# KNOWLEDGE AND SKILL REQUIREMENTS FOR IT/IS GRADUATES

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## ABSTRACT

In order to assess whether curricula for IT-related programs prepares graduates for entry-level IT positions, the authors collected data from nearly 400 IT managers using a survey instrument. The results of the survey are reported in this paper. The data collected will be used to help the ongoing design and evolution of IT-related curricula and courses. In addition, the results of the survey are compared to the ACM IT Curriculum to determine if there are any areas not currently covered by the curriculum.

## INTRODUCTION

Following the "dot com" bust, some questioned whether the impact of information technology (IT) on the economy was anything more than "smoke and mirrors". In his popular article, "IT Doesn't Matter", Nicholas Carr claimed that the strategic importance of IT had diminished (Carr, 2003). However, there are many that disagree with Carr. Recently, Atkinson & McKay (2007) claimed that the digital revolution is "… more than fulfilling its original promise, with digital adoption rates actually exceeding the most optimistic forecasts of the late 1990s" (Atkinson & McKay, 2007, p. 3). Atkinson and McKay also claim that information and communications technologies are a major driver of economic growth and will continue to drive growth in the foreseeable future.

Studies have shown that capital investment in IT impacts worker productivity by three to five times that of non-IT capital expenditures. According to Atkinson & McKay (2007), IT was responsible for most of the growth in labor productivity in the U.S. between 1995 and 2002. The IT industry improves the economy by creating high paying jobs, allowing more people to work, and making it easier for more people to join the workforce. On average, IT jobs pay 84% more than other jobs. IT also improves the quality, level of customization, and processes involved in creating and delivering products and services. (Atkinson & McKay, 2007)

As IT continues to positively impact the economy, ensuring that graduates of IT-related programs are properly prepared to enter the IT workforce becomes increasingly important. A well-prepared, efficient, professional IT workforce will only add to the positive impact on the economy.

To determine the preparation level of our students, we examined the skills typically required of entry-level IT workers and compared them to what is currently taught in IT-related curricula. Despite the existence of several model curricula (such as AIS IS 2002 Model Curriculum, ACM IT Curriculum), several studies suggest that there is a gap between the skills achieved by IS/IT graduates and the skills required by employers (Trauth et al., 1993; Lee et al., 2002; Kim et al., 2006; Cappel, 2001/2002). A number of studies have examined this gap as it is perceived by IT professionals, academics, students, and users (Tang et al., 2001/2002; Randall & Price, 2006). Several have made recommendations for how to improve the IS curriculum (Trauth et al., 1993; Leitheiser, 1992; Young, 1996; Abraham et al, 2006; Lee et al., 1995). However, many of these previous studies are now outdated, calling into question the continuing validity of their findings and recommendations. Additionally, there are few, if any studies, that compare the entry-level skills required by employers to the skills included in the IT model curriculum. (http://www.acm.org/education/curric_vols/IT_October_2005.pdf).

To address these gaps in the literature, the authors collected data from a nationwide cross-section of 364 IT managers to (1) examine the views of IT managers on the skills required of entry-level IT workers and (2) to compare these skills to the IT model curriculum.

# METHODOLOGY

The primary purpose of this study is to determine the importance of various skills for entry-level IT workers as perceived by IT managers. Survey instruments are typically used to examine the skills gap and as a basis for comparing the skills required by employers to the skills set forth within model curricula. To this end, a survey was designed and administered to IT managers nationwide.

The skill items in the survey were created by examining the ACM IT Curriculum (http://www.acm.org/education/curric_vols/IT_October_2005.pdf), IS 2002 Curriculum from the Association of Information Systems (www.aisnet.org/Curriculum/), and current empirical studies (Fang et al., 2005 and Abraham et al., 2006). In addition, several demographic questions were added to the survey to gather information about the respondents and the IT operations of their respective organizations.

A pilot study was conducted to test the questionnaire. The survey was administered to faculty, students and IT staff at the authors' university. Approximately 30 people participated in the pilot study. Feedback was gathered, leading to an improved version of the survey that was used in the data collection.

The final survey consisted of 32 skills/traits that were ranked in terms of importance on a scale of 1 (not important) to 5 (very important). The survey was web-based and administered via email by a reputable online survey company. The survey was administered to IT managers only. There were 390 respondents with 364 surveys that were complete enough to use for data analysis.

# DATA ANALYSIS

**Demographics of Respondents**

Responses were received from IT managers in all but five states in the U.S. Twenty-eight percent (28%) of respondents were in organizations with annual gross revenue of over $1 billion and 30% were in organizations with over 10,000 employees. Sixteen percent (16%) of organizations had annual gross revenue under $50 million and 12% had fewer than 100 employees. Ninety-four percent (94%) of respondents stated that their organizations employed a full-time IT staff and 44% said that the number of IT employees exceeded 100.

The respondents represented a cross-section of industries. Table 1 provides an overview of the characteristics of the respondents and their organizations with regards to (a) the industry to which they belong, (b) the areas of demand for IT workers within their organization, and (c) the sources they use to acquire new IT staff. Nineteen percent (19%) of respondents were in an organization in the IT industry.

Respondents could select more than one response for areas of demand for IT workers and sources for finding IT workers. The most common areas of demand cited by respondents for full-time entry-level IT employees were IT help desk (70%), networking (56%) and programming (55%). The most common sources cited for finding entry-level IT workers were the web and internships. Respondents were fairly optimistic about the job market next year – 28% of respondents said that the job market would be better next year while 49% said it would stay the same.

### TABLE 1: CHARACTERISTICS OF RESPONDENTS AND THEIR ORGANIZATIONS

**(a)**

| Industry | % of Respondents |
|---|---|
| IT | 19 |
| Education | 11 |
| Health care related | 10 |
| Government/Military | 8 |
| Manufacturing | 8 |
| Financial | 6 |
| Other | 6 |
| Computer technology vendor | 5 |
| Consulting (not in IT) | 4 |
| Insurance | 4 |
| Retail | 4 |
| Telecommunications | 3 |
| Transportation | 3 |
| Non-Profit | 2 |
| Utilities | 2 |
| Other | 10 |

**(b)**

| Area | % of Respondents |
|---|---|
| Clerical/Data Entry | 29 |
| Database Area | 44 |
| IT Help Desk | 70 |
| Networking | 56 |
| Programming | 55 |
| Systems Analysis & Design | 48 |
| Web Design & Development | 46 |
| Other | 9 |

**(c)**

| Source | % of Respondents |
|---|---|
| Co-op | 13% |
| Instructors' recommendations | 6% |
| Internships | 39% |
| IT department office | 34% |
| Newspapers | 37% |
| Relatives/friends | 24% |
| School's career planning office | 24% |
| Web | 48% |
| Other | 15% |

### Results

For ease of interpretation and consistency with the methodology used in similar studies (Fang et al., 2005; Tang et al., 2000), most of the skills/traits can be classified into one of four categories: technical skills,

organizational knowledge, personal skills/traits and interpersonal skills/traits. Lee et al. (1995) used a slightly different classification of technical, organizational, IT management, and interpersonal/management knowledge/skills. We use a combination of the two approaches to arrive at four categories: technical, organizational, managerial and personal/interpersonal skills/traits. Table 2 provides a rank ordering of the 32 skills/traits surveyed based on the average score for each item.

## TABLE 2: RANK OF SKILLS/TRAITS

| Rank | Skill/Trait | Average Score |
|---|---|---|
| 1 | Honesty/integrity | 4.62 |
| 2 | Communication skills (oral and written) | 4.54 |
| 3 | Analytical skills (e.g., ability to analyze and evaluate) | 4.51 |
| 4 | Ability to work in teams | 4.49 |
| 5 | Motivation | 4.37 |
| 6 | Interpersonal skills | 4.37 |
| 7 | Flexibility/adaptability | 4.33 |
| 8 | Creative thinking (e.g., ability to generate new ideas) | 4.18 |
| 9 | Organizational skills | 4.13 |
| 10 | Relevant work experience | 4.06 |
| 11 | Awareness of IT technology trends | 4.04 |
| 12 | Operating systems | 3.99 |
| 13 | Hardware concepts (PCs/Server/Router/Network) | 3.92 |
| 14 | Database | 3.92 |
| 15 | Security | 3.91 |
| 16 | Telecommunications/Networking | 3.90 |
| 17 | Web development programming languages (XHTML, XML, Javascript, JSP, ASP, etc.) | 3.85 |
| 18 | Any work experience | 3.83 |
| 19 | Packaged software (word processing, spreadsheets, etc.) | 3.82 |
| 20 | Systems development life cycle methodologies | 3.75 |
| 21 | Programming languages (Java, COBOL, etc.) | 3.72 |
| 22 | Knowledge of primary business functions (e.g., finance, marketing) | 3.65 |
| 23 | Project management skills | 3.65 |
| 24 | Leadership skills | 3.63 |
| 25 | Knowledge of your company (e.g., your goals and objectives) | 3.59 |
| 26 | High IT GPA | 3.50 |
| 27 | Knowledge of specific industry (e.g., retail, health care, transportation) | 3.50 |
| 28 | Internship experience | 3.40 |
| 29 | High overall college GPA | 3.34 |
| 30 | Entrepreneurial/risk taker | 3.21 |
| 31 | Co-op experience | 3.20 |
| 32 | Extra-curricular activities (other than work) | 3.04 |

Of the eleven skills/traits that had a ranking above 4.0, the top nine are in the category of personal/interpersonal skills. The top five skills/traits are honesty/integrity, communication skills, analytical skills, ability to work in teams, and motivation. Entrepreneurial/risk taker (3.21) and leadership (3.63) were ranked as the lowest skills in this category.

The only technical skill that was ranked above 4.0 was awareness of IT technology trends (4.04). The remaining technical skills were ranked in between 3.5 and 4.0 with operating systems receiving the highest average score (3.99) and programming receiving the lowest (3.65).

The highest ranking skill/trait in the organizational knowledge category was knowledge of primary business functions (3.65) with a ranking of 22. The initial indication is that personal and interpersonal skills are the most important, technical skills are next and organizational knowledge third.

There are a few other items worth noting. Project management, the only IT management skill on the survey, was ranked as the 23rd most important item. Relevant work experience was ranked as the 10th most important item. Yet, internship experience was only ranked as 28th. If the internship was specified as an IT internship, the results may have been different. The respondents may have assumed that the internship was general in nature as opposed to specific to IT.


# DISCUSSION AND CONCLUSION


The results of the survey have several implications worth noting. In addition, some of the results of this study are in concurrence with the ACM Computing Curricula - IT Volume and some are in contradiction.

1. **Personal and interpersonal skills are the top-rated skills**. This is consistent with the findings in other studies and is also consistent with the current draft of the ACM Computing Curricula - IT Volume, as there are several program outcomes related to personal/interpersonal skills:
   o "Design effective and usable IT-based solutions and integrate them into the user environment"
   o "Demonstrate independent critical thinking and problem solving skills"
   o "Collaborate in teams to accomplish a common goal by integrating personal initiative and group cooperation"
   o "Communicate effectively and efficiently with clients, users and peers both verbally and in writing, using appropriate terminology"
   o "Recognize the need for continued learning throughout their career"
   (http://www.acm.org/education/curric_vols/IT_October_2005.pdf, p. 6).
2. **Project management is the least important IT technical or management skill cited in the study for entry-level employees cited in the study**. According to the current draft of the ACM Computing Curricula - IT Volume project management is important as there is a program outcome related to project management: "Assist in the creation of an effective project plan" (http://www.acm.org/education/curric_vols/IT_October_2005.pdf, p. 6).
3. **The highest ranked IT skill is awareness of IT technology trends**. This is consistent with the current draft of the ACM Computing Curricula - IT Volume as there is a program outcome related to this skill: "Identify and evaluate current and emerging technologies and assess their applicability to address the users' needs" (http://www.acm.org/education/curric_vols/IT_October_2005.pdf, p. 6).
4. **Internship experience is relatively low in importance for entry-level IT workers**. However, relevant work experience is much higher in the ranking (10th versus 28th) based on average importance scores. This seems contradictory. In addition, internships were cited as one of the most often used sources for hiring IT employees, second only to the web. This may partially be explained by not specifying that the internship was an IT internship.

As educators, we need to think about how to develop several of the aforementioned skills, specifically the personal/interpersonal skills that are so important to the employers that hire our graduates. Some of these

skills - such as analytical and communication skills - are already being taught. But how do we teach honesty and integrity? This is a personal value typically set prior to a student arriving at a college campus. As educators, we can talk about the importance of the privacy, ethical, security and legal issues surrounding IT, but we can not teach honesty/integrity.

Similarly, we may have students work in teams for projects and other activities in the classroom, but are we teaching how to work in teams? Just because students do work in teams does not necessarily mean they know how to do so effectively.

Based on our findings, project management is not as important as other skills. The findings in Abraham et al. (2006) might provide an explanation. Based on structured interviews with 100+ senior IT managers, they found that project management skills were not cited as the most important for entry-level workers. However, these skills were cited as important for mid-level employees and as skills likely to remain in-house as opposed to being outsourced. Our results are in contradiction to the findings of Kim et al. (2006) where project management was cited as the most important skill in the field as perceived by IS employees over the next three years. However, this study was conducted at a single manufacturing firm and did not target entry-level employees. The question that comes to mind for IT educators is whether or not project management is important in the curriculum. The current draft of the ACM Computing Curricula - IT Volume only states that a student needs to assist in the creation of a project plan, not manage an entire project. This is what an IT graduate should be able to do and this may shed light on the seemingly contradictory findings on project management.

## SUMMARY

In this study, we collected data from nearly 400 IT managers to assess whether IT-related curricula properly prepare graduates of IT-related programs for entry-level IT positions. One desired outcome of the study was to help the ongoing design and evolution of IT-related curricula and courses. The data we have collected will be used for this purpose. Results of our efforts in this area will be reported in future studies. Another desired outcome was to compare our results to the ACM IT Curriculum to determine if there are any areas not currently covered by the curriculum.

In keeping with previous studies, our findings suggest that personal and interpersonal skills are the top rated skills with technical skills taking second place. Our findings also suggest that although the ACM IT Curriculum appears to adequately address the technical and project management skills expected of entry-level IT workers, it does not provide adequate preparation for several of the most important "soft" skills (such as honesty, integrity, motivation, etc.). Whether these soft skills can (or should) be taught, and if so, how they can (or should) be taught, will be an ongoing challenge and subject of debate among IT educators for years to come.

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