QUALITY COSTS – AN ACCOUNTING CHALLENGE

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ABSTRACT

What are the costs of not having perfect quality in your business? If you don't know, you may be surprised to hear researchers who have studied this area estimate that the costs of poor quality in manufacturing companies average around 15%, with a range from 5-35% of your sales dollar, depending on product complexity. In service organizations, it averages 30%, with a range from 25-40%. For most managers, this is significant enough to get their attention. Unfortunately, many, if not most, companies do not really know what their quality costs are because of the difficulty in measuring them.

QUALITY COSTS – AN ACCOUNTING CHALLENGE

What are the costs of quality in your business? Or, put another way, what are the costs of not having perfect quality in your business? If you don't know, you may be surprised to hear researchers who have studied this area estimate that the costs of poor quality in manufacturing companies average around 15%, with a range from 5-35% of your sales dollar, depending on product complexity. In service organizations, it averages 30%, with a range from 25-40% (Juran 1993; Krishnan 2006). For most managers, this is significant enough to get their attention. Unfortunately, many, if not most, companies do not really know what their quality costs are because of the difficulty in measuring them (Feigenbaum 1991; Schiffaueroya 2006).

WHY ARE QUALITY COSTS IMPORTANT?

Aside from the fact that poor quality may represent a large portion of total costs, there are other reasons to be interested in quality costs.

- Quality, along with costs, response time and flexibility, is a critical success factor (CSF) for most businesses. High quality is necessary to survive.
- Because some quality costs are hidden or intangible, they are difficult to control and, in some instances, could cause a crisis in a company.
- The quality concept continues to evolve; as a result, the standard by which we measure quality keeps changing.
- Finally, there are differences between product quality and service quality. As companies increase their mix of product and services, they need to differentiate between the two insofar as measuring quality.

WHAT ARE QUALITY COSTS?

The American Society of Quality (ASQ) defines quality costs, or "the cost of quality," as follows:

> The "cost of quality" is a term that's widely used – and widely misunderstood. It isn't the price of creating a quality product or service. It's the cost of NOT creating a quality product or service. Any cost that would not have been expended if quality were perfect contributes to the cost of quality. Quality costs are the total of the cost incurred by investing in the prevention of nonconformance to requirements, appraising a product or service for conformance to requirements, and failing to meet requirements. The sum of these costs represents the difference between the actual cost of a product or service and what the reduced cost would be if there were no possibility of substandard service, failure of products or defects in their manufacture. (ASQ 2008).

The APICS Dictionary defines quality costs as "the overall costs associated with prevention activities and the improvement of quality throughout the firm before, during, and after production of a product. (Blackstone 2008)

These definitions suggest quality costs can be associated with products and services, an area of responsibility usually assigned to accounting. However, being able to define cost elements and actually reporting them in a usable format are two different things.

TANGIBLE QUALITY COSTS

Both ASQ and APICS classify the tangible quality costs as internal failure, external failure, appraisal and prevention costs. This classification is widely accepted as the prevention, appraisal and failure (PAF) model (Schiffaueroya 2006). The following examples of these costs are taken from Juran (1993) and are similar to definitions by Feigenbaum (1991) and other writers.

Internal failure costs are those costs associated with defects (nonconformance) that are found prior to shipment of the product to the customer and are costs that would disappear if there were no defects. Examples include scrap, rework, failure analysis, scrap and rework supplies, sorting inspection, reinspection and retesting, avoidable process losses, and downgrading.

Internal Failure Example
In the early nineties, when a sweeper manufacturer was in the process of implementing Phil Crosby's Quality Improvement Process, the engineers hit upon a way to detect and then eliminate internal failures. We made sure that every workstation had an air grinder. Every time we heard the air grinders' characteristic screams, we investigated and set up a team to eliminate the cause. Gradually the screams became less frequent; however, it took almost a year before we could safely eliminate the air grinder from the list of required workstation tools. Because we had reduced structural variances, we were able to increase output by one-half a sweeper a day with no increase in labor costs! QUALITY PAYS!

External failure costs are costs associated with defects that are found after product is shipped to the customer and include warranty charges, complaint adjustment, returned material, and allowances.

External Failure Example
A major automotive manufacturer implemented a reliability improvement: replacing ignition points with an electronic module that provided the same function. After approximately six months of production (500,000 vehicles), modules were being returned under warranty by the dealers, but they were "non-defective". (That is they tested OK in the lab). More importantly, the customers' problems were not fixed! At the same time we were having intermittent fuel filter clogging. Both of these failures produced the same symptom: the car stops running, but only for an hour or so! Then it goes again! In order to solve everyone's problems (customers, dealers & our company), we invented a tester that identified the culprit and provided testers to 6000 dealers. This saved all of us significant emotions, bad press and untold expenses. Moral of the story? Identify quality issues early and eliminate them, even if it takes an invention! QUALITY PAYS!

Appraisal costs are costs incurred in determining the degree of conformance to quality requirements, and include: incoming inspection and testing, in-process inspection and testing, final inspection and testing, product quality audits, maintaining accuracy of testing equipment, inspection and testing of materials and services, and evaluation of stock (inventory) for degradation.

Appraisal Example
In the late seventies, snowmobiles had a notorious reputation for poor reliability. There were even barroom jokes about them. A major manufacturer decided to implement significant reliability improvements to its product line. In addition to an increase in prototype testing, we took the opportunity to completely restructure the assembly process. This opportunity existed because the business was seasonal so the plant remained unused for half of the year. Instead of a serial process, we set up sub-assembly operations with integral inspection operations. Therefore we knew that all final line components were OK before we installed them on a unit. End-of-line failures and warranty costs were reduced significantly in the following year! QUALITY PAYS!

Prevention costs are costs incurred in keeping failure and appraisal costs to a minimum. They include quality planning, new product review, process control, quality audits, supplier quality evaluation, and training.

Prevention Example

In the late eighties, a manufacturer of forestry equipment identified an opportunity to dramatically reduce warranty costs and assembly time. Forestry equipment is subjected to one of the worst operating environments in the industrial world! After less than 6 months in operation, an operator could not even determine the original color! We implemented just-in-time practices, reducing the need for inventory storage. We had to redesign many of the structural components, nest the flame cutting patterns based on model needs instead of by part numbers and only prep and paint sub-assemblies needed for the final line. By clustering all the parts needed for a given model we reduced the number of different thicknesses of steel from 9 to 4: resulting in additional savings through smart buying. We could buy from the mill (instead of from the distributor), because of the size of our orders. Investment velocity was increased because we could now produce any of our models in eight work days, instead of the previous best time of 28 work days. Customers could also receive their complex tractors in 2 weeks instead of 2 months. These improvements required significant labor flexibility, engineering creativity, organizational revisions and commitment by everyone during the nearly 2 years of planning and implementation. Result? Both our customers and our holding company accountants loved us! In addition, we did not need to work as hard because we reduced most of our variances. QUALITY PAYS.

These costs are tangible; however, as we describe later, not always easily determined.

INTANGIBLE, OR HIDDEN, QUALITY COSTS

In addition to the tangible PAF costs, there are hidden, or intangible, costs. Krishnan (2006) warns that conventional accounting systems have been inadequate to accurately report the costs of poor quality. He lists some of the hidden costs, originally reported in Juran (1993) as:

- potential lost sales
- costs of redesign due to quality reasons
- costs of changing manufacturing processes inadequate to meet quality standards
- costs of software changes due to quality reasons
- costs included in standard costs because they were considered inevitable
- costs for space and inventory changes
- scrap not reported
- costs of errors made in support operations such as order filling and production control
- costs of poor quality within a supplier's plant

Freiesleben (2004) also cites management time as a hidden cost. Problems of any sort require the time of managers at all levels to resolve and few, if any, systems record how CEOs spend their time.

In addition to the hidden costs reported above that may be difficult to dig out of accounting systems, there are other intangible costs that are even more difficult to determine. They include costs associated with sales lost when a company's acceptance in the marketplace may be eroded because of product recalls, or bad publicity from association with suppliers operating sweatshops or child labor factories.

The pressure to get products to market quickly may also contribute to hidden costs of quality. In the trade-off between speed to market and designed-in quality, the more tangible pressure to get the product to market may overshadow the loss in quality (Ball 2006).

In addition to social acceptance considerations, customers may also consider quality failures to be products containing hazardous or non-biodegradable materials, or processes with high carbon or harmful waste emissions.

COSTS VERSUS LEVEL OF QUALITY

An area of great interest is the behavior of the PAF costs as quality improvement efforts bring about change. The consensus among researchers is that increased spending on prevention costs will bring about decreases in internal failure and external failure costs. This appears logical – as quality improves, there will be fewer failures. The effect on appraisal costs is less certain. Most researchers agree that appraisal costs follow failure costs. If failures increase, appraisal costs, largely inspection, will increase. On the other hand, if failures decrease, appraisal costs will also decrease, because less inspection will be required.

The early versions of the cost of quality (COQ) model described companies with less well-developed quality improvement programs where failure costs were high (60-70%), appraisal costs moderate (20-25%) and prevention costs were low (5-10%) (Feigenbaum 1991). There was a need to increase prevention costs to reduce failure costs. However, the feeling at that time was that total quality costs would decrease to a minimum point and then begin to increase as the prevention costs began to increase faster than failure costs decreased. Figure 1 shows this relationship (Juran 1993).

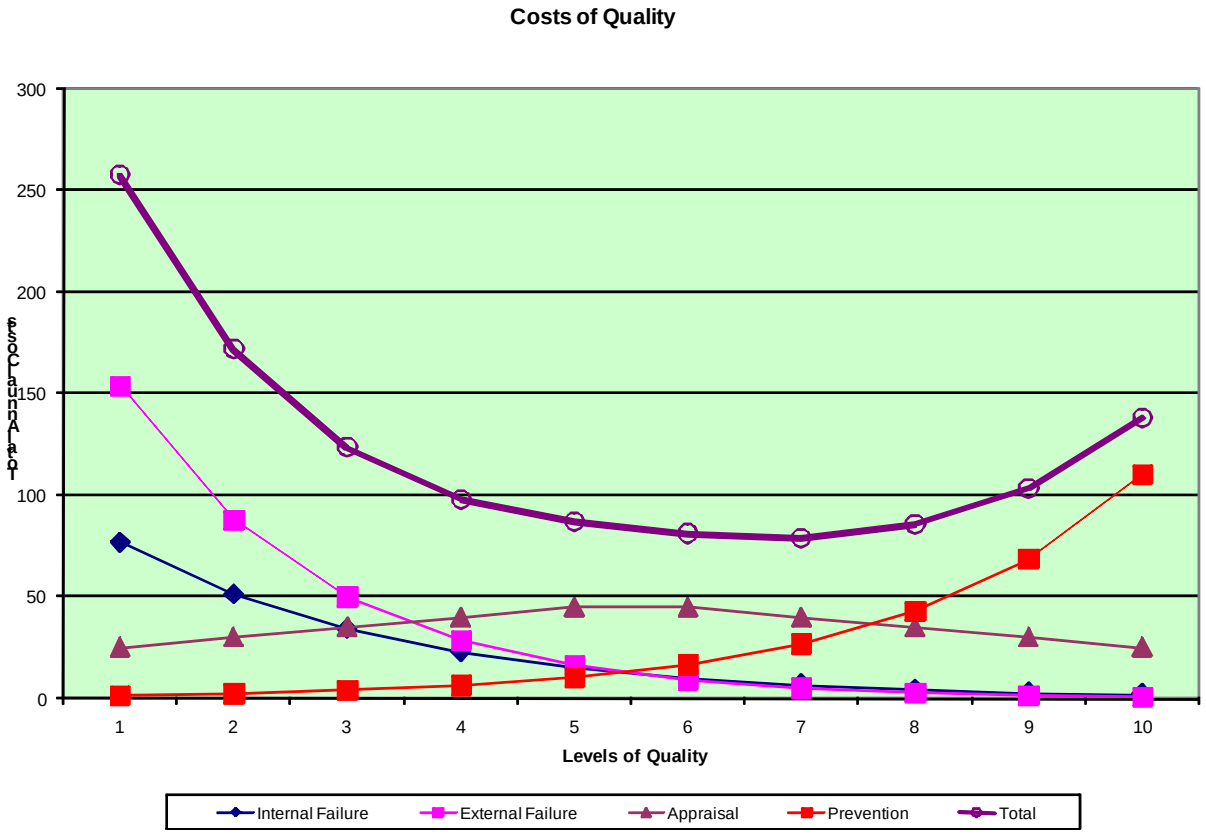

Figure 1. Cost of Quality (COQ) Model (Original)

As quality programs improved toward the end of the 20th century, and the goal became zero defects, or perfect quality, this early COQ model presented conflict, because it suggested the optimum quality was less than perfect quality. This was resolved by concluding that, as quality programs improved, the total quality cost curve could reflect this improvement, as shown in Figure 2, where the total quality cost curve continues to decrease as quality approaches perfection. Juran (1993) calls this the COQ curve in emerging processes. Freiesleben (2004) also endorses this new version and attributes it to the learning process and discovery of root causes in quality programs.

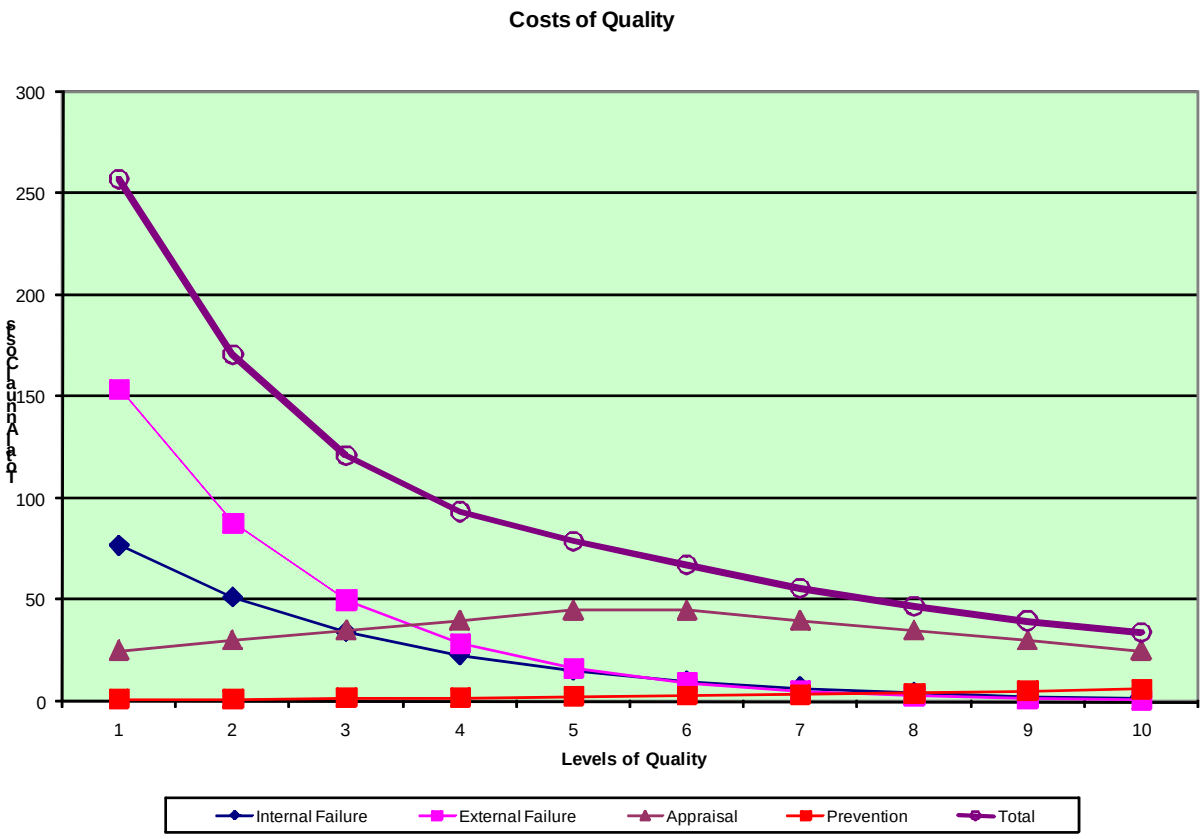

Figure 2. Cost of Quality (COQ) Model – Contemporary

However, Freiesleben (2004) warns that COQ models are not adequate for determining an economically optimal quality level, and that increased profit must be considered in addition to reduced cost benefits. We show this conceptual relationship in Figure 3. Initially, total quality costs decrease until prevention costs begin to increase faster than failure costs decrease. Eventually, as quality continues to improve and increased revenues result, profits from improved quality eventually increase faster than total quality costs increase.

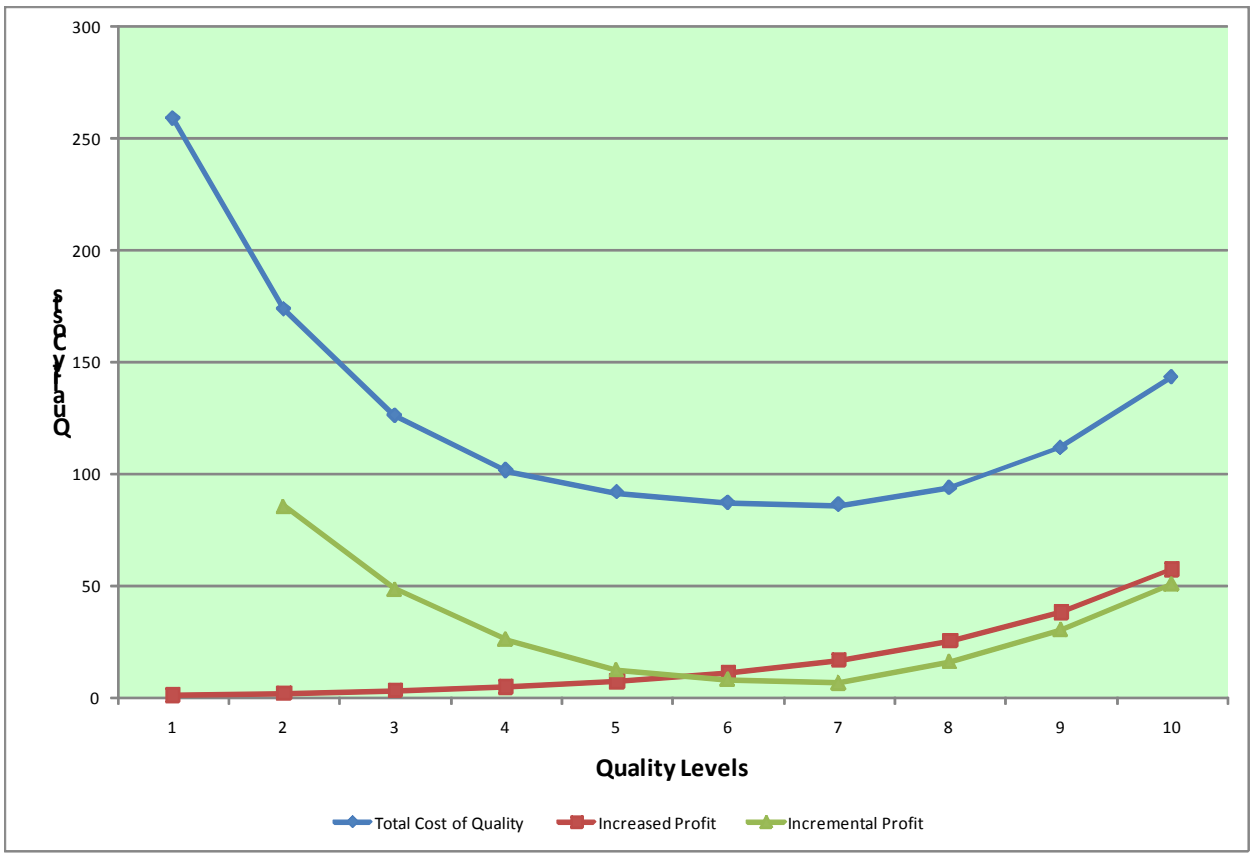

Figure 3. Incremental Profit as Quality Levels Increase

The quality cost curves shown in Figures 1, 2 and 3 represent the behavior reported by most researchers. However, there are few well-documented case histories in this area.

CRISIS MANAGEMENT

In some cases, the cost of quality failures can be catastrophic, resulting in the need for crisis management. In these cases, the considerations are more than economic; they include permanent damage to the company's capability to continue in business. Most of the attention in a crisis is focused on the reaction of customers or the public; often overlooked is the effect on the company's employees and the possible erosion of their confidence in the company and their continued willingness to stay with the company. Companies should always spend some time in trying to prevent this type of quality costs by anticipating and avoiding their occurrence. Keeping a focus on this is a test of good top management.

DETERMINING QUALITY COSTS

While conventional accounting systems may have the pieces of the total quality cost puzzle, they rarely put them together into a completed picture. Activity-based-costing (ABC) systems help because they provide more specific classification of costs than can be assembled into composite reports; however, they are not the total answer because some costs are difficult to assign to a quality problem versus to some other cause. (Evans and Lindsay 1999) Sower (2004) points out the ERP systems also can facilitate the identification and analysis of quality costs. However, some costs, such as lost sales, are not included in any type of accounting system.

Ball (2006) points out that COQ systems can be designed from the top-down or the bottom-up. He cautions that only a bottom-up system will yield actionable data and a sufficient understanding for driving operational decisions.

While a perfect quality cost reporting system may be elusive, companies should recognize they could identify the major quality costs – the vital few – and begin to measure them. They should recognize that this is only a partial solution, but it is a step toward a more complete solution (Cheng 1976). Donovan (2006) describes such a partial system for a company that makes specialty chemicals for maintenance and repair professionals.

Usually, it takes a special study or a specific system to isolate and summarize quality costs. Eldridge, Balubaid and Barber (2006) designed a quality cost classification system to provide a way for researchers to investigate quality cost behavior in a well-structured environment. However, it appears that few companies have progressed to the point of having comprehensive quality cost reports being produced on a regular basis.

Quality costs, as described earlier, represent a wide variety of cost accounts. Table 1 shows possible sources of the tangible quality costs – internal failure, external failure, appraisal and prevention. It also shows how the absence of perfect quality can adversely affect revenues and even have catastrophic consequences for a business.

Table 1. Location of Quality Costs in a Chart of Accounts

	Tangible Quality Costs				Intangible Quality Costs		
Revenue and Cost Elements	Internal failure	External failure	Appraisal	Prevention	Lost Sales	Lost Customers	Crisis Mgmt
Revenues					Easy	Moderate	Difficult
Direct costs							
Direct materials	Easy						
Direct labor	Easy			Easy			
Factory Overhead Labor							
Inspection			Easy				
Quality Assurance			Easy	Easy			
Manufacturing Engineering		Moderate	Moderate	Moderate			
Human Resources				Moderate			
Design Engineering				Moderate			Difficult
Other Factory Expenses							
Transportation		Moderate					
Returns and replacement		Easy			Moderate	Moderate	Moderate
S, G and A Labor							
Mktg. Customer Relations		Difficult			Difficult	Difficult	Difficult
Marketing - Product Design				Difficult			Difficult
Legal Services		Moderate					Difficult
Top Management		Difficult				Difficult	Difficult
S, G and A Expenses							
Warranty claims		Easy					Easy
Lawsuits		Easy					Easy
Fines and penalties		Easy					Easy
Degree of difficulty to obtain costs	Easy		Moderate		Difficult		

The accounts designated in Table 1 are somewhat arbitrary; they will vary among companies. Even though the quality cost may originate in the accounts shown, they will not be the entire account cost. Every account would have to be searched to identify that portion of costs to be assigned as quality costs. Activity-based-costing systems may help; however, they are not designed to identify quality costs, as described in this paper. Although identification of quality costs is theoretically possible, it will probably prove to be unrealistic with today's accounting systems.

QUALITY COSTS AND IMPROVEMENT PROGRAMS

Companies actively pursue a number of improvement programs. Do these programs help in the assessment of quality costs?

- **Six Sigma** is one of the most active improvement programs these days. However, Six Sigma is associated with the completion of discrete projects, each of which may help to reduce quality costs or improve revenues and the contribution is usually quantified. However, Six Sigma does not normally have preparation of quality cost reports as a prime objective.

- **Lean production** is another improvement program that requires quality improvement to be successful. Eliminating waste is an objective of lean programs. Waste includes product and service failures, components of quality costs. Therefore, reducing quality costs is an integral element of lean production; however, as with Six Sigma, lean production systems do not necessarily require quality cost reports.

- **Customer relationship management (CRM)** is a program to improve the retention of good customers. Customer retention usually requires good customer service and consistently high quality products; consequently, CRM is a program that supports quality improvements.

- **Product lifecycle management (PLM)** attempts to preserve the quality of information about products throughout their life cycles. This requires product designs that maintain value throughout their useful lives and a compatibility with sustainability considerations, such as reuse and recycling. PLM also strives for information integrity that can be used by multiple parties as the product moves through both its forward and reverse life cycles. (Crandall 2008)

- **Supply chain management (SCM**) requires the reduction of variances throughout the supply chain. One of the major variances is often product or service quality. To assure a smooth flow of physical goods, information, and funds through all participants, quality must be improved.

These, and other, programs encourage, even require, the improvement of quality. If companies are to confidently participate in these programs, they must assure themselves that improved quality reduces the cost of poor quality. Ford (2008) studied a multi-division company and classified the divisions participating in a quality improvement program as enthusiastic (positive), ceremonial (passive), and dissident (resistors). He found that the enthusiastic participants had much greater improvements than the dissident groups.

FUTURE

What does the future hold for quality costs? Competition will require continued improvement in quality levels, probably even greater than those achieved so far. Improved quality will be important, not only to reduce the tangible quality costs but also in reducing or preventing the hidden, or intangible, quality costs.

Sustainability issues will become more closely linked with quality, because of the need to reduce waste. When sustainability becomes a major driver of change, companies will be forced to pursue reductions in quality costs and will need to design systems that assure them improved quality will have an economic benefit.

Accounting will have to develop better systems. Up to now, financial, or external, accounting requirements have been more important than internal, or management, accounting needs. If companies are to continue to progress in their improvement efforts, they will have to have performance measurement systems that help them identify improvement opportunities, such as in quality costs.

Top management will have to support an integrated approach. Localized improvement programs will no longer suffice. While they are beneficial in many cases, they may actually cause increased costs in areas other than where the improvements are being made. Quality costs thinking used to involve the trade-offs between prevention and failures. Today, the consensus is that there should be continued pressure to improve quality levels to the ultimate level – to perfection. Only top management can require cross-functional participation or endorse decisions that may not have complete tangible justification.

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