and instructor evaluations (yellow).

On rare occasions, students will try to “game” the system, and this is usually a pair of students who give each other a high evaluation. A review of the summary charts will usually discover such anomalies because these high evaluations appear as outliers relative to the other evaluations. This is illustrated in Table 4. In the top chart of the table, team members #2 and #3 give each other 10 points and the others none, and this clearly does not agree with the evaluations assigned by the other team members and especially those assigned by the customer and instructor. Such situations are handled in the same manner as the students not submitting evaluations, by assigning the “gaming” students -3 points and assigning the other team members values so the total distributed adds to 10, as shown in the bottom chart.

Team Member	Eval 1	Eval 2	Eval 3	Eval 4	Eval Cust	Eval Inst	Sum	Grade
1		0	0	8	5	5	3	88
2	5		10	0	1	1	2	87
3	0	10		2	1	1	-1	84
4	5	0	0		3	3	-4	81
Total	10	10	10	10	10	10	0	85

Team Member	Eval 1	Eval 2	Eval 3	Eval 4	Eval Cust	Eval Inst	Sum	Grade
1		4.3	4.3	8	5	5	11.7	96.7
2	5	-3.0	4.3	0	1	1	-6.7	78.3
3	0	4.3	-3.0	2	1	1	-9.7	75.3
4	5	4.3	4.3		3	3	4.7	89.7
Total	10	10	10	10	10	10	0	85

Table 4. Team members 2 and 3 tried to “game” the system by giving each other the full 10 points (top chart), and the revised chart (bottom).

Individual student grades are posted each quarter as obtained from the appropriate peer evaluation summary charts. These charts are created in a spreadsheet that automatically makes all the computations once the project grade (lower right-hand corner) and the peer, customer, and instructor evaluations are entered. We are investigating methods of automatically entering the information from the Google Form.

CONCLUSIONS

Capstone courses are particularly important to computing and information systems education. Students develop hard and soft skills, are exposed to a wide range of topics, and foster interdisciplinary collaboration. Student assessment can be difficult in capstone courses where most of the work is performed in geographically dispersed teams. The assessment techniques described here have been tested and shown to be successful over the last two semesters and should be of value to other institutions.

REFERENCES

- [1] Brooks, F.P., Keynote Address, EDSIG 2015 Conference, Wilmington, N.C., November 2015.
- [2] Brewer, T., Campoverde, N., Hanna, J., Humphries, B., & Tappert, C.C. (2015). Analysis of Capstone Computing Courses. Proc. Student-Faculty Research Day, CSIS, Pace University.
- [3] Brown, R.W. (1995). Autorating: Getting Individual Marks from Team Marks and Enhancing Teamwork. *Proceedings of the Frontiers in Education Conference*, IEEE/ASEE, Pittsburgh, Pa.
- [4] Clark, N., Davies, P., & Skeers, R. (2005). Self and Peer Assessment in Software Engineering Projects. *Proceedings of the 7th Australasian Conference on Computing Education*, Newcastle, Australia.
- [5] Cusumano, M. (2008). Managing Software Development in Globally Distributed Teams. *Communications of the ACM*, 51(2), 15-17.
- [6] Denning, P.J. & Dunham, R. (2001). The core of the third-wave professional. *Communications of the ACM*, 44(11), 21-25.
- [7] Ford, M. (2002). *Beyond the Modern University: Toward a Constructive Postmodern University*. Praeger.
- [8] Gardiner, B. (2015). Soft skills now an essential focus of IT recruitment. CIO Magazine, 2015.
- [9] Goldberg, J. & Howe, S. (2014). Virtual Capstone Design Teams: Preparing for Global Innovation. *Proc. Capstone Design Conf.*, Columbus, Ohio, June 2014.
- [10] Redacted to preserve anonymity.
- [11] Turnitin, Wikipedia, <https://en.wikipedia.org/wiki/Turnitin>, accessed 2017.
- [12] Virtual Team, Wikipedia, https://en.wikipedia.org/wiki/Virtual_team, accessed 2017.
- [13] Wilkins, D.E. & Lawhead, P.B. (2000). Evaluating Individuals in Team Projects. *Proceedings of the 31st SIGCSE Technology Symposium on CS Education*, Austin, Texas, 172-175.

Unleashing the Hidden Power of the ETS Major Field Test

John W. Mortimer, Ph.D., Professor of Accounting Coastal Carolina University

Barbara A. Ritter, Ph.D., Dean, Professor of Management, Coastal Carolina University

Christopher J. Becker, Ph.D., Assistant Professor of Accounting, Coastal Carolina University

Phillip K. Njoroge, Ph.D., Assistant Professor of Accounting, Coastal Carolina University

Abstract

Current trends in technology, globalization, and academic credential creep are among factors increasing the demand for college education. At the same time, many national and state governments are reducing their financial support of public postsecondary institutions and universities and are redressing this funding shortfall by charging higher tuition fees. Given the upward spiraling costs of education; students and their benefactors, not-for-profits and governmental entities are questioning the cost/benefit of a college-level education. To justify charging ever higher tuition fees and remain competitive with their peers, educational institutions seek academic accreditations to differentiate the quality of their programs from their competitors. A major tenet of all academic accreditation programs is the assurance of student learning. The purpose of this paper is to examine and share techniques that administrators can use with the ETS Major Field Test to assess student learning, not only at the discipline-level but, also at the department and in some instances, the course-level specific student learning outcomes to document learning assessment.

Introduction

The Demand for Education

Disruptive technologies are changing the U.S. employment landscape at an ever-faster pace. During the twentieth Century, combustion engines, electricity and urbanization were major factors in the U.S. employ shift from lower paid manual laborers to white collar and service workers.¹ Today automated, robotic and digital technologies are eliminating hundreds of thousands of lower to mid-level blue collar jobs. Among the projected future job losses Table 1, shows simple disruptive technologies like e-mail are estimated to eliminate 18,300 postal service clerks, 78,100 mail carriers and 4,600 post master who are paid median wages of \$56,790, \$58,110 and \$71,670, respectively in 2016. Emerging technologies, like chat bots, are expected to eliminate the majority of staffing for entire industries. Parmy Olson (2016) discusses the promise of chat bots with Mark Zuckerberg and his plan to run Facebook with chat bots. She further points to the types of jobs that chat bots may make obsolete: customer service agents, fast food workers, and personal assistants. Even the once safe domain of the white-collar professional is now under assault as automation and big data analytics provide faster and more precise information than human professionals. For example, IBM Watson for Oncology helps physicians quickly identify key

¹ See: Wyatt, Ian D. and Daniel E. Hecker, Occupational Changes during the 20th Century, Monthly Labor Review, 2006, P. 35-57, <https://www.bls.gov/mlr/2006/03/art3full.pdf>

information in a patient’s medical record, surface relevant articles and explore treatment options to reduce unwanted variation of care and give time back to their patients.²

Table 1
Employment Projections

This chart shows the U.S. Bureau of Labor Statistics, Employment Projection Program, estimate of fastest U.S. declining jobs from 2014 to 2024.

2014 National Employment Matrix title and code	Employment		Change, 2014–24		Median annual wage, 2016(1)	
	2014	2024	Number	Percent		
Total, all occupations	00-0000	150,539.90	160,328.80	9,788.90	6.5	\$37,040
Locomotive firers	53-4012	1.7	0.5	-1.2	-69.9	\$58,230
Electronic equipment installers and repairers, motor vehicles	49-2096	11.5	5.8	-5.8	-50	\$32,220
Telephone operators	43-2021	13.1	7.5	-5.5	-42.4	\$37,000
Postal service mail sorters, processors, and processing machine operators	43-5053	117.6	78	-39.7	-33.7	\$56,220
Switchboard operators, including answering service	43-2011	112.4	75.4	-37	-32.9	\$28,030
Photographic process workers and processing machine operators	51-9151	28.8	19.4	-9.5	-32.9	\$26,470
Shoe machine operators and tenders	51-6042	3.5	2.5	-1.1	-30.5	\$26,150
Manufactured building and mobile home installers	49-9095	4	2.8	-1.2	-30	\$29,810
Foundry mold and coremakers	51-4071	12	8.7	-3.3	-27.7	\$34,790
Sewing machine operators	51-6031	153.9	112.2	-41.7	-27.1	\$23,670
Pourers and casters, metal	51-4052	9.8	7.2	-2.6	-26.6	\$36,180
Postal service clerks	43-5051	69.6	51.3	-18.3	-26.2	\$56,790
Postmasters and mail superintendents	Nov-31	17.3	12.8	-4.6	-26.2	\$71,670
Postal service mail carriers	43-5052	297.4	219.4	-78.1	-26.2	\$58,110
Textile knitting and weaving machine setters, operators, and tenders	51-6063	27.9	20.6	-7.3	-26.2	\$27,470
Fabric and apparel patternmakers	51-6092	5.4	4	-1.4	-26	\$39,650
Textile cutting machine setters, operators, and tenders	51-6062	14.3	10.6	-3.7	-25.7	\$26,090
Watch repairers	49-9064	2.7	2	-0.7	-25.7	\$36,740
Molding, coremaking, and casting machine setters, operators, and tenders, metal and plastic	51-4072	129.5	97.2	-32.3	-25	\$30,480
Prepress technicians and workers	51-5111	36.5	27.5	-9	-24.6	\$38,930
Extruding and drawing machine setters, operators, and tenders, metal and plastic	51-4021	73.4	55.5	-17.9	-24.4	\$33,870
Textile bleaching and dyeing machine operators and tenders	51-6061	11.7	8.9	-2.8	-23.9	\$27,270
Patternmakers, metal and plastic	51-4062	3.8	2.9	-0.9	-23.4	\$44,210
Grinding, lapping, polishing, and buffing machine tool setters, operators, and tenders, metal and plastic	51-4033	71.4	55.8	-15.7	-21.9	\$32,890
Textile winding, twisting, and drawing out machine setters, operators, and tenders	51-6064	26	20.3	-5.6	-21.7	\$27,500
Model makers, metal and plastic	51-4061	6.2	4.9	-1.3	-21.5	\$48,550
Forging machine setters, operators, and tenders, metal and plastic	51-4022	21.6	17	-4.6	-21.5	\$36,930
Desktop publishers	43-9031	14.8	11.7	-3.1	-21	\$41,090
Parking enforcement workers	33-3041	9.4	7.4	-2	-20.8	\$37,950
Milling and planing machine setters, operators, and tenders, metal and plastic	51-4035	22.4	17.8	-4.6	-20.6	\$39,840

(1) Data are from the Occupational Employment Statistics program, U.S. Bureau of Labor Statistics.

Source: Employment Projections program, U.S. Bureau of Labor Statistics

Table 2, shows the U.S. Bureau of Labor Statistics estimate of fastest growing jobs through 2014. As automation, technology and outsourcing continue to make many of the manual laborer jobs obsolete, the fastest growing jobs are likely to require higher level academic credentials. Another phenomenon, credential creep or up-credentialing, occurs when employers seek workers with degrees for jobs that traditionally not required them.³ Some argue that credential creep squeezes non-degreed workers to seek degrees.

² See: <https://www.ibm.com/watson/health/oncology-and-genomics/oncology/>

³ See: Doug Lederman, Sep 9, 2014, Credential Creep Confirmed, Inside Higher Ed, <https://www.insidehighered.com/news/2014/09/09/demand-degrees-grows-many-fields-havent-required-them>

The Cost of Education

Colleges have been raising tuition rates for decades. In the decade of the 80s when college tuition rates were increasing more than three percent annually, critics called U.S. colleges and universities that consistently raised their tuitions faster than inflation greedy and inefficient (see, e.g., Bennett 1987, A31; Washington Post Weekly 1989; Finn 1984,29- 33, 47-51).⁴ Between 1979 and 1987, for example, tuition and fees increased in real terms at an average rate of 3.0 percent a year in public institutions and 4.9 percent a year in private institution. More recently, the U.S. Department of Education reported that for academic year 2014-5, average annual current dollar prices for undergraduate tuition, fees, room, and board were estimated to be \$16,188 at public institutions, \$41,970 at private nonprofit institutions, and \$23,372 at private for-profit institutions.⁵ According to the US Department of Education, the average annual cost of public school increased 6.5 percent each year over the last decade. That means that by 2030, annual public tuition will be \$44,047. The total cost for a four-year degree will be more than \$205,000.

Table 2

Employment Projections

This chart shows the U.S. Bureau of Labor Statistics, Employment Projection Program, estimate of fastest U.S. growing jobs from 2014 to 2024.

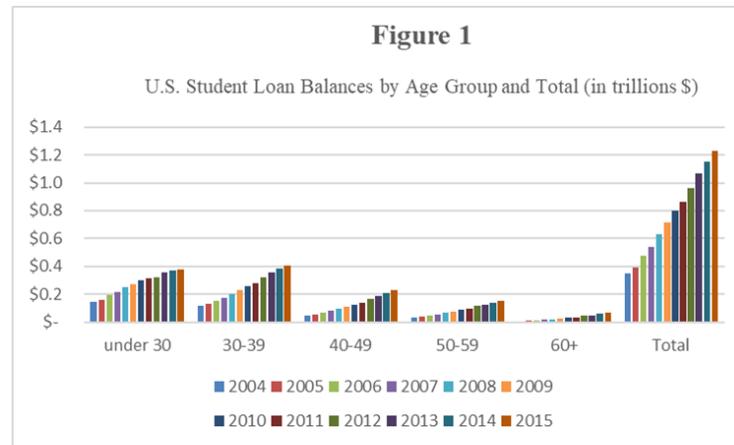
2014 National Employment Matrix title and code	Employment		Change, 2014-24		Median annual wage, 2016 ⁽¹⁾	
	2014	2024	Number	Percent		
Total, all occupations	00-0000	150,539.9	160,328.8	9,788.9	6.5	\$37,040
Wind turbine service technicians	49-9081	4.4	9.2	4.8	108.0	\$52,260
Occupational therapy assistants	31-2011	33.0	47.1	14.1	42.7	\$59,010
Physical therapist assistants	31-2021	78.7	110.7	31.9	40.6	\$56,610
Physical therapist aides	31-2022	50.0	69.5	19.5	39.0	\$25,680
Home health aides	31-1011	913.5	1,261.9	348.4	38.1	\$22,600
Commercial divers	49-9092	4.4	6.0	1.6	36.9	\$49,090
Nurse practitioners	29-1171	126.9	171.7	44.7	35.2	\$100,910
Physical therapists	29-1123	210.9	282.7	71.8	34.0	\$85,400
Statisticians	15-2041	30.0	40.1	10.1	33.8	\$80,500
Ambulance drivers and attendants, except emergency medical technicians	53-3011	19.6	26.1	6.5	33.0	\$23,850
Occupational therapy aides	31-2012	8.8	11.6	2.7	30.6	\$28,330
Physician assistants	29-1071	94.4	123.2	28.7	30.4	\$101,480
Operations research analysts	15-2031	91.3	118.9	27.6	30.2	\$79,200
Personal financial advisors	13-2052	249.4	323.2	73.9	29.6	\$90,530
Cartographers and photogrammetrists	17-1021	12.3	15.9	3.6	29.3	\$62,750
Genetic counselors	29-9092	2.4	3.1	0.7	28.8	\$74,120
Interpreters and translators	27-3091	61.0	78.5	17.5	28.7	\$46,120
Audiologists	29-1181	13.2	16.9	3.8	28.6	\$75,980
Hearing aid specialists	29-2092	5.9	7.5	1.6	27.2	\$50,250
Optometrists	29-1041	40.6	51.6	11.0	27.0	\$106,140
Forensic science technicians	19-4092	14.4	18.2	3.8	26.6	\$56,750
Web developers	15-1134	148.5	188.0	39.5	26.6	\$66,130
Occupational therapists	29-1122	114.6	145.1	30.4	26.5	\$81,910
Diagnostic medical sonographers	29-2032	60.7	76.7	16.0	26.4	\$69,650
Personal care aides	39-9021	1,768.4	2,226.5	458.1	25.9	\$21,920
Phlebotomists	31-9097	112.7	140.8	28.1	24.9	\$32,710
Ophthalmic medical technicians	29-2057	37.0	46.1	9.1	24.7	\$35,530
Nurse midwives	29-1161	5.3	6.6	1.3	24.6	\$99,770
Solar photovoltaic installers	47-2231	5.9	7.4	1.4	24.3	\$39,240
Emergency medical technicians and paramedics	29-2041	241.2	299.6	58.5	24.2	\$32,670

⁽¹⁾ Data are from the Occupational Employment Statistics program, U.S. Bureau of Labor Statistics.
Source: Employment Projections program, U.S. Bureau of Labor Statistics

⁴ See: Clotfelter, Charles and Michael Rothschild, 1993.

⁵ See National Center for Education Statistics, Fast Facts, Tuition costs of colleges and universities.
<https://nces.ed.gov/fastfacts/display.asp?id=76>

The increase in tuition is causing the U.S. total debt to swell. A 2016 Federal Reserve Bank report, *Student Loan Debt by Age Group*, provides segment information on student loan debt for students under 30, in their 30s, 40s, 50s, and over 60. Aggregate data are also presented. Figure 1 shows aggregate student debt in 2015 at \$1.23 trillion dollars. Figure 1 shows aggregate annual student total debt grew at a staggering annual rate of 21.2 percent over the 12 years from \$346.2 billion in 2004 to \$1.230 Trillion in 2015. In 2015, the individuals under 30 with student loans had a \$21,778 average balance. Furthermore, in 2015 this age group had 2.4 million individuals had student loan balance in excess of 90 days past due and 4.7 million in default.



Source: Federal Reserve Bank of New York Consumer Credit Panel / Equifax

The Call for Educational Accountability

Given the high cost of tuition and the staggering debt burden that many students assume during their college years, public outcry inspired both governmental and academic oversight organizations to take action. In 2009, the Center for American Progress published a white paper on higher education encouraging the U.S. Department of Education to create an “Office of Consumer Protection in Higher Education.”⁶ Hearing the clarion’s call for action, in 2013 the U.S. Department of Education partnered with the White House to launch College Scorecard, a tool to help prospective students and their families find information concerning the quality of colleges and universities in the United States. A school’s scorecard also will show important information about the schools:

- Typical costs to attend the school
- Graduation rates
- Average loan amounts for students
- Types of jobs students obtain after graduation

U.S. Secretary of Education Arne Duncan noted, “We know students and families are often overwhelmed in the college search process – but feel they lack the tools to sort through the information and decide which school is right for them ... The College Scorecard provides a snapshot about an institution’s cost

⁶ See: Center for American Progress. November 2, 2009. Putting the Customer First in College: Why We Need an Office of Consumer Protection in Higher Education.

and value to help families make smart decisions about where to enroll.”⁷ In response to the increasing student loan default rate, on December 21, 2012 the U.S. Department of Education announced a ‘Pay As You Earn’ student loan repayment plan that caps payments for Federal Direct Loans at 10 percent of discretionary income for eligible borrowers.

Some academic accreditation organizations also heard the clarion’s call and took action. The Association to Advance Collegiate Schools (AACSB) is one such organization.⁸ AACSB officials announced, “As the higher education landscape becomes more challenging to navigate, business schools struggle to demonstrate excellence and stand out among peer institutions. Consequently, the management education industry has placed a renewed emphasis on accountability and innovation in assessment.”⁹ The AACSB began this transition in 2013 when they announced a shift from their 2003 Business Accreditation Standards which focused on providing assurance of member college’s educational processes for relevance and currency to the AACSB’s new strategy of providing assurance that member college’s educational processes provide for engagement, innovation and impact. The new AACSB strategy is imbedded in four major areas with fifteen standards: Strategic Management and Innovation (standards 1-3); Students, Faculty, and Professional Staff (standards 4-7); Learning and Teaching (standards 8-12); and Academic and Professional Engagement (standards 13-15). AACSB Standard 8 requires, “The school uses well-documented, systematic processes for determining and revising degree program learning goals; designing, delivering, and improving degree program curricula to achieve learning goals; and demonstrating that degree program learning goals have been met.”¹⁰ Coastal Carolina University, E. Craig Wall Sr., College of Business (WCOB) is an AACSB member institution. The purpose of this study is to examine and share the techniques that the WCOB uses to assess and document ETS® Major Field Test (MFT) – Business assessment results for the learning goal, “Demonstrate competence in the core subjects of business administration: accounting, finance, management, marketing, economics, international issues, legal and social business issues, and quantitative analysis.”¹¹

Decision Useful Assessment Reporting to Support Assurance of Learning

ETS as an Assessment Instrument

ETS® Major Field Tests are outcomes assessments designed to measure the critical knowledge and understanding obtained by students in a major field of study. ETS® Major Field Tests offer student assessments at the undergraduate-levels in the fields of Biology, Chemistry, Computer Science, Criminal Justice, Economics, Literature in English, Mathematics, Music, Physics, Political Sciences, Psychology, and Sociology. In the field of Business, assessments are offered at the Associate-, Bachelors-, and Master of Business Administration-level. The Major Field Tests go beyond the measurement of factual knowledge by evaluating students' ability to analyze and solve problems, understand relationships and

⁷ U.S. Department of Education. February 13, 2013. Education Department Releases College Scorecard to Help Students Choose Best College for Them. <https://www.ed.gov/news/press-releases/education-department-releases-college-scorecard-help-students-choose-best-college-them>

⁸ The AACSB provides quality assurance, business education intelligence, and professional development services to over 1,600 member organizations and nearly 800 accredited business schools worldwide.

⁹ Association to Advance Collegiate Schools of Business. 2016. Assessment and Impact Conference.

¹⁰ Association to Advance Collegiate Schools of Business. September 22, 2017. Eligibility Procedures and Accreditation Standards for Business Accreditation (Standard 8, Pages 32-34).

¹¹ Coastal Carolina University 2016-17 Undergraduate Catalog.

interpret material from their major field of study. This paper focuses solely on the Business undergraduate assessment, henceforth MFTB. For more information see: <https://www.ets.org/mft/about>

The MFTB assessments are two-hour, 120 question multiple-choice examinations. College officials administer the MFTB exam to cohorts of students. Many of the tests contain questions requiring interpretation of graphs, diagrams and charts based on material related to the field of study, and score reports may be used in making medium to high-stakes decisions.

MFTB student scores are reported on a scale of 120-200. At the aggregate-level, assessment indicators report the average percent of students' correct answers in each subject domain. The purpose of this paper is to illustrate the manipulation of these reported scores to provide multi-echelon longitudinal and cross-sectional decision-useful information to Deans, Chairs, and Faculty is the purpose of this paper and is discussed next.

How the WCOB sets up and conducts MFTB testing is instrumental to understanding how it achieves multi-level learning goal analysis. The MFTB allows its users to collect information by user defined groups called cohorts. The WCOB has a cohort for each of its majors (Accounting, Finance, Economics, Management, Marketing and Hotel Resort Tourism). The WCOB requires business major seniors to take the MFTB in the fall or spring semester in the college's capstone course, CBAD 478.

College-level MFTB Analysis

Business deans require a broad array of information to satisfy the external and internal forces that influence their strategic, operational and current environments. Economic conditions, enrollments, legislators, and regulatory bodies are among the major external forces that deans must provide information to satisfy organizational funding requirements (Goldstein 2005; Rajagolopalan, Rasheed, & Datar 1993). The MBFT provides college deans with need the information to assess the overall quality of students' learning experiences and faculty instructional performance.

At the Macro-level, the MBTF's Departmental Summary of Assessment Indicators can be used to provide aggregate student scores for comprehensive analysis of college-level performance. The following illustration is a notional example of that report.

College-Level Summary of Assessment Scores

Illustration 1

College-wide Summary of Assessment Indicators (Raw Data)

Test: Business
 Form Code: 4JMF
 Institution: Coastal Carolina University
 Cohort: 2015-2016 Undergraduate Accounting
 Closed on: July 19, 2016

Assessment Indicator Number	Assessment Indicator Title	Mean Percent Correct
1	Accounting	50
2	Economics	50
3	Management	50
4	Quantitative Business Analysis	50
5	Finance	50
6	Marketing	50
7	Legal and Social Environment	50
8	Information Systems	50
9	International Issues	50

Students responding to less than 50% of the questions: 0
 Students in frequency distribution: 47
 Students tested: 47

Report Creation: To create a college-wide Summary Assessment Report, in the MFTB program, select Reports, Departmental Summary Assessment Indicators, select business test, select the form, select “all cohorts” and run the report.

Report Output: This report provides a list of the mean (average) percent of test questions answered correctly by all of the college’s students in the nine assessment indicators.

Report Utility: As this is raw, and not comparative data, this report is not very informative. Transforming the data in this report with the Institutional Assessment Indicator Mean Score Distributions (see Appendix A) ranks the data into terms of relative percentiles based on the user’s defined peer institutions. Illustration 2 shows the transformation of Illustration 1 using Appendix A. The utility of the transformed score is it allows the user to directly compare their aggregate students’ score to the chosen peer group.¹² The disadvantage of this report is that assessment indicators include all of the college’s students. For example, the accounting assessment indicator includes test results from accounting and non-accounting majors. The issue of mixed data in assessment indicators is resolved next.

Illustration 2

College-wide Summary of Assessment Indicators (Percentile Ranking)

Test: Business
Form Code: 4JMF
Institution: Coastal Carolina University
Cohort: 2015-2016 Undergraduate Accounting
Closed on: July 19, 2016

Assessment Indicator Number	Assessment Indicator Title	Percentile Ranking
1	Accounting	92
2	Economics	96
3	Management	21
4	Quantitative Business Analysis	99
5	Finance	86
6	Marketing	18
7	Legal and Social Environment	6
8	Information Systems	47
9	International Issues	97

Students responding to less than 50% of the questions: 0
Students in frequency distribution: 47
Students tested: 47

Departmental-Level Scores (Majors Only)

Report Creation: To create a Major Only Departmental Summary Assessment Report, in the MFTB program, select Reports, Departmental Summary Assessment Indicators, select business test, select the form, select the desired major cohort and run the report.

Report Output: Provides a list of the mean (average) percent of test questions answered correctly by the department’s majors in the nine assessment indicators. Transform the mean percent data into percentile rankings using the table in Appendix A. The report will include nine

¹² Note that all Illustration 1 the mean percent correct was 50 for each assessment indicator. A percentile ranking of 99 on Indicator 4, Quantitative Business Analysis, means answering 50 percent of the assessment question correctly, as shown on Illustration 1, is a near perfect score. Quantitative Business Analysis questions are challenging. Contrarily, a Legal and Social Environment raw mean score of 50, Illustration 1 Indicator 7, yields a very low percentile ranking, 7, as shown in Illustration 2. Legal and Social Environment questions must not be challenging.

indicators. The focus of the report is how the majors scored compared to their user defined peers on the major assessment indicator.

Report Utility: The departmental report is vital to administrators as it shows the departmental percentile ranking compared to their user defined peer group. For example, it shows the percentile ranking of the college's accounting students compared to all students in their user defined peer group. This answers the question, "How well do accounting majors perform in accounting compared to all other students on a standardized test?" An expectation is that the percentile of the observed department-level report (major) should be much higher than that observed in the college-wide report as the latter contains both majors and non-majors.

Departmental-Level Scores (Non-majors Only)

Report Creation: To create a Non-Major Only Departmental Summary Assessment Report, in the MFTB program, select Reports, Departmental Summary Assessment Indicators, select business test, select the form, select the desired non-majors cohorts and run the report. For example, to see how well non-accounting majors perform in accounting as compared to other students in their defined reporting group, the finance, economics, management, marketing and hotel resort tourism cohorts are selected.

Report Output: This report provides a list of the mean (average) percent of test questions answered correctly by the non-majors in the nine assessment indicators. Transform the mean percent data into percentile rankings using the table in Appendix A.

Report Utility: The non-majors departmental report is vital to administrators as it shows the non-majors percentile ranking compared to their user defined peer group. For example, it shows the percentile ranking of the college's non-accounting students compared to all students in their user defined peer group. This answers the question, "How well do non-accounting majors perform in accounting compared to all other students on a standardized test?" This is a quality indicator of the non-major accounting core courses. An expectation is that the percentile of the observed department-level report (major) should be much lower than that observed in the college-wide report as the latter contains both majors and non-majors.

Course-level Analyses (Majors)

Course-level analyses (Majors) answers the question, "How well did majors score on content questions in a specific major class?" This study uses Intermediate 1/Cost Accounting as exemplars.

Report Creation: To create this report, select Reports, select Item Information Report¹³, select test, select the form, select cohort, select run the report. Export the report to ExCel.¹⁴

¹³ Provides a question-by-question analysis of your students' performance on the test compared to a larger comparison group. The report will provide the percentage of your students responding to each question correctly as well as the percentage of students responding correctly from the national sample. The report includes scaled scores to which each question contributes as well as a description of the construct measured by each question in order to facilitate meaningful dialogue about curriculum effectiveness. Report based on a group of 20 or more students from a cohort or combination of cohorts that have taken the same form of the Major Field Test.

¹⁴ This report includes all test questions and in its raw unsorted format is not very useful. Export the document to ExCel and conduct a multi-level sort on Domain, Content Area and Sub-content area. The utility of this refined report is immediately obvious.

Report Output: This report provides a list of the accounting content and sub content area questions in financial and managerial accounting, percent the institution’s students correctly answered and the national average percent correct. The difference column was added to the report.

Report Utility: The departmental item report is vital to departmental administrators as it shows the Intermediate I/Financial Accounting, Illustration 3, and Cost Accounting/Managerial Accounting, Illustration 4, and sub content area strengths and weaknesses.

Illustration 3					
WCOB accounting majors scored in Intermediate I Sub Content area, the national average score and the difference between the two.					
Domain	Content Area	SubContent Area	Percent Correct Institution	Percent Correct National ^(b)	Difference
Accounting	Financial Accounting	Balance Sheet	90	51.6	38.4
Accounting	Financial Accounting	Balance Sheet	90	15.4	74.6
Accounting	Financial Accounting	Conceptual foundations	90	28.9	61.1
Accounting	Financial Accounting	Conceptual foundations	90	28.9	61.1
Accounting	Financial Accounting	Income Statement and Statement of Retained Earnings	90	62	28
Accounting	Financial Accounting	Income Statement and Statement of Retained Earnings	90	34.4	55.6
Accounting	Financial Accounting	Income Statement and Statement of Retained Earnings	90	63.4	26.6
Accounting	Financial Accounting	Statement of Cash Flows	90	36.1	53.9

Illustration 4					
WCOB accounting majors scored in Intermediate I Sub Content area, the national average score and the difference between the two.					
Domain	Content Area	SubContent Area	Percent Correct Institution	Percent Correct National ^(b)	Difference
Accounting	Managerial Accounting	Budgeting	90	44.5	45.5
Accounting	Managerial Accounting	Budgeting	90	62.1	27.9
Accounting	Managerial Accounting	Cost concepts	90	90.7	-0.7
Accounting	Managerial Accounting	Cost/volume/profit analysis	90	22.6	67.4
Accounting	Managerial Accounting	Cost/volume/profit analysis	90	58.5	31.5
Accounting	Managerial Accounting	Nonroutine decision making	90	70.3	19.7
Accounting	Managerial Accounting	Product costing systems	90	14.9	75.1
Accounting	Managerial Accounting	Product costing systems	90	36	54

Course-level Analyses (Non-Majors)

Course-level analyses (Non-Majors) answers the question, “How well did non-major students score on individual questions in a specific business core curriculum class?” This study will use the business core accounting classes as exemplars.

Report Creation: To create this report, select Reports, select Item Information Report¹⁵, select test, select the form, select all non-accounting cohorts, select run the report. Export the report to ExCel.¹⁶

Report Output: Provides a list of the Content and Sub Content Area questions in financial and managerial accounting, percent the institution’s students correctly answered and the national average percent correct. The difference column was added to the report.

Report Utility: The non-major departmental item report is vital to departmental administrators as it shows Introductory Financial Accounting and Cost Accounting/Managerial Accounting, and sub content area strengths and weaknesses.

Closing the Loop

The AACSB includes a basis of judgement for each of the fifteen standards as guidance to participating institutions. The final step for Standard 8’s basis of judgement is, “Evidence of recent curricula development, review, or revision demonstrates the effectiveness of curricula/program management. The WCOB annually conducts the ETS analysis reports listed above. Data anomalies are first presented to the Department Chairs for resolution. A comprehensive written report is prepared for the Dean. The ETS results are presented at a meeting of the full faculty. The assessment committee and curriculum committees also review the reports. Intermittently, copies of the ETS tests are requested and reviewed with the departments for analysis of content.

Conclusion

Technology, globalization, and academic credential creep are among factors increasing the demand for college education. At the same time, public postsecondary institutions and universities are charging higher tuition fees. This has led students, non-profits and governmental entities to question the cost/benefit of a college-level education. In an era of high public scrutiny, educational institutions seek academic accreditations to provide assurance of the quality of their programs. This paper has demonstrated the techniques that administrators can use with ETS Major Field Test reporting to assess student learning not only at the discipline-level but, also at the department and in some instances, the course-level sub content area information to document learning assurance.

¹⁵ Provides a question-by-question analysis of your students’ performance on the test compared to a larger comparison group. The report will provide the percentage of your students responding to each question correctly as well as the percentage of students responding correctly from the national sample. The report includes scaled scores to which each question contributes as well as a description of the construct measured by each question in order to facilitate meaningful dialogue about curriculum effectiveness. Report based on a group of 20 or more students from a cohort or combination of cohorts that have taken the same form of the Major Field Test.

¹⁶ This report includes all test questions and in its raw unsorted format is not very useful. Export the document to ExCel and conduct a multi-level sort on Domain, Content Area and Sub-content area. The utility of this refined report is immediately obvious.

Bibliography

- Association to Advance Collegiate Schools of Business. <http://www.aacsb.edu/about>
- Association to Advance Collegiate Schools of Business. 2016. Assessment and Impact Conference. <http://www.aacsb.edu/events/conference/2016/assessment>
- Association to Advance Collegiate Schools of Business. September 22, 2017. Eligibility Procedures and Accreditation Standards for Business Accreditation. <http://www.aacsb.edu/-/media/aacsb/docs/accreditation/standards/business-2017-update.ashx?la=en>
- Bennett, William. 1987. Our greedy colleges. New York Times, February 18:A31.
- Broadbent, Jane, Michael Dietrich and Jennifer Roberts. 1997. The End of The Professions? The restructuring of professional work, Routledge
- Center for American Progress. November 2, 2009. Putting the Customer First in College: Why We Need an Office of Consumer Protection in Higher Education. <https://www.americanprogress.org/issues/economy/reports/2009/11/02/6985/putting-the-customer-first-in-college/>
- Clotfelter, Charles and Michael Rothschild. 1993, Studies of Supply and Demand in Higher Education, University of Chicago Press, <http://www.nber.org/books/clot93-1>
- Coastal Carolina University 2016-17 Undergraduate Catalog. <https://www.coastal.edu/media/academics/catalog/2016-2017%20CCU%20UG%20Catalog.pdf>
- ETS Major Field Tests. <https://www.ets.org/mft/about>
- Federal Reserve Bank of New York. March 29, 2013. Student Loan Debt by Age Group. <https://www.newyorkfed.org/studentloandebt/index.html>
- Finn, Chester. 1984. Trying higher education: An eight count indictment. Change 16 (May-June): 29-33, 47-51.
- Finnigan, Kara S. and Tricia J. Stewart. 2009. "Leading Change under Pressure: An Examination of Principal Leadership in Low-Performing Schools." *Journal of School Leadership* 19, no. 5: 586-618. ERIC, EBSCOhost (accessed May 31, 2016).
- Ford, Martin. 2015. Rise of the Robots. Basic Books, a division of PBG Publishing, LLC
- Goldstein, L. (2005). College and university budgeting: An introduction for faculty and academic administrators. Washington, DC: National Association of College and University Business Officers.
- Institute of Education Sciences: <https://ies.ed.gov/>
- Lederman, Doug. Sep 9, 2014, Credential Creep Confirmed, Inside Higher Ed, <https://www.insidehighered.com/news/2014/09/09/demand-degrees-grows-many-fields-havent-required-them>

National Center for Education Statistics, Fast Facts, Tuition costs of colleges and universities.

<https://nces.ed.gov/fastfacts/display.asp?id=76>

Olson, Parmy. 2016. Could Chat Bots Replace Human Jobs? *Forbes Magazine*, 9

<https://www.forbes.com/sites/parmyolson/2016/05/09/could-chat-bots-replace-human-jobs-facebook/#4ef76aa07564>

The Economist. "Gallop inflation in American college fees", Sept. 2, 2010.

<http://www.economist.com/node/16960438>

U.S. Department of Education. College Scorecard. <https://collegescorecard.ed.gov/>

U.S. Department of Education. December 21, 2012. Education Department Launches 'Pay As You Earn' Student Loan Repayment Plan. <https://www.ed.gov/news/press-releases/education-department-launches-pay-you-earn-student-loan-repayment-plan>

U.S. Department of Education. February 13, 2013. Education Department Releases College Scorecard to Help Students Choose Best College for Them. <https://www.ed.gov/news/press-releases/education-department-releases-college-scorecard-help-students-choose-best-college-them>

U.S. Department of Labor, Bureau of Labor Statistics,

https://www.bls.gov/emp/ep_table_105.htm#ep_table_105.f.1

U.S. News. 2012. How Much Will You Need to Send Your Child to College in 2030?

<https://money.usnews.com/money/blogs/my-money/2012/07/25/how-much-will-you-need-to-send-your-child-to-college-in-2030>

Washington Post Weekly. 1989. Colleges: A machine with no brakes. August 21-27.

Wyatt, Ian D. and Daniel E. Hecker, Occupational Changes during the 20th Century, Monthly Labor Review, 2006, P. 35-57, <https://www.bls.gov/mlr/2006/03/art3full.pdf>

Yaman, Devrim, "Standardized Tests and Assessment in the Business School: A Pilot Study" (2014). Assessment Fellows Grant. Paper 32.

http://scholarworks.wmich.edu/assessment_faculty_grant/32

Appendix A-1 Institutional Assessment Indicator Mean Score Distributions

Mean Percent Correct	Assessment Indicators2									Mean Percent Correct
	Percent Below									
	A1	A2	A3	A4	A5	A6	A7	A8	A9	
72 - 100	99	99	99	99	99	99	99	99	99	76 - 100
71	99	99	99	99	99	99	98	99	99	71
70	99	99	99	99	99	99	97	99	99	70
69	99	99	99	99	99	99	96	99	99	69
68	99	99	98	99	99	99	95	99	99	68
67	99	99	98	99	99	98	92	99	99	67
66	99	99	98	99	99	96	86	99	99	66
65	99	99	97	99	99	94	82	99	99	65
64	99	99	96	99	99	92	75	98	99	64
63	99	99	93	99	99	89	68	98	99	63
62	99	99	89	99	99	84	60	97	99	62
61	99	99	86	99	99	80	52	95	99	61
60	99	99	80	99	99	73	44	93	99	60
59	99	99	73	99	98	69	39	91	99	59
58	99	99	67	99	98	61	31	87	99	58
57	99	99	61	99	98	55	26	83	99	57
56	98	99	53	99	97	48	21	81	99	56
55	98	99	47	99	96	40	18	76	99	55
54	97	98	41	99	95	35	16	70	99	54
53	96	98	36	99	93	30	13	63	99	53
52	95	97	31	99	91	25	10	58	98	52
51	94	97	27	99	89	22	8	53	98	51
50	92	96	21	99	86	18	6	47	97	50
49	90	93	18	99	84	16	4	40	93	49
48	85	91	16	98	80	14	3	34	91	48
47	81	87	14	97	76	13	2	29	88	47
46	76	83	11	96	70	10	1	23	83	46
45	72	78	8	93	65	8	1	19	78	45
44	65	72	6	90	59	6	1	14	71	44
43	58	67	4	87	53	4	1	11	66	43
42	50	60	3	84	46	3	1	9	57	42
41	43	54	2	79	39	3	1	6	50	41
40	37	46	1	73	34	2	1	5	44	40
39	31	42	1	65	28	2	1	4	35	39
38	23	35	1	58	21	1	1	3	29	38
37	20	29	1	50	17	1	1	2	24	37
36	15	24	1	42	14	1	1	1	20	36
Number of Institutions	602	602	602	602	602	602	602	602	602	
Mean	41	40	54	36	42	55	59	50	40	
Median	41	40	55	36	42	56	60	50	40	
Standard Deviation	6.1	6.1	6.4	5.2	6.5	6.7	6	6.5	5.8	

Precision Learning and Programmed Learning; Systematic improvement or Retrograde Motion? Work in Process

Donna Schaeffer, Marymount University; Patrick Olson, National University; Cynthia Knott, Marymount, University

Many scholars in computing and information systems have sufficient experience to notice that, sometimes, when the word “innovation” begins to appear the reality generally involves a new “feature” looking for an “application”. This is not saying that this phenomenon is necessarily bad, but if there are important assumptions involved in the development of the “feature” and the race for “innovation” involves overlooking these assumptions, the result might necessarily be unfortunate. One of our favorite examples of this is when a hospital gift shop eliminated its cashbox and installed a Point of Sale terminal connected online to the hospital’s accounting system. The gift shop had been staffed by volunteers who subsequently quit because they could not adjust to the new system. As a result, the hospital had to hire staff. The hospital incurred more expense and had generated poor will among the volunteers.

Given that this phenomenon is known, does it apply to Precision Learning? In fact, Precision Learning has attracted attention and support, while at the same time failing to be specific about what it is. Ideas like competency based learning, proceeding through learning materials at a faster or slower pace, and different paths through curriculum are mentioned for students. Yet, the focus is often on the Learning Management Systems (LMS), or blended learning platforms and little attention is paid to student information systems. In effect, if there are to be multiple paths thru a curriculum, how is that represented on the transcripts produced by the student information system? Of course, there is an “innovation” in the application of Watson that might be a contributor to the interest in Precision Learning. (Note: while applying IBM’s artificial intelligence Watson to the development and application of a dynamic curriculum is very attractive – does it follow that this would necessarily be Precision Learning?)

For our colleagues that develop their own courses in their Learning Management Systems, we think it is likely that they may have noticed how easy it would be to implement a Programmed Learning approach, especially a linear version. Additionally, simply adding some control statements (if, do, while, etc.) would produce a close approximation of the benefits for students suggested by Precision Learning. Thus, the focus of this work is to consider Programmed Learning and Precision Learning and illustrate how they are similar and how they differ.

The history of the concepts “Precision Learning” and “Programmed Learning” will be traced as they appear in scholarly publications. This result will show where there is scholarship in common and where there is divergence. Additionally, the simpler concept of dynamic curriculum will be investigated. The intended result is to provide more information about the effects we might experience from forthcoming innovations in teaching and learning.

This paper will be of interest to any faculty who work with online programs or whose classes are supported by Learning Management Systems (LMS). It may also be relevant for administrators and staff. This work could also be of interest to a variety of vendors.

Student Professional Organizations the Segments Within
Jeananne Nicholls, Slippery Rock University
Bruce Orvis, Slippery Rock University

Introduction

This paper examines student perceptions of collegiate professional clubs and organizations. The purpose of the study was to determine if there is an underlying heterogeneity to the members of the clubs and organizations or if a more homogeneous group exists. To explore the underlying heterogeneity K means cluster analysis was utilized. Cluster analysis has been utilized to determine underlying segments in student populations and interest areas for business school recruiting. Examples of this include Heslop & Nadeau (2010) and Dailey (2011) in which underlying segments for MBA student recruiting was explored. Coccari & Javalgi (1995) and Veloutsou, Lewis, & Paton (2004) utilized cluster analysis for university student targeting and recruiting. Similarly, this paper utilizes this approach to determine if there are underlying segments for student membership in collegiate professional clubs and organizations.

Survey Development

Literature suggests that involvement with student clubs and organizations leads to positive relations with other students and faculty as well as college in general (Abrahamowicz, 1988). Club involvement also develops job related skills (Peltier, Scovotti, & Pointer, 2008; Wresch & Pondell 2014) and students benefit through experiential exercises such as case studies and leadership development (Serviere-Munoz & Counts, 2014). Students and faculty advisors were asked to develop a list activities that they believe motivate students to participate in extracurricular, professional collegiate clubs and organizations. Other club activities were also added to the list in order to reflect the scope of activities that occur within student organizations and capture the extant literature. The final list of activities yielded 29 items.

Online Questionnaire Design

The questionnaire was designed using Qualtrics which is commercially available survey software. The survey included features to improve visual clarity and attractiveness, simplify the layout, and ease of navigation. In addition, a progress bar indicated progress toward completion. All these features reduced the potential for measurement error and increased likelihood of completion (Hair et al., 2010; Singh, Taneja, & Mangalaraj, 2009).

Technical Features

Qualtrics hosts the website and provides 24/7 access to the survey and secure data collection and retention. Each page was designed to limit the amount of information on it and preferably included only one construct. To reduce missing values, the survey it had to be completed or abandoned once it was begun and there was not a way to return and complete the survey at a later time, which some researchers consider a deficiency (Dillman et al., 2009). In addition to reducing missing values, a response was required for each question on a page before the next page appeared. The survey was pretested to ensure it worked on a variety of platforms. There were not any technical issues. The survey itself was estimated to take 15 to 20 minutes (an upper limit for completing the survey), and, on average, the surveys took 15 minutes. The survey was broken up into sections (screens) and an indicator visually showed how much of the survey was completed. After the data were collected, it was exported into SPSS for analysis.

Sampling Procedures and Web Response

The population under investigation is college students participating in a college professional club experience. All students in the College of Business at a northeastern regional state school were surveyed. Some of the departments in that college included business, communication, sport management, hospitality management and safety management. The

question “Are you in a club or organization within the college?” was used as a screening question.

Data were cleaned and examined for outliers (Hair et al., 2010) and other anomalies (e.g., straight-lining, in which the respondent clicks on the same response without regard to question and results in inaccurate data). Missing data was not a concern because of the research design (which required that all questions be completed before moving on. No cases appeared to be outliers, and there is no evidence of straight-lining so no cases were removed from final set of 143 responses. The respondents were comprised of 12.7 percent freshman, 14.8 percent sophomores, 26.1 percent juniors, and 43.7 percent seniors.

Analysis and Results

Analysis was conducted using IBM SPSS statistics 23. The three cluster solution converged in 10 iterations and yielded managerially useful segments. The first cluster had 20 members and was the most negative in their responses to the activities surveyed. We named this segment the “nay-sayers.” The second cluster had 76 members and was positive toward the activities and opportunities. We named this segment the “do-gooders. The third cluster, which we named the “go getters,” had 68 members and had the most positive responses to the items. The initial cluster ANOVAs indicated differences existed between the segments, but did not specify exactly which segments were different from each other. Post hoc analysis was done using Tamhane’s t square statistics since equal variances could not be assumed across the groups. The resulting means for each segment and the statistical differences are presented in Table One. These results reveal statistical differences in the means between the “nay-sayers” and the “go-getters” (groups one and three) and between the “do-gooders” and the “go-getters” (groups two and three) for every item tested. Statistical differences existed across almost all

items with the exception of the following four items. For the items “finding internships” and “finding jobs,” all segments were positive. However, “consulting” and “etiquette dinners” the first and second groups (“nay-sayers” and “do-gooders”) were more closely aligned in their *dislike*.

These results indicate that indeed there are underlying segments among students who join business professional clubs/organization. Club and organization advisors should understand that the interest in participating in different activities will vary across the segments. Efforts to reach each segment in a meaningful way should be made to increase the relevance of the clubs and organizations. For instance the “nay-sayers” were the most interested in activities that contributed to their personal career development such as leadership development, professional speakers, and internship opportunities. For this segment, emphasizing professional development would be the best appeal. For the “do-gooders,” there was positive importance placed on many of the activities, but the idea of providing a selection where they could participate in their personal interests would be appropriate. Finally, the “go-getters” love all aspects of the clubs activities, these students may be the ones to target to become the officers and organizers. Providing opportunities for their enthusiasm to shine would be an ideal approach to involve them.

Selected references

- Abrahamowicz, D. (1988). College Involvement, Perceptions, and Satisfaction: A Study of Membership in Student Organizations. *Journal of College Student Development*, 29(3), 233-38.
- Coccarri, R. L., & Javalgi, R. G. (1995). Analysis of students' needs in selecting a college or university in a changing environment. *Journal of Marketing for Higher Education*, 6(2), 27-40.
- Dailey, L. C. (2011). Marketing Part-Time MBA Programs: Understanding the Need for and Dimensions of Flexibility. *Journal of Marketing Development and Competitiveness*, 5(2), 122.
- Hair, J., Black, W., Babin, B., & Anderson, R. (2010). *Multivariate Data Analysis*. Upper Saddle River, NJ: Prentice Hall.
- Heslop, L. A., & Nadeau, J. (2010). Branding MBA programs: The use of target market desired outcomes for effective brand positioning. *Journal of Marketing for Higher Education*, 20(1), 85-117.
- Peltier, J. W., Scovotti, C., & Pointer, L. (2008). The role the collegiate American Marketing Association plays in professional and entrepreneurial skill development. *Journal of Marketing Education*, 30(1), 47-56.
- Serviere-Munoz, L., & Counts, R. W. (2014). Recruiting millennials into student organizations: Exploring Cialdini's principles of human influence. *Journal of Business and Economics*, 5, 306-315
- Veloutsou, C., Lewis, J. W., & Paton, R. A. (2004). University selection: information requirements and importance. *International Journal of Educational Management*, 18(3), 160-171.
- Wresch, W., & Pondell, J. (2015). Assessing cocurricular impacts on the development of business student professionalism: supporting rites of passage. *Journal of Education for Business*, 90(3), 113-118.

Final Cluster Means

	Cluster Mean			
	1	2	3	Post Hoc
Q16_1 - Scheduled meetings	5.75	7.91	9.34	a,b,c
Q16_2 - Fundraising activities	3.15	6.78	8.99	a,b,c
Q16_3 - Social activities	4.05	7.30	9.12	a,b,c
Q16_4 - Committee meetings	3.80	7.03	9.07	a,b,c
Q16_5 - Alumni events	4.00	5.89	8.28	a,b,c
Q16_6 - Annual dinner/banquet	3.70	5.29	8.66	a,b,c
Q16_7 – Certificates	3.30	6.01	8.74	a,b,c
Q16_8 – Competitions	3.45	5.24	8.31	a,b,c
Q16_9 - Consulting projects	4.35	5.86	8.71	b,c
Q16_10 - Cover letter development	4.35	6.36	9.15	a,b,c
Q16_11 - Etiquette dinner	3.75	5.04	8.53	b,c
Q16_12 - “Field” trips to companies	4.75	6.66	9.35	a,b,c
Q16_13 - Finding internships	6.60	8.18	9.69	b,c
Q16_14 - Finding jobs	6.70	8.45	9.74	b,c
Q16_15 - Fundraising experience	3.10	6.59	9.07	a,b,c
Q16_16 - Leadership development	5.45	8.70	9.65	a,b,c
Q16_17 - Leadership experience	5.30	8.67	9.68	a,b,c
Q16_18 - LinkedIn development	4.45	7.47	9.50	a,b,c
Q16_19 - Local conference	3.90	6.75	9.21	a,b,c
Q16_20 - National conference	3.90	6.54	9.24	a,b,c
Q16_21 - Presentation skills	4.80	7.99	9.57	a,b,c
Q16_22 - Professional speakers	5.05	7.70	9.43	a,b,c
Q16_23 - Regional conference	3.75	6.34	9.16	a,b,c
Q16_24 - Resume development	4.85	7.97	9.75	a,b,c
Q16_25 - Skill development	4.95	8.36	9.78	a,b,c
Q16_26 - Social events	4.45	7.24	9.34	a,b,c
Q16_27 - Team/group member/leader skills	5.15	7.97	9.60	a,b,c
Q16_28 – Travel	3.45	6.08	9.04	a,b,c
Q16_29 - Volunteering/service	4.10	7.47	9.28	a,b,c

Diff between group 1 and 2 = a
 Diff between group 1 and 3= b
 Diff between group 2 and 2 =c

What Activities Lead to Student Satisfaction with Professional Clubs

Kurt Schimmel, Slippery Rock University; Bruce Orvis, Slippery Rock University

Introduction

As faculty advisors, we are constantly looking to improve our student clubs and organizations. Student organizations have been found to provide multiple benefits to students. Student involvement with student/college clubs and organizations leads to positive relations with other students and faculty as well as college in general (Abrahamowicz, 1988). Club involvement develops job-related skills (Peltier, Scovotti, & Pointer, 2008; Wresch & Pondell 2014) and students benefit through experiential exercises such as case studies and leadership development opportunities (Serviere-Munoz & Counts, 2014). Given these positive outcomes documented in the literature, we look to identify the club/organization attributes students consider to be most important so recruitment to and participation in clubs/organizations can be increased.

Satisfaction

Satisfaction is defined as a function of expectation and expectancy disconfirmation (Oliver, 1980). Disconfirmation and satisfaction are positively correlated such that satisfaction occurs when “actual outcomes exceed expectations (positive disconfirmation)” and are “dissatisfied when expectations exceed outcomes (negative disconfirmation)” and “just satisfied (zero or simple disconfirmation) when outcomes match expectations” (Szymanski & Henard, 2001, p. 17). Expectations are activated through disconfirmation (i.e., do not happen until after exposure, behavior, or action) (Oliver, 1980), can be active or passive (van Raaij, 1991), and are

an outcome of a cognitive (decision-making) process (Oliver, 1980). In other words, regarding satisfaction, people have context-specific expectations and make decisions “about alternatives with uncertain outcomes, and they have to judge the consequences of their present choices” (van Raaij, 1991, p. 415), or they create reasons for or reasons against a particular choice and may or may not be satisfied based on their expectation and participation in the behavior

As part of the traditional view of consumer satisfaction and attitudes, Bearden and Teel (1983) found that satisfaction correlated with attitudes (post-purchase) and found a strong relationship between attitudes and intentions within time periods. Suh and Yi (2006) found that customer satisfaction led to brand attitude under different levels of (product) involvement, and Bolton and Drew (1991) found a link between disconfirmation as result of an experience (feedback loop) and attitudes, such that favorable disconfirmation (satisfaction) experiences have positive effects on customer attitudes (which lead to behavioral intentions).

Scale Development

Students and faculty advisors were asked to list activities that motivated them to participate in extracurricular clubs and organizations. Club activities were also added to the list in order to reflect the scope of activities that occur within student organizations. The final list of activities yielded 29 items. The satisfaction scale consisted of seven items. .

In order to determine which student activities/programs from club involvement most impact satisfaction with participation in clubs and organizations, the list of 29 activities/programs were provided to students in the College of Business at a Northeastern public institution via email with a link to the survey in Qualtrics. Students who identified themselves as members of student organizations were asked questions about the level importance of a number

the items. The scale used a one to ten response option where 1=least important and 10=most important. There were 143 usable responses. There were 103 female respondents (72%) and 40 male (28%). Freshman comprised 12.7 percent of the respondents, sophomores 14.8 percent, juniors 26.1 percent, and seniors 43.7 percent.

To determine the underlying factor structure of the 29 activity items, principle components factor analysis with a varimax rotation was conducted. The dimensions were saved as orthogonally rotated variables for use in further analysis (Hair et al 2010). The four dimensions identified explained 71 percent of the variance. The first factor included items emphasizing activities related to personal job search and personal development. The second factor emphasized social interactions. The third factor included items that emphasized professional development skills. The fourth and final factor included items dealing with travel.

A regression was conducted to determine which of the factors predicted satisfaction with club membership. The results indicate that 49.3 percent of the variance was explained by two significant factors (predictors). The two factors emphasizing personal activities and social interactions were significant predictors of satisfaction. The travel factor was not significant at the .05 level, but had a p-value of .09. Probably most surprising is that the factor including items for professional development was not a significant predictor of satisfaction even though many advisers we spoke with believe professional development is a strong benefit to students participating in clubs/organizations. Advisers and club/organization executive board leadership would be well-advised to take note of these factors and focus on providing activities students believe are important as well as do a better job managing the expectations of their members.

References

- Abrahamowicz, D. (1988). College Involvement, Perceptions, and Satisfaction: A Study of Membership in Student Organizations. *Journal of College Student Development*, 29(3), 233-38.
- Cronin Jr, J. J., Brady, M. K., & Hult, G. T. M. (2000). Assessing the Effects of Quality, Value, and Customer Satisfaction on Consumer Behavioral Intentions in Service Environments. *Journal of Retailing*, 76(2), 193-218.
- Hair, J., Black, W., Babin, B., & Anderson, R. (2010). *Multivariate Data Analysis*. Upper Saddle River, NJ: Prentice Hall.
- Mittal, V., & Kamakura, W. A. (2001). Satisfaction, Repurchase Intent, and Repurchase Behavior: Investigating the Moderating Effect of Customer Characteristics. *Journal of Marketing Research*, XXXVIII(February), 131-142.
- Oliver, R. (1980). A cognitive model of the antecedents and consequences of satisfaction decisions. *Journal of Marketing Research*, 17(4), 460-469.
- Oliver, R. L. (1999). Whence Consumer Loyalty? *The Journal of Marketing*, 63, *Fundamental Issues and Directions for Marketing*(1999), 33-44.
- Peltier, J. W., Scovotti, C., & Pointer, L. (2008). The role the collegiate American Marketing Association plays in professional and entrepreneurial skill development. *Journal of Marketing Education*, 30(1), 47-56.
- Serviere-Munoz, L., & Counts, R. W. (2014). Recruiting millennials into student organizations: Exploring Cialdini's principles of human influence. *Journal of Business and Economics*, 5, 306-315.
- Szymanski, D. M., & Henard, D. H. (2001). Customer satisfaction: A meta-analysis of the empirical evidence. *Journal of the Academy of Marketing Science*, 29(1), 16-35.
- van Raaij, W. (1991). The Formation and Use of Expectations in Consumer Decision Making. In T. Robertson & H. Kassarian (Eds.), *Handbook of Consumer Behavior* (pp. 401-418). New York: Prentice Hall
- Webb, D., Green, C., & Brashear, T. (2000). Development and Validation of Scales to Measure Attitudes Influencing Monetary Donations to Charitable Organizations. *Journal of the Academy of Marketing Science*, 28(2), 299-309.
- Wresch, W., & Pondell, J. (2015). Assessing cocurricular impacts on the development of business student professionalism: supporting rites of passage. *Journal of Education for*

*Business, 90(3), 113-118.***Rotated Component Matrix^a**

	Component			
	1	2	3	4
Q16_8 - Competitions	.746			
Q16_6 - Annual dinner/banquet	.724			
Q16_2 - Fundraising activities	.700			
Q16_11 - Etiquette dinner	.686			
Q16_15 - Fundraising experience	.685			
Q16_9 - Consulting projects	.679			
Q16_7 - Certificates	.655			
Q16_5 - Alumni events	.597			
Q16_10 - Cover letter development	.556		.509	
Q16_17 - Leadership experience		.816		
Q16_16 - Leadership development		.791		
Q16_27 - Team/group member/leader skills		.776		
Q16_3 - Social activities	.490	.679		
Q16_21 - Presentation skills		.656		
Q16_26 - Social events	.511	.649		
Q16_29 - Volunteering/service		.594		
Q16_1 - Scheduled meetings		.592		
Q16_4 - Committee meetings	.527	.558		
Q16_25 - Skill development		.523	.468	
Q16_14 - Finding jobs			.898	
Q16_13 - Finding internships			.873	
Q16_24 - Resume development			.626	
Q16_12 - "Field" trips to companies			.598	
Q16_22 - Professional speakers		.469	.537	
Q16_18 - LinkedIn development		.464	.536	
Q16_20 - National conference				.825
Q16_19 - Local conference				.760
Q16_23 - Regional conference				.728
Q16_28 - Travel	.450			.580

Extraction Method: Principal Component Analysis.
 Rotation Method: Varimax with Kaiser Normalization. a.
 Rotation converged in 7 iterations.

ANOVA^a

Model	Sum of Squares	df	Mean Square	F	Sig.
1					.000 ^b
Regression	2650.030	4	662.507	21.123	
Residual	2728.699	87	31.364		
Total	5378.728	91			

a. Dependent Variable: satisfaction

b. Predictors: (Constant), REGR factor score 4 for analysis 2, REGR factor score 1 for analysis 2, REGR factor score 3 for analysis 2, REGR factor score 2 for analysis 2

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.702 ^a	.493	.469	5.60039

a. Predictors: (Constant), REGR factor score 4 for analysis 2, REGR factor score 1 for analysis 2, REGR factor score 3 for analysis 2, REGR factor score 2 for analysis 2

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	40.393	.597		67.703	.000
	REGR factor score 1 for analysis 2	3.700	.558	.508	6.630	.000
	REGR factor score 2 for analysis 2	4.149	.621	.519	6.680	.000

REGR factor score 3 for analysis 2	.803	.595	.105	1.349	.181
REGR factor score 4 for analysis 2	.964	.576	.130	1.674	.098

a. Dependent Variable: satisfaction

Is there any Brand Loyalty in the Use of Over-The-Counter Pain Medications?

Michael Latta
Coastal Carolina University

53rd Annual Meeting of Southeastern Chapter of INFORMS
Hilton Myrtle Beach Resort
Myrtle Beach, South Carolina
October 5-6, 2017

ABSTRACT

One of the largest categories of medications sold in pharmacies without prescriptions is the wide variety of pain medications. This Over-The-Counter (OTC) category defines a market typically segmented by active ingredients including four main formulations with generic names: acetaminophen (Tylenol), ibuprofen (Advil), naproxen sodium (Aleve), and acetylsalicylic acid (Bayer Aspirin). The question rarely addressed in marketing research in this product category concerns possible brand loyalty and preferences in use of OTC analgesics containing these four active ingredients. Results from a web survey of 862 consumers suggest there is loyalty to specific OTC pain medication formulations, but many consumers have more than one on hand.

INTRODUCTION

There are two main types of OTC pain medications as shown in Table 1 below:

Table 1: Types of OTC Pain Medications

2 MAIN TYPES	Acetaminophen	NSAIDs nonsteroidal anti-inflammatory drugs		
ACTIVE INGREDIENT	Acetaminophen <i>for example:</i> Tylenol®, Excedrin® Tension Headache	Ibuprofen <i>for example:</i> Motrin® IB, Advil®	Naproxen sodium <i>for example:</i> Aleve®	Aspirin <i>for example:</i> Bayer® Extra Strength
WHAT TO KNOW	Acetaminophen and NSAIDs may treat the same symptoms, but they work differently in your body, and they have different warnings and dosing directions. One type may be more appropriate for you than the other.			

Traditionally, pain medication products can be usefully segmented based on ingredients (narcotic vs. Nonsteroidal anti-inflammatory or NSAIDS vs. COX-II inhibitors). For the purposes of this study, the market includes only OTC products containing one of the four main ingredients acetaminophen, acetylsalicylic acid, ibuprofen, or naproxen sodium. However, from a marketing perspective, the analgesic consumer market can also be segmented on the basis of whether the consumer uses one product exclusively or multiple products.

Consumer Healthcare Products Association (2017) has data showing the Over-The-Counter (OTC) pain medication market has grown has grown 7.2 % from 2013 to 2016. Currently, these products generate billions of dollars and are used by around 80% of the population. Market shares in sales dollars for the top four are: Tylenol, 27.9%, Advil (16.5%), Aleve (7.9%), and Bayer Aspirin (5.5%) according to Simon, Cilibertoz, and Liukonytex (2008).

It has been reported by Neilson and IMS (2013) that consumers generally trust OTC medications. This trust has five aspects including:

1. OTC medications are a first choice for both healthcare providers and consumers.
2. For a range of illnesses, 8 in 10 consumers use OTC medications to relieve symptoms without having to see a doctor.
3. 91-92 percent of doctors believe OTC medications are safe and effective.
4. 87 percent of doctors believe OTC medications are an important part of healthcare delivery.
5. 89 percent of consumers believe OTC medications are an important part of their healthcare for their family.

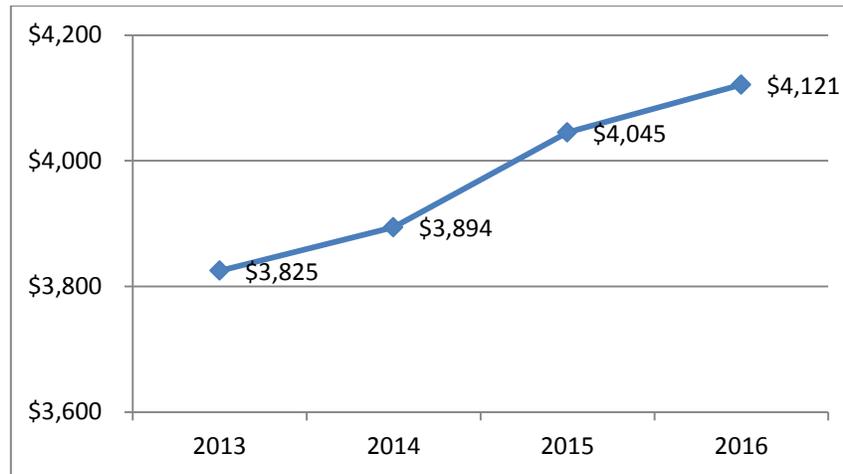
Booz Allen Hamilton (2012) has done research showing OTC medications benefit consumers in at least five ways:

1. 96 percent of U.S. adults say OTC medications make it easy for them to take care of minor ailments.
2. 93 percent of U.S. adults would rather treat their minor ailments with OTC medications instead of seeing a doctor.
3. 85 percent of U.S. parents would rather treat their children's minor ailments OTC medications instead of seeing a doctor.
4. 61 million consumers have avoided missing work, school, or other scheduled activities due to illness because they had access to OTC medications to alleviate their symptoms according to census data.
5. 70-90 percent of all illnesses are handled with self-medication.

The current and potential economic value of OTC medications is substantial according to Booz Allen Hamilton (2008) as follows:

1. OTC medications provide treatment options for consumers that are less expensive than prescription alternatives.
2. Access to OTC medications is widespread creating \$102 billion in annual savings relative to prescription drugs. This value is based on:
 - \$77 billion in cost savings by avoiding doctor's office visits and diagnostic tests); and by
 - \$25 billion in lower priced OTC pain medications.
3. By keeping the American workforce healthy and at work, OTC medications produce \$23 billion work productivity benefits from avoiding doctor's office visits and time not having to be away from work for testing and follow-up appointments.
4. Consumers and taxpayers could save \$5.2 billion annually if half of the visits to primary care doctors for minor ailments were avoided by more self-care utilizing OTC medications.
5. 86 percent of U.S. adults believe responsible OTC medicine use helps lower healthcare costs for people like them.
6. For every \$1 spent on OTC medication, the U.S. healthcare system saves \$6 to \$7.

Figure 1 below shows the OTC medication sales dollar growth in millions of dollars from 2013 to 2016 provided by the Consumer Healthcare Products Association (2017).

Figure 1: Over-The-Counter Pain Medication Sales

PURPOSE AND EXPECTATIONS

The overall purpose of the survey is to determine the extent of product loyalty and the extent of and nature of combination product use in the OTC pain medication market. Multiple product use by a segment of consumers may be one possible reason for the continued growth in OTC pain medication sales noted above. Many medicine cabinets in the home may have more than one OTC pain medication on the shelf.

This survey allows assessment of the following market conditions:

- Both OTC pain medication loyalty through exclusive use as well as dual OTC pain medication use and the combinations involved will be assessed.
- Those using acetaminophen (Tylenol) are expected to define the largest segment of loyal users.
- It is also expected that many consumers will define a segment using more than one OTC product from the four typically included in research of this kind: acetaminophen (Tylenol), ibuprophen (Advil), naproxen sodium (Aleve), and acetylsalicylic acid (Bayer Aspirin).
- It is also expected that acetaminophen (Tylenol) will have the most overall use since it is the product that does not have the side effect profile and drug interaction effects of the other three non-steroidal anti-inflammatory drugs and will be used frequently in more than one combination.

METHODOLOGY

Questionnaire Development

Focus group research was used to identify pertinent areas of inquiry regarding the use of OTC analgesics. From this beginning effort, subsequent pre-tests were used to further refine the self-administered questionnaire used in this study. The finalized questionnaire was then posted to a unique Internet address on the University internet website for data collection utilizing SNAP software and Institutional Research programmers. The survey questionnaire is in the Appendix.

Sample Demographics

The sample of analysis for this study came from the general population. The sample was generated using a snowball approach. Here, snowball sampling, sometimes called chain sampling, chain-referral sampling, or referral sampling, is a non-probability sampling technique where existing survey participants recruit future participants from among their friends and family members. The original 121 participants from marketing courses at two mid-sized universities generated a total of 862 participants in the survey.

The demographics of the survey sample are below in Table 2.

Table 2: Sample Demographics

Gender	Age	Education
43% Female	55% 18-25 Years	6% High School Graduate or Less
57% Male	20% 26-44 Years	61% Attending College
	25% 45+ Years	21% College Graduate
		12% Post Graduate Study or Degree

RESULTS

Demographic Profile of Single and Multiple OTC Medication Use

Table 3 below shows gender differences in the number of different OTC pain medications used by males and females. The differences show males are more loyal to a single OTC product than are females. Males also used 'other' pain medications more compared to females, but those participants only numbered 6 in the analysis. However, males also say they use two and four OTC pain medications more often than females.

Table 3: Gender Differences in Number of OTC Pain Medications Used

Gender	1	2	3	4	5	Row Total
Male	63.8%	56.5%	49.2%	54.8%	66.7%	57.6%
Female	36.2%	43.5%	50.8%	45.2%	33.3%	42.4%
Column N	329	253	187	84	6	859

Table 4 shows the age difference in participants who used single and multiple OTC pain medications. The younger age group (18 to 25) indicate they are more loyal to a single OTC pain medication. They also show they use more 2, 3, 4, and 5 different types of OTC pain medications.

Table 4: Age Differences in Number of OTC Pain Medications Used

Age	1	2	3	4	5	Row Total
18 to 25	58.1%	48.4%	54.5%	64.3%	66.7%	55.1%
26 to 44	18.8%	21.3%	21.9%	15.5%	0.0%	19.8%
45 to 64	23.1%	30.3%	23.5%	20.2%	33.3%	25.1%
Column N	329	254	187	84	6	860

Table 5 shows similar results as Table 4 due to the confounding of Age with Education level. The differences between those in the largest group Attending College and the other education levels are surprising in their magnitude.

Table 5: Education Differences in Number of OTC Pain Medications Used

Education	1	2	3	4	5	Row Total
High School Grad or Less	7.0%	5.1%	4.8%	6.0%	0.0%	5.8%
Attending College	62.3%	56.9%	63.1%	65.5%	66.7%	61.2%
Graduated from 4 yr. College	19.8%	23.7%	18.7%	17.9%	33.3%	20.6%
Postgraduate Study or Degree	10.9%	14.2%	13.4%	10.7%	0.0%	12.3%
Column N	329	253	187	84	6	859

Other Segments of OTC Pain Medication Use

Segments of OTC pain medication use can also be defined by the number of OTC pain medications in use regardless of gender, age and education. Single OTC pain medication users comprised 38.4% of the total sample.

The distribution of users by number of OTC pain medications used appears below in Table 6.

Table 6: Segments Defined By Number of OTC Pain Medications Used

Number Of Drugs Used	N	%
1	331	38.4%
2	254	29.5%
3	187	21.7%
4	84	9.7%
5	6	.7%
Total	862	100%

Exclusive/Loyal Use of OTC Pain Medications

The loyal single OTC pain medications users were distributed as follows among the five options in the survey. These results indicated Advil has the greatest brand loyalty followed by Tylenol.

Those who use Advil and Other OTC pain medications are more likely to be loyal single OTC pain medication users.

Table 7: Exclusive Use of OTC Pain Medications

OTC Pain Medication Brand Name	% of Exclusive Users
Tylenol	17.4%
Advil	26.5%
Aleve	9.4%
Bayer Aspirin	11.1%
Other	23.3%

Combination Use of OTC Pain Medications

When looking at pairs of OTC pain medications used in combination, it becomes apparent that Advil is the most often used OTC pain medication in combination (47%) and the most popular pair in a combination is Tylenol and Advil (73%).

These patterns can be seen in Table 8 below.

Table 8: OTC Pain Medication Pairs and the Combinations in Use

Main OTC Pain Medication	Alternate OTC Pain Medication	Number Of Users	Combination Use
Tylenol	Advil	405	73%
Tylenol	Aleve	200	36%
Tylenol	Aspirin	190	34%
Tylenol	Other	26	5%
Advil	Aleve	204	32%
Advil	Aspirin	202	31%
Advil	Other	30	5%
Aleve	Aspirin	97	38%
Aleve	Other	12	5%
Aspirin	Other	13	5%

Overall Use of Five OTC Pain Medications in Pairs

However, despite Advil's lead in exclusive and two OTC pain medication combination use; Tylenol is the product most often combined with another product in combination use. Thus, Tylenol surpasses Advil to be number one overall in pair use as shown by the sum of combinations in Table 9 below.

Table 9: Overall Use of Five OTC Pain Medications in Brand Pairs

	Tylenol	Advil	Aleve	Aspirin	Other
First Combination	73.2%	73.2%	36.2%	34.4%	4.7%
Second Combination	36.2%	31.6%	31.6%	31.3%	4.6%
Third Combination	34.4%	31.3%	38.2%	38.2%	4.7%
Fourth Combination	4.7%	4.6%	4.7%	4.8%	4.8%
Sum of Combinations	148.5%	140.7%	111%	108.7%	19%

Other Drugs Used

There were 45 mentions of OTC compounds that were not in the original four. The most common other OTC pain medication named was Excedrin at 15 mentions. Excedrin contains 250 mg of aspirin, 250 mg of acetaminophen, and 65 mg of caffeine which is considered a therapeutic dose for migraine headaches. That formulation constitutes a branded OTC combination product. The incidence of the other mentioned OTC compounds is presented in Table 10 below.

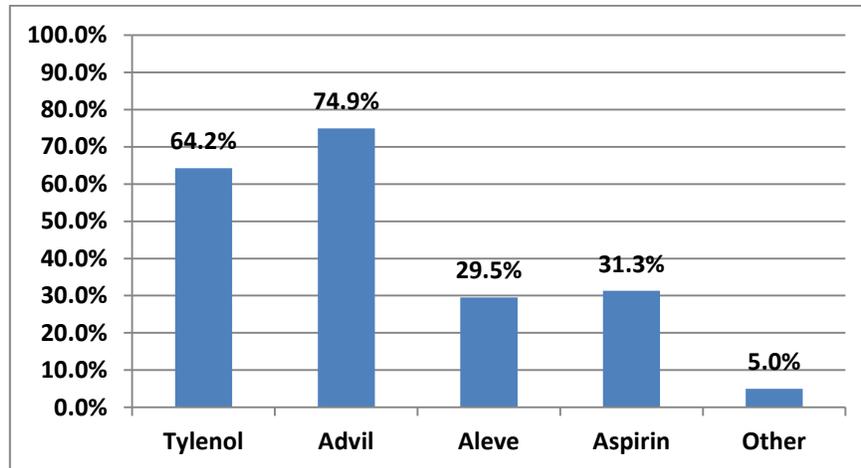
Table 10: Incidence of Other Drugs Used

Write-In	N
None	817
800mg Mo	1
Alavert	2
Alcohol	1
alka-sel	1
Anti-Flu	1
BC or Go	1
bc powder	1
Benadryl	1
Claritin	1
cough sy	1
cumodin	1
Dimetapp	1
Excedrin	15
Gas X	1
Generic	1
Goody Po	2
Goody's	1
Medicina	1
muscilex	1
Nightqui	1
Oxcotin	1
pamprin	2
Pepcid A	1
Percocet	1
SR lotion	1
stamina	1
Sudafedr	1
ZiCam	1
Total	862

Overall Use of OTC Pain Medications

When ignoring loyalty or pairs of OTC pain medications used, the overall use of OTC pain medications can be found. The overall number of OTC pain medication uses reported, whether alone or in combination was 1,766, with the typical survey participant using two or more different OTC pain medications. The incidence of overall use for the five possible OTC pain medications is presented in Figure 2 below. In addition to the most loyal users, Advil is also the most used product overall.

Figure 2: Overall Use of OTC Pain Medications



DISCUSSION AND IMPLICATIONS

Discussion

Regarding a loyal user segment the following findings are relevant:

- The expectation that loyal users would be a relatively large segment was confirmed. The largest segment of OTC pain medication consumers are loyal and use only one product (38.4%).
- The single drug loyalty is due more to males (63.8%) than females (36.2).
- It also extends more to the youngest segment (58.1%) more so than consumers age 26 or older, who also tend to be in the college education segment (62.3).
- Surprisingly, Advil emerged as the product with the largest segment of loyal users (26.5%).

Regarding combination user segments, the following findings are relevant:

- This loyal user segment was followed by a two drug combination segment which was the second largest user segment (29.5%).
- Advil is the most often used OTC pain medication in combination (47%).
- As expected, the most popular pair in combinations involves Tylenol.
- The most popular pair combination is Tylenol and Advil (73%).

Regarding the product with the largest share of overall use (single loyal use and combination use) the following finding is offered:

- Advil held the largest share of overall use of OTC pain medications at 74.9% beating Tylenol at 64.2% by 10.7%.

Implications

To maintain its 9.1% advantage over Tylenol in the loyal user segment, Advil may want to continue or implement strategies to attract and maintain use by males in the youngest segment (18-25 years old). Aleve and Bayer Aspirin may not be able to catch Tylenol and Advil given they are around 30% of share of use points behind the market leaders.

The advantage that Advil and Tylenol have may be found in the price points in the marketplace. For example the prices for the house brand generic and the brand products found on Walmart's website show the following differences in Table 11:

Generic	Generic Price	Brand	Brand Price	Differential
Ibuprophen	\$01.4	Advil	\$08.0	\$06.6
Acetaminophen	\$01.4	Tylenol	\$07.0	\$05.6
Naproxen-Sodium	\$04.0	Aleve	\$12.9	\$08.9
Acetyl Salicylic Acid	\$02.1	Bayer Aspirin	\$02.7	\$00.6

The price per pill does not seem to be an advantage in this market. However, Advil is getting a small premium over Tylenol to go along with its larger overall market share. Bayer Aspirin may be relegated to last place due to it's being the oldest product in the marketplace with an entry in the 1890's.

REFERENCES

Booz Allen Hamilton. (2012) ["The Value of OTC Medicines to the United States"](#). Accessed at 6:05 PM 5/10/17.

Consumer Healthcare Products Association (2017). <http://www.chpa.org/OTCsCategory.aspx> . Accessed 4/3/2017 8:30 PM

DeSarbo, W S., Atalay, A. S., LeBaron, D., and Blanchard, S.J. (2008). Estimating Multiple Segment-Level Ideal Points from Context Dependent Survey Data, *Journal of Consumer Research*, 35, 142-153.

Nielsen Holdings PLC and IMS Health, (2013). ["Understanding Trust in OTC Medicines: Consumer and Healthcare Provider Perspectives"](#) March, Accessed at 3:01 PM 5/10/17

Simon P. Anderson, S.P, Ciliberto, F. and Liaukonyte, J. (2008). Getting into Your Head(ache): Advertising Content for OTC Analgesics, *Marketing Science Institute Working Paper*, February, 1-34.

Walmart Pain Medications. (2017). https://www.walmart.com/browse/health/pain-relievers/976760_976798_1001537 Accessed 5/14/2017.

**WORKSHOP, PANEL OR
TUTORIAL**

Use of Teams Within a Program: Hodgepodge or Mosaic

Janice Black, Coastal Carolina University; Jess Doll, Coastal Carolina University; J. Kay Keels, Coastal Carolina University; Nicholas Rhew, Coastal Carolina University; April Spivack, Coastal Carolina University

Session Description: This session presents a panel of faculty who have actively been using teams in their classes which range from junior required courses, to upper division electives, to a final required capstone. Their use of teams and what they share/teach their students about teams and team processes are presented and a compare and contrast with justifications leads the discussion.

Session Agenda (50 Minutes): This session will have 6 parts:

Welcome/Introductions; Overview of the Business program and the placement of the courses; presentation of team introduction materials by each discussant; Discussion of emergent qualities; survey of audience for any additional qualities to consider; Discussion based on compare and contrast across emergent categories with justification of use.

Welcome/Introductions (5 minutes):

Panelist 1 is a professor of strategic management at Coastal Carolina University, whose research is in the development of intangible resources to convey a competitive advantage. She has over 8 published articles in the last 5 years. One of her earlier articles on bundling resources together to achieve a competitive advantage has over 900 citations. She has developed and presented pedagogical workshops that are centered on critical thinking and hands on activities.

Panelist 2 is an assistant professor of human resource management and organizational behavior at Coastal Carolina University and teaches a course about leading teams. Within the course students practice organizing, leading, and collaborating in a team environment. They also devote significant time to personal leadership development and the improvement of interpersonal skills, such as conflict management, active listening, and support communication.

Panelist 3 is a professor of strategic management at Coastal Carolina University, whose research has enabled her to win several professorships over the years. She is a case editor for several journals. Recently her research has focused on pedagogical issues.

Panelist 4 is an assistant professor of management at Coastal Carolina University whose research focuses on entrepreneurship and who has been teaching an integration course that uses an entrepreneurial simulation.

Panelist 5 is an assistant professor of management at Coastal Carolina University whose research focuses on international business and ethical considerations. He has been teaching international business and taking students on study abroad trips.

History of Business Program at Coastal Carolina University (2 minutes)

Prior to 2010

Between 2010 and 2012

From 2012 to Present

The Use of Teams (3 minutes = 12 minutes)

Junior Required Course for the Management Major: MGMT 309: Leading High Performance Teams

The obvious content of this course is teams and leading them. Often the term has a service project component and sometimes the course leads freshmen teams in accomplishing the service project.

Junior Required Business Course: CBAD 373: Business Integration and Application

This course integrates business disciplines through the use of an online simulation. Teams meet face to face and virtually to collaborate and compete with other teams.

Junior/Senior Required Course for concentration or management elective: MGMT 320: Entrepreneurial Leadership

This course examines entrepreneurs and their companies. The term project is a documentary around entrepreneurial thought and behavior themes that highlight the biographies of two to three entrepreneurs. Student teams video tape interviews and use that to collaborative create the documentaries.

Junior/Senior Required Course for International Management concentration or management elective: MGMT 462 Competing in Foreign Market

This course focuses on why, where, and how firms choose to enter and compete in foreign markets. The role of geographical, economic, cultural, and institutional environments in foreign market entry and competition will be addressed. Particular attention will also be paid to the ethical dilemmas presented by operating internationally. Students do a term project in teams.

Senior Required Course: CBAD 478: Strategic Management

This capstone course focuses on completing a single in-depth strategic assessment of a publicly traded firm. The assessment has between 15 and 22 assessments that uses data found by students. Students work together in groups that range from 3 to 6 members.

Observed Emergent Themes (Audience Participation: 20 minutes)

Some potential themes include: Team Processes; Team Development; Team Roles; & Team Member Peer Evaluations.

Justifications and Pros & Cons of Each (Responses: 8 minutes)

Emergent results will be synthesized and discussed during this time. The reasons behind the variations of use of teams will be presented and ideally common aspects identified for going forward in the future.

Hodgepodge or Mosaic Conclusion (3 minutes)

The final conclusion and a time for Q&A occur at this time.

WORKSHOP: HAPPINESS AS A KEY INGREDIENT FOR INNOVATION IN EDUCATION

Uma Gupta, State University of New York

This 2-hour interactive workshop uses findings from neuroscience to establish the link between happiness and innovation and creativity. There is a growing concern that institutions of higher learning fall short when it comes to innovation and creativity, even as organizations around the world are clamoring for graduates that have an entrepreneurial spirit and passion for innovation.

Cutting-edge research from neuroscience shows that we can only be creative and innovative if each of us remains focused and dedicated to expanding our comfort zone, seeking variety in all that we think and do, and embrace experiences that disrupt our closely held assumptions and beliefs about our ability to be creative and innovative.

Highly structured, small comfort zones, and failure-free lives are the antithesis and enemies of innovation. This workshop will challenge participants to view innovation and creativity through the lens of happiness since a happy brain is also a creative brain.

Today, with advances in neuroscience, we know that in order to become engines of innovation that is holistic, meaningful, impactful and lasting at both an individual level and at an organizational level, we need to understand the human brain and its cravings for creativity and new experiences. A greater awareness of the decision-making pathways embedded deep in our brains will help us learn more, achieve more, and most importantly, help us to be innovative in our approaches to learning and teaching.

Key elements of this workshop include:

1. Key findings from neuroscience that links happiness to creativity and innovation.
2. Specific recommendations to increase classroom innovation through a deeper understanding of the perpetual conflict between being on autopilot and embarking on creativity.
3. Hands-on exercises (individual and group) to strengthen innovation in education.

Sensemaking in an Era of Big Data Science

Michael Latta
Coastal Carolina University
Subhajit Chakraborty
Coastal Carolina University
Monica Fine
Coastal Carolina University
Bomi Kang
Coastal Carolina University
Leann Mischel
Coastal Carolina University
Stephanie Revels
Coastal Carolina University

53rd Annual Meeting of Southeastern Chapter of INFORMS
Hilton Myrtle Beach Resort
Myrtle Beach, South Carolina
October 5-6, 2017

ABSTRACT

The story of how Big Data Science was enabled through the marriage of technology in the form of the young discipline of computer science and the mature discipline of statistics was told by Gil Press in his (2013) Forbes piece titled ‘A Very Short History Of Data Science.’ The name “Data Science” is now the discipline charged with utilizing Big Data. But making sense of data has a much longer history and has been debated by scientists, statisticians, librarians, computer scientists and others for years. More recently, the ideas surrounding the importance of ‘context’ have been integrated into the use of big data in strategic decision making. Karl Weick (1993) introduced the concept of Sensemaking in organizational decision making to account for failures in data-driven decision making. This approach has been brought forward by Christian Madsjerg in his new book *Sensemaking: The Power of Humanities in the age of the Algorithm* (2017). However, McNamara (2005) has questioned whether or not many people really understand what Sensemaking is in practice, and Jones (2015) has argued that it is merely a collection of methodologies that are equivalent to thinking paradigms for doing research. This panel will explore Sensemaking and its relationship to Big Data Science today and offer examples of where it succeeds and fails.

Where Did Big Data Begin?

In 1947, John Tukey coined the term “bit” according to Claude Shannon as recorded in his 1948 paper “A Mathematical Theory of Communications.” In Tukey’s work done for the Army Research Office in 1961 and published in 1962 titled, “The Future of Data Analysis,” John Tukey wrote,

“For a long time I thought I was a statistician, interested in inferences from the particular to the general. But as I have watched mathematical statistics evolve, I have had cause to wonder and doubt... I have come to feel that my central interest is in data analysis... Data analysis, and the parts of statistics which adhere to it, must...take on the characteristics of science rather than those of mathematics... data analysis is intrinsically an empirical science... How vital and how important... is the rise of the stored-program electronic computer? In many instances the answer may surprise many

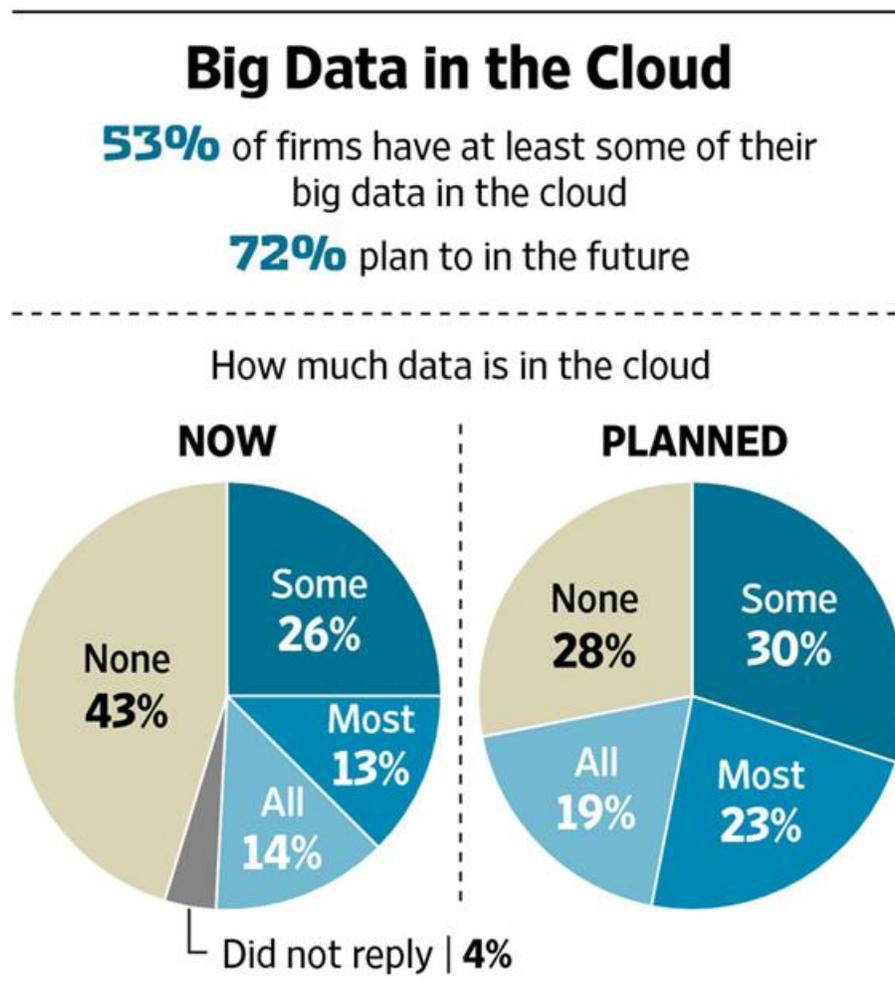
by being 'important but not vital,' although in others there is no doubt but what the computer has been 'vital.'"

Then, in 1977, Tukey published his widely used text "Exploratory Data Analysis," where he said that, "more emphasis needs to be placed on using data to suggest hypotheses to test and that *Exploratory Data Analysis and Confirmatory Data Analysis* "can—and should—proceed side by side."

Where Is Big Data Today?

Some say John Massey made the term "Big Data" popular in his presentation "Big Data...and the Next wave of InfraStress" (1998).

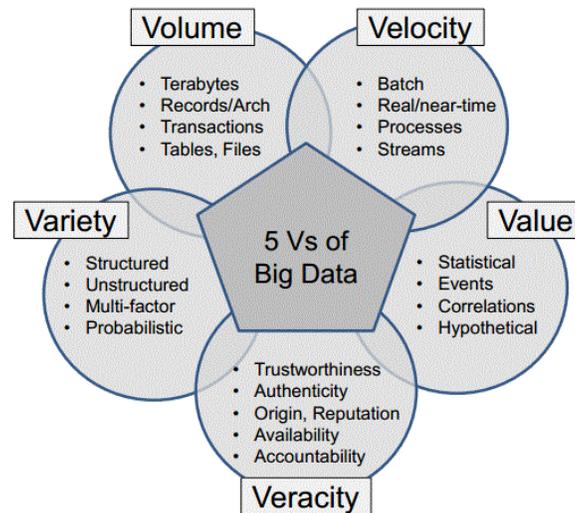
The Wall Street Journal has estimated the extent of 'Big Data' collection there as follows:



Source: AtScale Inc. global survey of more than 2,550 big-data professionals, conducted in the fall of 2016

THE WALL STREET JOURNAL.

Four of the Five V's of Big Data provide a structure for evaluating sources of data and their integrity, but they don't provide value or meaning.



The Caveats

A strong caveat concerning Big Data came from a 1963 paper by sociologist William Bruce Cameron:

"It would be nice if all of the data which sociologists require could be enumerated because then we could run them through IBM machines and draw charts as the economists do. However, not everything that can be counted counts, and not everything that counts can be counted."

Some Big Data Analytic Companies Such as McKinsey & Company are having second thoughts about the value of growth in Big Data (Gordon, Perrey, & Spillecke, 2013).

Martin (2015) in a blog Q&A on Quora answered a question about how businesses can use Big Data effectively and recommends focusing on the following three principles of using Big Data to make decisions:

- Use analytics to identify valuable opportunities.
- Start with the customer decision journey.
- Keep it fast and simple.

What Is Sensemaking and Why Is It Important

Sensemaking combined with Big Data embodies the three decision making principles. In addition, Madsberg says it arises out of 'Thick Data' which is the stuff of knowledge coming primarily from Sensemaking. He defines the four types of knowledge underlying how we know what we know. These four types of knowledge are:

1. Objective Knowledge – involves all things that can be observed and measured directly making it akin to Big Data
2. Subjective Knowledge – involves personal opinions and feelings that are true for that person and moment

3. Shared Knowledge– this is public knowledge constituting knowledge that is ‘in between’ objective and subjective knowledge and which makes thick data powerful
4. Sensory Knowledge – comes from inside the ‘body’ and is sometimes described as a ‘sixth sense’ or being a part of the events in the environment

Operating in an integrated way, the synthesizing of these four kinds of knowledge leads to Pattern Recognition, the process of thinking combines reason, emotion, judgement, and analysis simultaneously into Thick Data as opposed to Big and Thin Data. This process has been physically documented by Frank (2009) in his research on Neuromarketing and how consumers’ medial prefrontal cortex react to storytelling about products.

Turning the Big Data Promise into Reality: Examples of Sensemaking and Big Data Analytics

The areas of application for Bid Data and Sensemaking are everywhere. One area where they are used in analytics daily is marketing. Some examples from this domain are below.

1. In Marketing, Big data has changed the way we target customers and interact/engage with them. Instead of giving consumers mass media messages in which they have no interest, marketers can show them ads for services/products they truly relate and care about based on their search activities, media preferences, shopping habits, interests, passions, etc. Big data can more accurately predict customer loyalty and satisfaction. Big data can be used to identify the problems marketers can solve and provide value to the consumers in their environments.
2. Data mining in the pharmaceutical industry to identify use segments prior to launch yet did not succeed in establishing a foothold in the market.
3. How Pepsi lost the Cola Wars to Coke despite winning taste tests consistently.

Other examples from other domains will be offered in the panel discussion.

REFERENCES

Cameron, W. B. (1963). *Informal sociology a casual introduction to sociological thinking*. New York: Ransom House.

Frank, L. (2009). How the Brain Reveals Why We Buy, *Scientific American*, November 2. Accessed 5/23/17 6:48 AM <https://www.scientificamerican.com/article/neuromarketing-brain/>

Gordon, J., Perrey, J., & Spillecke, D. (2013). Big Data Analytics and the Future of Marketing and Sales. *Forbes*. Accessed 5/22/17, 2:02 PM,

Jones, P. (2015). Sensemaking Methodology: A Liberation Theory of Communicative Agency. <https://www.epicpeople.org/sensemaking-methodology/> Accessed 5/29/17, 8:45 AM.

Madsbjerg, C. (2017). *Sensemaking: The Power of the Humanities in the Age of the Algorithm*. New York: Hatchette Books.

Martin, J. (2015) How do big data and analytics reports impact a business' productivity? *Quora*. <https://www.quora.com/How-do-big-data-and-analytics-reports-impact-a-business-productivity> Accessed 5/30/17 at 7:40 AM

Massey, J. R. (1998). Big Data...and the Next Wave of InfraStress. Accessed 5/22/17, 1/17 PM www.storage.ibm.com/hardsoft/disdrdl/library/technolo.htm IBM storage web page.

McNamara, L. A. (2015). Sensemaking in Organizations: Reflections on Karl Weick and Social Theory. <https://www.epicpeople.org/sensemaking-in-organizations/> Accessed 5/29/17, 7:40 AM.

Press, G. (2013). A Very Short History of Data Science, Forbes Magazine. <http://www.forbes.com/sites/gilpress/2013/05/28/a-very-short-history-of-data-science/2/#797cc6e318e7> Accessed May 28, 2013 at 09:09 AM

Shannon, C. (1948). A Mathematical Theory of Communication, *The Bell System Technical Journal*, Vol. 27, pp. 379–423.

Tukey, J. (1961). The Future of Data Analysis. *The Annals of Math Stat*, 33, 1-67.

Weick, K. E. (1993). The collapse of sensemaking in organizations: The Mann Gulch disaster. *Administrative Science Quarterly*, 38(4), 628-652.

Weick, K. E. (1990). Cognitive processes in organizations. In L. L. Cummings & B. M. Staw (Eds.), *Information and cognition in organizations* (pp. 287–320). Greenwich, CT: JAI Press.

ACCOUNTING CURRICULUM CHANGES

Douglas Ziegenfuss, Old Dominion University

A Workshop for Nearly All Business School Faculty Especially Accounting Faculty Two veteran accounting educators will discuss two accounting curriculum changes: (1) the development of a totally online asynchronous "Principles of Financial Accounting" course, and (2) the development of a upper division business elective, "Accounting for Entrepreneurs."

We begin our workshop by examining the various incentive/disincentives to course development. For instance, does your institution allocate resources based on numbers of majors or FTEs? Departments will act in differing ways depending on the answer.

We then present the motivation behind these two curriculum changes. Then we discuss each in greater detail:

- (1) Totally Online "Principles of Financial Accounting."
 - a. We discuss why we developed this course.
 - b. Who developed the course.
 - c. Course Content.
 - d. Where does the course fit in the Business and Accounting Curriculum.
 - e. Some challenges along the way.
 - f. Has the course met its objectives?
- (2) "Accounting for Entrepreneurs."
 - a. We discuss why we developed this course.

- b. Who developed the course.
- c. Course Content.
- d. Where does the course fit in the Business and Accounting Curriculum.
- e. Has the course met its objectives?

This session is meant to be interactive with active audience participation.

Workshop: Computer Science Capstone Experience

Bob Tucker, Liberty University

Each year our Liberty University graduating Computer Science (CS) seniors must complete an internal internship which is organized and managed by the CS faculty. This three semester course sequence in Software Engineering is called the Capstone experience. Organizations outside the School of Engineering and Computational Sciences (corporations, government agencies, as well as ministries) are selected as client-partners, and the students develop a software product or service for the client.

This internal internship pulls together the Computer Science principles and methodologies the students have learned in their program and provides a real-world experience in software development. Initially the students contact the client and solicit the requirements for the product; next they design, develop, and test the application, and finally they deliver the product to the client and if necessary train them on its use.

The client provides the subject matter expertise needed to define the requirements/needs of the project, as well as feedback on the design and early versions of the software.

Organization/Progression of the Capstone Course Sequence:

The Capstone experience is a three semester sequence of three credit courses. The first course is taken the spring semester of the junior year and provides a grounding in the basic tools, techniques, and methodologies of Software Engineering. All phases of the Software Development Life Cycle (SDLC) are taught using the scenario of developing a Student Information System (SIS) for a mythical small liberal arts college. This scenario was chosen as students are already quite familiar with the basic operation of a SIS. During the second half of this initial semester the students are assigned teams and projects they will pursue during their senior year. If the newly assigned project is a continuation of a current senior project, the junior year team will meet several times with the senior team for an introduction to the client, project, and software development environment.

The second and third courses are taken the fall and spring semesters of the senior year. To complete the team formation process, at the beginning of the fall semester the students attend an off-site event at the instructor's home where they participate in various team building exercises in an "office party" setting. In addition to team development, this experience also engenders a corporate-like vs academic atmosphere for the internal internship. Throughout the year the use of offices and conference rooms in lieu of classrooms further encourages the perception of a "job" environment.

During these two semesters, the teams will develop and submit to their client all the typical deliverables required of a software development project.

- Project Plan
- Requirements Specification
- High-Level and Detailed Design Specification

- Alpha and Beta Software Versions
- Deployment Package

Very simply put, the first course teaches the software development process and the other two courses provide the opportunity to develop a real-world product using the process they have learned.

Assessment Instruments:

Software development is very much a team sport. Rarely is software written by an individual working alone. Consequently, to provide this group-work experience the Capstone experience students are placed in three or four person teams that remain the same throughout the internal internship. During the first course in their junior year each student is required to develop a job resume and have a job interview with the course instructor. This enhances the job seeking skills of the students and provides needed details about individual students to the instructor so that each student can be assigned to the best team and most appropriate project.

To properly measure the performance of each student as a member of the team, after the completion of each deliverable listed above, the team members individually assess themselves and each other via a on-line survey instrument. A performance rating of Excellent, Good, Fair, Poor, Deficient, or

Unacceptable, along with a written justification, is assigned to all team members for each deliverable. Students with ratings in the lower three categories are counseled individually by the instructor as how best to improve their performance.

Next, each deliverable submitted by the team is graded in terms of proper application of tools and methods, consistency with the project goals and objectives, as well as overall quality. This assessment is done for the total product, independent of individual team members' contributions. This overall grade is then proportionally adjusted for each team member as a reflection of how well they performed as a member of the team that produced the deliverable. The individual counselling sessions mentioned above would have been done before this adjusted grade is assigned so the student can appreciate how their portion of the grade was determined.

In addition to the team member evaluations, twice each semester the students complete a personal evaluation similar to the annual reviews they might expect to receive from future employers. This survey asks for a rating and justification for such topics as technical competency, ability to communicate, reliability, as well as other items. After this survey is completed all students meet with the instructor to discuss their perceptions of themselves as an "employee" of the software development organization. This process provides the instructor additional insight in how to grade the performance of the students and provides the students with both a self-assessment and employer-assessment experience that they are likely to encounter in the working world.

Capstone Experience Design Challenge:

The internal internship is intended to help students make a successful transition to employees by both cultivating real-world job-seeking skills and providing valid work experiences that can be included in a student's job resume. Few students, however, know before their senior year what type of employment they will have after graduation. Therefore, it is impossible to provide each student the precise preparation for the job they may seek.

With this understanding the Capstone experience was designed to provide as wide a range of software development experiences as possible. The first process-oriented course covers all the essentials of the Software Development Life Cycle as practiced by any software development organization. Various common tools & techniques dealing with intra-team communications, development environments, project management, and version control are explained and used during this course.

The real-world projects for the second and third product-oriented courses are also carefully chosen with this need for wide ranging experiences in mind. The criteria for client and project selection includes several critical components. First, the project must include activities in all phases of the Software Development Life Cycle. Next, the project must be feasible in terms of the time available to students taking other courses in addition to the internal internship, as well as the limited software development experience of most students. Finally, the client must be willing to work proactively with the teams as the students are not likely to have established skills in soliciting and analyzing needs and requirements from a client.

Conclusion:

Over the last five years this Computer Science Capstone experience has evolved in many ways. This includes the number of courses in the sequence, the range of projects and clients undertaken, the variety of tools and methodologies used, as well as the quality of the deliverables expected from the students. With all the many changes that have occurred, the one consistency has been the enthusiasm shown by the students, clients, and ultimately the employers for this experience. The concept of using an internal internship to actively transition students into employees has been universally seen as very worthwhile.

Workshop: Engaging Generation Z

Stacy Wassell, Chelsea Schrader

Abstract:

Given the changing demographics of the workplace, there is a need for creative engagement techniques for the newest generation of students. There needs to be new perspectives in order to solve today's biggest challenges to impact managing, learning, and innovating in the new knowledge economy. To address this need, we need to reach beyond traditional classroom pedagogy and design strategies to leverage the best of the hyperconnected and hyperdynamic students known as Generation Z. Marrying inquiry-based learning (IBL) techniques and the theoretical premise of stakeholder engagement; we have developed activities that address these needs. In this workshop, we will summarize the theoretical frameworks and philosophies on which our work was based, discuss the design processes used, and share our experiences.

Outcomes:

As a result of this workshop, participants will:

1. Develop an understanding of multigenerational workplaces, inquiry-based learning (IBL), and stakeholder engagement.
2. Discuss sample approaches taken to teach Generation Z students.
3. Discuss the benefits of such activities to students, stakeholders, and the organization.
4. Engage in dialogue about the adaptability of such activities to other institutions.

Proposal:

Given the changing demographics of the workplace, there is a need for creative engagement techniques for the newest generation of students. There needs to be new perspectives in order to solve today's biggest challenges to impact managing, learning, and innovating in the new knowledge economy. To address this need, we need to reach beyond traditional classroom pedagogy and design strategies to leverage the best talent of the hyperconnected and hyperdynamic students known as Generation Z. Marrying inquiry-based learning (IBL) techniques and the theoretical premise of stakeholder engagement; we have developed activities that address these needs. In this workshop, we will summarize the theoretical frameworks and philosophies on which our work was based, discuss the design processes used, and share our experiences.

Generation Z is the newest cohort in the classrooms and entering the workplace. They were born between the mid-90s and early 2000s (Koulopoulos & Keldsen, 2014; Whitehead, 2016). Identified as the Net Generation or digital natives, this group is considered as those that have been tethered to technologies, such as cell phones, the internet, e-mail, and instant messaging since childhood and into adolescence (Tyler, 2007, p. 41). In short, they have been hyperconnected via technologies from an early age. A poll by Common Sense Media (2013) reported that 38% of American toddlers regularly use a tablet. Therefore, learning with technology is not only a norm for this group, but is expected. This is clearly becoming evident in the classroom. It is for this reason that new approaches to learning are essential for capitalizing

on and building this cohort's skills and behaviors. New modes of educating need to start with creating ideas and connections that consist of out-of-the-box thinking by making sense of the masses of data and information that this Generation finds through the countless number of online communities to which they belong. No longer are classroom lectures sufficient. There needs to be an augmentation of traditional teaching with emerging technologies and active learning.

Inquiry-based learning (IBL) is a type of active learning pedagogy that shifts the responsibility for the learning process from teacher to student (Lazonder & Harmsen, 2016). Inquiry becomes the primary driver of seeking knowledge and skills acquisition (Lazonder & Harmsen, 2016). Students are given authentic problems early on, before they know how to solve them. Then they are asked to discover/research ways to solve, synthesize the information, present a solution, and evaluate the outcome. In other words, IBL takes the focus on "what we know" to an emphasis on "how we come to know" (Exline, 2004). IBL in its purest form is criticized, but adaptable variations of IBL produce many interesting avenues. In the case of Generation Z students, we found it most effective when inquiry-based learning was accompanied with an appropriate scaffolding and well-timed instruction, guidance, and feedback.

In this workshop, we will present our approach to addressing Generation Z students with IBL techniques. Our specific approach meshed the theoretical underpinnings of stakeholder engagement. Specifically, we on-boarded external advisory board members (stakeholders to the organization's College of Business), within the classroom through the spectrum of a recommendation-seeking level of involvement (Addor, 2013, p. 4). The stakeholders provided influential advice and/or comments through various consultative methods, moderated by the stakeholders' selection method. More in-depth and further overview of stakeholder engagement, as well as, the specific activities we used within this framework will be discussed. We will do this through a combination of formal presentation, panel discussion, and question and answer session.

Our discussion will include the outcomes and benefits that were resultant of this project. Narrative examples will reinforce the impact this project had on the students. We will also discuss the relationship building between the stakeholders, students, and our organization. On a professional development level as faculty, the implications of pedagogical activities using stakeholders, technology, and IBL were recognized. The most significant outcome was realizing that this particular active learning method was far more effective than just having students submit an assignment for grading. The discussion on the level of inquiry and engagement will potentially open the door to dialogues on how new teaching techniques with new instructional modes via IBL in combination with technological approaches, will apply to and meet the demands of Generation Zers at any institution.

References

- Addor, M. L. (2013). *Generation Z: What is the future of stakeholder engagement?*. NC State Institute for Emerging Issues. Retrieved from <https://iei.ncsu.edu/wp-content/uploads/2013/01/GenZStakeholders2.pdf>
- Common Sense Media. (2013). *Zero to eight: Children's media use in America 2013*. Retrieved from <http://www.commonsensemedia.org/sites/default/files/research/zero-to-eight-2013.pdf>.
- Exline, J. (2004). *Inquiry based learning*. Retrieved from <http://www.thirteen.org/edonline/concept2class/inquiry/index.html>
- Koulopoulos, T., & Keldsen, D. (2014). *The Gen Z effect*. Brookline, MA: Bibliomotion, Inc.
- Lazonder, A. W., & Harmsen, R. (2016). Meta-analysis of inquiry-based learning: Effects of guidance. *Review of Educational Research*, 86(3), 681-718. doi 10.3102/0034654315627366
- Tyler, K. (2007). The tethered generation. (cover story). *HR Magazine*, 52(5), 40-46.
- Whitehead, R. (2016). Generation Z is here!. *Plant & Works Engineering*, (406), 52.

SMALL BUSINESS ACCOUNTING VERSUS CORPORATE ACCOUNTING FOR NON-ACCOUNTING/FINANCE MAJORS: A DEBATE

Janice Black, Coastal Carolina University; Christopher Becker, Coastal Carolina University

Session Name: Small Business Accounting Versus Corporate Accounting for Non-Accounting/Finance Majors: A Debate

Session Description: This panel session/workshop provides a quasi-debate between an entrepreneurship professor and an accounting assistant professor. They discuss the pros and cons of a contextualized entrepreneurial/small business focused accounting text versus the traditional accounting text. Comparisons of content and framing of issues is shown. Audience participation is sought. Conclusion reached about usefulness of an out of print textbook contextualized to small businesses, writing a new text or sticking with a traditional accounting textbook.

Session Benefit to Members: In many schools, the beginning two accounting classes are classes with high DFW rates. Using a contextualized small businesses versus the traditional corporate business environment may help more sophomores become engaged with the content. Engagement with content and professor have been shown to be positively correlated with retention, performance, and course satisfaction. This session takes an explicit look at the similarities and differences between the small business perspective in accounting and the corporate perspective. While the small business perspective may not work for accounting and finance students, it may be very worthwhile to the typical management or marketing student. This allows such faculty to see the actual course content and how each type addresses different student and employer needs. Such examinations are not common in larger business schools and may be of interest to the accounting, management, marketing, and entrepreneurship faculty.

Session Agenda (50 minutes):

Welcome and Introduction of Panelists (6 minutes):

Panelist 1: This Entrepreneurship faculty member has taught a variety of entrepreneurship courses and has a passion for reaching this next generation of entrepreneurs. She often uses creative and innovative exercises in her course work. She'd like to see higher retention of students both in the management degree and in the entrepreneurship concentration.

Panelist 2: This Accounting faculty member often teaches the sophomore introduction to accounting courses. He is seeking ways to improve the DFW rate in the basic accounting 1 & 2 classes. This may be a way to actively engage these students in the course work and reduce the DFW rates.

Introduction of the two textbooks (10 minutes):

The general format and similarities and differences of the two textbooks' table of contents will be presented by Panelist 1 & 2 in an interactive fashion.

A Presentation of Similar Exercises and/or Explanations (10 minutes):

Panelist 1 & 2 will rotate presenting similarities between the two books.

A Presentation of Contrasting Exercises and/or Explanations with Justifications for Differences (14 minutes):

Panelist 1 & 2 will rotate presenting contrasting views between the two books and solicit reasons for the differences from the audience along with providing justifications from their interactions.

Q&A and Solicited Comments from the Audience addressing the reasonable coverage of materials between the two perspectives (15 minutes):

Panelists will record and facilitate audience interaction with content, reasoning, and conclusions about adequacy of Small Business text for non-accounting and non-finance students.

What We Have Learned From/About Teaching Quantitative, Technology and Communication Classes in a School of Business

Robert L. Andrews,

Virginia Commonwealth University,
Department of Supply Chain Management and Analytics,
Richmond, VA. 23284-4000, 804-355-4645, randrews@vcu.edu

Wilma M. Andrews,

Virginia Commonwealth University,
Department of Information Systems,
Richmond, VA. 23284-4000, 804-827-0956, wandrews@vcu.edu

Annie Stith-Willis,

Virginia Commonwealth University,
Department of Supply Chain Management and Analytics,
Richmond, VA. 23284-4000, 804-828-7111, amstithw@vcu.edu

ABSTRACT

Experienced teachers will lead a dialogue with those attending about lessons learned from teaching classes in mathematics, statistics, analytics, technology and communication. The session will focus on discussion of how to provide the best instruction in a class. Designing instruction for a course is a constrained optimization problem with numerous criteria and constraints. Members of the audience will be invited to participate with their questions and lessons learned. Discussion will address a variety of topics including:

- Establishing course content to best prepare students for their future based on best practices at other institutions and by obtaining feedback from employers and instructors of courses that come after your course in the students' program
- Selecting and using software for the course based on cost to the student, anticipated value to the student, and your knowledge
- Determining the external supplements such as textbooks, homework managers, automated response systems, applets, etc. that will be used to aid instruction
- Creating the types of assessments/assignments that will allow you to assess the important things a student has learned and promote the learning of important skills
- Structuring course activities to effectively engage the students in the course and promote the desired learning
- Establishing an effective style for you that best fits your students and you

INTRODUCTION

The intension is for the session to result in an interactive discussion among the panel and those attending. The panel members have some definite statements to make and opinions to share based on their own experiences and interactions with other academics. The plan is for the panel members to make initial presentations from their perspectives to set the stage for a broader discussion. The goal of the session is get the session participants to think about how they structure their classes and what is taught to best prepare students for what they need to know and be able to do in the future.

ESTABLISHING COURSE CONTENT TO BEST PREPARE STUDENTS FOR THEIR FUTURE

A course should not be about the instructor but about the students. The phrase “From sage on the stage to guide on the side” emphasizes that the instructor is not an actor performing on a stage. The primary focus of an instructional session should not be on the performance of the instructor but on preparing students to be able to perform in the future. A course needs to provide information to the students but the students also must have practice performances where they can fail and learn from their failures so they, in the future, will not make the same mistakes that lead to a failure when then cost of failure will be much higher.

SELECTING AND USING SOFTWARE FOR THE COURSE

In today’s world, there is a plethora of software available that automate many of the procedures that are presented in our courses. Multiple criteria must be considered when selecting software to be used in a course. Two primary criteria must be the effectiveness of the software and cost to the student for using it in the course. When considering software to perform computations, one must also consider how widely the software is used in areas where your students will likely be performing in their future. An additional criterion is to consider the learning curve for you and your students for the software. The investment of money and time by the student and instructor needs to have a positive expected return on their investment.

DETERMINING THE EXTERNAL SUPPLEMENTS THAT WILL BE USED TO AID INSTRUCTION

In addition to functional software, there are a plethora of technology and other supplements to the class instruction. These can facilitate student learning and provide operational efficiencies in the education process. Obvious examples are textbooks, homework managers, automated response systems, applets, etc. Many of these are designed to assist with presentation and understanding of important concepts and procedures for courses. Like the use of software, the use of a supplement should have a positive expected return for the student and the instructor.

CREATING THE TYPES OF ASSESSMENTS/ASSIGNMENTS THAT WILL PROMOTE THE LEARNING OF IMPORTANT SKILLS

“Practice makes perfect” emphasizes the importance of practicing skills. Memorizing and reproducing certain tasks and functions is needed but should not be the primary component in a university course. We must not spend all of our time on the ground floor of Bloom’s Taxonomy, shown in Figure 1. However, creating assignments and assessments to promote the higher learning capabilities is more difficult than creating assignments and assessments for Remembering and Understanding. The retention of learning rates for the different instructional modalities in Figure 2 shows that to be effective in our course we must do more than merely assign readings, lecture and show videos.

Figure 1
Bloom's Taxonomy

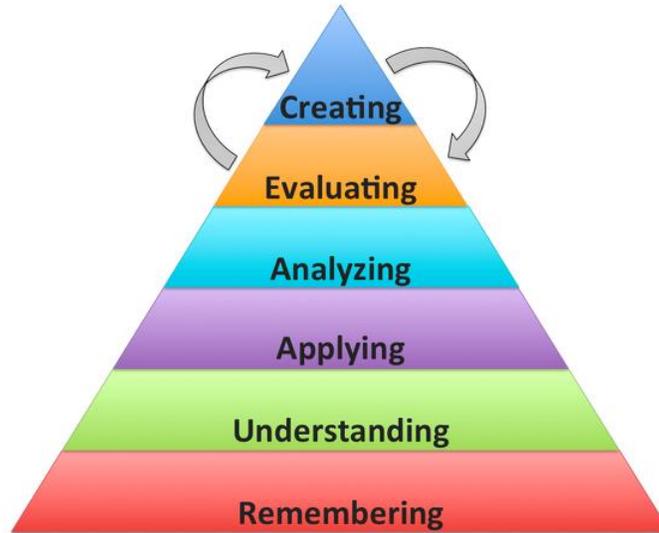


Figure 2



Source: National Training Laboratories, Bethel, Maine

STRUCTURING COURSE ACTIVITIES TO EFFECTIVELY ENGAGE THE STUDENTS

We cannot teach our students everything they will need to know for their future. We need to prepare our students to become life-long learners. In Figure 2 we see that the modalities with higher retention rates all involve engaging in activities with other people. For students to truly take the course activities seriously, the activities need to be of interest to the student. It is desirable to pick topics to address that are of interest to them. To effectively grade the product of their work, it is important to prescribe structure for how they report their work. This allows for constructing a rubric for grading and makes grading a less ominous task.

ESTABLISHING AN EFFECTIVE STYLE FOR YOU THAT BEST FITS YOUR STUDENTS AND YOU

Each of us is different. We can learn from other good teachers. However, trying to copy what is successful for someone else does not guarantee that it will make you have the same level of success as the other teacher. You lose credibility and effectiveness if students leave class with the impression that you are a fake based on what you did in class. You must choose a style that is consistent with your background, strengths and personality. If you want your students to become passionate about what you are teaching then you need to demonstrate a passion for your topic

Regulating Artificial Intelligence: Does It Really Pose an Existential Risk? – A Discussion

Harry Katzan, Jr.
Webster University

Abstract

This presentation concerns one of the most influential subjects in the current decade, Artificial Intelligence. Industry leaders have flatly stated that they thought implementation of artificial intelligence dominated systems would eliminate humanity and the way of life that we all experience. For the record, a definition of artificial intelligence randomly obtained through the Internet defines “artificial intelligence as the theory and development of computer systems able to perform tasks that normally require human intelligence such as visual perception, speech recognition, decision-making and translation between languages.” The presentation will begin with a short 10-minute presentation on the dimensions of artificial intelligence by an author, who spent several years as an artificial intelligence consultant and has completed a number of successful relevant projects in that area. A collection of controversial topics will be given and the audience will be engaged in giving their opinion on the various topics. Most large companies are currently concentrating on basic research in the area of artificial intelligence to aid in the development of products and to make sure that competitors will not get a head start on the technology. The notion of a paper that involves a discussion by the audience is a relatively new concept and is a technique applicable to small conferences.

Symposium: Understanding the Impact of Budget Cuts on Higher Education

Wiley S. Brown, NC A&T State University, Department of Management

Sherrie Drye, NC A&T State University, Department of Business Education

Lisa Gueldenzoph Snyder, NC A&T State University, Department of Business Education

This symposium will provide a discussion forum for attendees to describe their own experiences with budget cuts in higher education and the impact these cuts have on their teaching, research, and service. We seek to identify the critical issues associated with budget cuts in higher education and how they affect student success and faculty productivity. A second goal of the symposium is to identify “best practices” of effective teaching and learning with fewer resources. Attendees will be asked to work together to create a list of impacts, consequences, and strategies to meet their goals and objectives under the stress of continuing budget cuts, limited faculty resources, and larger class sections. These factors will be discussed in small groups to determine “best practices” to meet continuous improvement goals under these fiscal circumstances and the consequences on student success and faculty productivity.

The most recent financial depression in 2008 set forth an onslaught of budget cuts to public education (Barr & Turner, 2013). To help balance smaller state budgets, legislators cut the support of public schools, and that support has not returned to pre-recession funding amounts (Mitchell & Leachman, 2015). While, the history of continued decreases in support to public Universities over the past ten years is well documented other factors also continue to influence the landscape of Higher Education. The Baby-Boomers (born in 1946-1964) created an 8.6% increase in higher education in the 1970's and 1980's, requiring public educational institutions to do much more with less money (Mitchell & Leachman, 2015). Although recent generations have been less populous, the more Millennial-age students are attending college than any other generation group before them, increasing the numbers of students in our higher education classrooms. In some states, such as North Carolina, instead of using recent budget improvements to reverse the budget cuts in public education, legislators are choosing to provide corporate tax cuts to boost job growth. As the economy slowly improves, it is important for legislators to consider job growth in terms of having enough skilled students graduating to fill high demand jobs, such as those in the technology sector. It is a bit of the *chicken-and-egg paradox*: if new jobs are provided through corporate tax cuts, will there be enough skilled graduates to fill these

positions? And if there aren't enough new jobs created, will it matter if there are skilled graduates seeking jobs?

In 2015, states were still spending 20% less per student than in 2008, and some states continue to decrease the amount that they spend (Mitchell & Leachman, 2015). The following results significantly impact the effectiveness of higher education:

- Universities have had to look for alternative sources of funding, and many have begun to require faculty to search externally for grants and other funding opportunities.
- Tuition has risen, shifting some of the burden to students. In some cases, tuition has risen by 80%. In North Carolina, the average tuition percentage change was 35.8% between 2008-2015 (Mitchell & Leachman, 2015). This increase in tuition has been an obstacle to lower-income students who either are not able to obtain college degrees or, if they do, result in increased student debt levels.
- Continuing budget restrictions result in possible consequences, such as:
 - Loss of faculty positions, which create larger teacher-student ratios that result in less individual time spent per student in grading and mentoring;
 - Increased service commitments placed on faculty, which further restricts their ability to effectively advise and mentor students;
 - Fewer course offerings—for example, between 2008 and 2014, UNC Greensboro eliminated 390 course sections due to a \$4 million budget cut (Mitchell & Leachman, 2015);
 - Lack of resources for creation of new courses, programs, and other innovative practices
 - Increase in class sizes. --A “large” class is difficult to define, but Maringe and Sing state that in the *massification* of Higher Education, a large class is “any class where the numbers of students pose both perceived and real challenges in the delivery of quality and equal learning opportunities to all students in that classroom (2014, p. 763);
 - Increase in number of students advised by faculty members;
 - Fewer resources for information technology, library services, etc.;
 - Lack of funding resources for faculty to travel to conferences;
 - Fewer resources for internal research funding, meaning faculty spend more time to write grants for research;
 - Fewer resources for faculty professional development;
 - With more responsibilities, faculty may find that they have less time for teaching and advising of students; and
 - Closing of campuses.

Given that employers are expecting more in terms of skills and knowledge from their new employees, are faculty able to continue teaching in a way that still provides what students need to be successful in the workplace? For example, technology skills such as data analytics are in high demand, but those skills come at a price through enhanced technology and development of new course offerings

and programs for students. How can education shift to meet the needs of employers when funds continue to be inadequate?

References

- Barr, A., & Turner, S. E. (2013, November). Expanding Enrollments and Contracting State Budgets: The Effect of the Great Recession on Higher Education. *The Annals of the American Academy of Political and Social Science*, 650, 168-193.
- Maringe, F., & Sing, N. (2014). Teaching large classes in an increasingly internationalising higher education environment: pedagogical, quality, and equity issues. *Higher Education*, 67, 761-782.
- Mitchell, M., & Leachman, M. (2015). *Years of cuts threaten to put college out of reach for more students*. Washington, DC: Center on Budget and Policy Priorities.

Faculty Transitions: From New Hire to Retirement

Panelists: Douglas Ziegenfuss, Old Dominion University; Randall Spurrier, Old Dominion University; Gregory Krippel, Coastal Carolina University

This panel will present and discuss the journey made by most faculty during the later parts of their academic careers. Specifically, three veteran professors will discuss:

- (1) The transition to faculty;
 - a. The importance of understanding the culture of your institution and specifically, what it takes to get tenured or your contract renewed.
 - b. The importance of getting your research pipeline filled.
 - c. The importance of getting your teaching up to standards.
- (2) The transition from faculty to administrator;
 - a. What kind of administrator are you?
 - b. The three big issues for Department Chairs.
 - c. How to handle whinny faculty, students, and outside parties.
- (3) The transition from administrator to faculty; and finally,
 - a. You are no longer in control.
 - b. How to still contribute at this late stage of your career.
 - c. How to mentor your department without nagging.
- (4) The transition from faculty to retirement and beyond.
 - a. When do you know it is time to retire.
 - b. Financial Planning
 - c. Work/life Balance in retirement.
 - d. How to feel engaged and fulfilled in retirement.

This session is meant to be interactive with active audience participation.

Authors Index

Aggrawal, A.	2	Katzan, H.	83, 266, 312, 418, 496
Alesius, C.	142	Keels, J.	474
Andrews, R.	186, 492	Kheirandish, R.	401
Andrews, W.	186, 492	Kimmons, B.	327
Baker, D.	327	Knott, C.	449
Becker, C.	15, 436, 490	Kordecki, G.	41, 347, 354
Beggs, J.	75	Krimminger, M.	157
Bilbrey, B.	376	Krippel, G.	15, 500
Black, J.	474, 490	La Roche, C.	131
Bowles, J.	255	Lang, S.	220
Bradberry, C.	267	Latta, M.	6, 464, 477
Brown, W.	497	Levernier, B.	241
Chakraborty, S.	477	Liu, M.	403
Crandall, D.	112	Liu, X.	55
Damonte, T.	280, 292	Lowry, G.	74
Doll, J.	474	Martin, R.	100
Domke-Damonte, D.	280	McDonald, D.	29
Drye, S.	497	McManus, J.	74
Erkan, G.	403	Menter, L.	41
Fine, M.	477	Mischel, L.	188, 477
Garey, R.	363	Mitchell, M.	255
Grant, D.	41	Monroe, R.	100
Gupta, U.	381, 476	Mortimer, J.	15, 436
Harshaw, C.	104	Mousavi, S.	401
Hashemzadeh, N.	386	Nicholls, N.	451
Hightower, R.	29	Njoroge, P.	15, 436
Holmes, Y.	29	Olson, P.	317, 449
Hong, J.	90, 171	Orvis, B.	451, 457
Jadav, J.	428	Peters, A.	63
Jernigan, E.	75	Peters, M.	63
Johnson, B.	11	Pfitzner, B.	220
Kadlec, C.	327	Pittges, J.	267
Kang, B.	477	Plate, Jr., W.	6
		Pollard, W.	33, 69
		Raggad, B.	343

Ray, A.	267	Stith-Willis, A.	186, 492
Revels, S.	477	Tappert, C.	428
Rhew, N.	474	Taylor, P.	29
Ritter, B.	436	Taylor, S.	171
Rutner, P.	275	Teets, J.	100
Salvino, R.	280	Tomlin, S.	426
Schaeffer, D.	317, 449	Tucker, B.	484
Schimmel, K.	142, 457	Valdema, P.	292
Schrader, C.	487	Wassell, S.	487
Shipps, B.	185	Wathen, S.	255
Showalter, E.	74	Weible, R.	414, 425
Shurden, M.	376	Whitehead, K.	48
Smith, M.	195	Williams, F.	275
Snyder, L.	497	Winder, J.	210
Soisson, E.	6	Xiong, C.	55
Sollosy, M.	414	Ziegenfuss, D.	482, 500
Somma, A.	210		
Spivack, A.	474		
Spurrier, R.	482, 500		

