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Study of Effect of Implementation of Cost of Quality System on Cost Management in Fajr Jam Gas Refinering Company

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ABSTRACT

In addition to quality enhancement, extra expenses and ineffective activities are eliminated by using CoQ system. So as a result, in addition to supply customer satisfaction, quality expenses and eventually product expenses can be reduced by using resources and facilities better and more appropriate and also by investing in preventative actions. With the aim of expanding practical knowledge about CoQ system, this research tries to study and inspect this system's execution's effects on management of expenses in Fajr Jam Gas Refinering Company. In order to do this research with the aim of identification of topics of hidden quality expenses in organization for an one – year term, quality expenses paper work was sent to units in order to completing the information. In this research correlation examination was used in order for testing theories. Furthermore software packages (EXCEL and SPSS) and descriptive statistics were used in order for analyzing data. The research's findings indicate that there's a negative correlation between prevention, appraisal costs and profit's organization with inner and outer organization mistake costs that by increasing the efforts towards prevention and appraisal activities, inner and outer organization mistake costs decrease and by using CoQ reporter and informer system, managing the expenses in order to deduct the mistake in organization and subsequently decreasing in total of costs and increasing gas sell income will be easier and more accessible.

KEYWORDS: quality expenses, CoQ system, managing expense, gas industry, Fajr Jam Gas Refinering Company

INTRODUCTION

Although implementing quality systems has become a necessity for survival in the turbid and competitive world of today, one should remember that the aim for such endeavors is still promoting organizations, maximizing resources and ensuring customer satisfaction. This aim, however, needs to be realized at the lowest costs possible. If one considers quality as a need for the promotion of a given organization, then cost of quality also becomes an essential tool to manage organizational promotion. For this very reason, familiarity with cost of quality philosophies and methods would be crucial for executives that favor promoting their organizations through paying attention to quality and strategies related thereto.

Chopra &Garg (2011) consider the co-relation co-efficient between different cost of quality categories, in a study called "Behavior Patterns of Quality Cost Categories", and propose that increasing efforts towards appraisal and prevention activities would decrease the costs of non-conformance, while there is also a negative co-relation co-efficient between conformance costs and those of non-conformance.

In another study entitled "Engineering Quality Systems: Cost of Quality" (2010), He discusses the concepts of quality control and management. He concludes that the objective for implementing a quality system is to minimize total cost of quality in order to make the largest amount of profit. Therefore, one needs to look at cost of quality systems as precious investments that assists profit making.

Quarles et al. (2007) consider the relation between cost of quality distribution, and quality system maturity of organizations in a study called "Cost of Quality Usage and Its Relationship to Quality System Maturity". Their findings show that external failure costs decrease as a percentage of total cost of quality parallel to quality system maturity, which means an increase in the appraisal and internal failure costs, while the share of prevention activities in the total cost of quality increases. As a result, as the quality system of the organization matures, the budget distribution among different cost of quality categories needs to be modified accordingly. Immature programs cause higher appraisal and failure costs, while larger prevention costs are usually observed in more mature programs. The findings of this study suggest that organizations planning to implement cost of quality systems should make sure that program management is sufficiently supported, which would inevitably lead to a short-term increase in the total cost of quality.

In his study "On the Limited Value of Cost of Quality Models" (2004), Freiesleben considers new and traditional models for cost of quality. According to this study, although cost of quality models can only

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determine the minimum cost of quality needed, it must be noted that this minimum cost level is considered equal to maximum cost in the new models.

In another research called "Obstacles of Establishing and Developing Cost of Quality Systems in Companies Manufacturing Consumer Products in Tehran Stock Market Using a Fuzzy Approach"(2010), Dehdar & Hemmati attempt to identify the obstacles for establishing and developing cost of quality systems, by sampling companies that manufacture consumer products in the Iranian central stock market for a descriptive research, using questionnaires to gather the required data from their senior executives. The findings of the research show that establishing and developing cost of quality systems will be feasible in Iranian companies if due attention is paid to variables such as increasing personnel's participation motives, informing executives and personnel, calculating costs accurately, strengthening accounting systems, promoting organizational culture to support cost assessment systems and assisting universities in regard with the subjects related to cost assessment education.

Zanjirdar et al. (2009), in their article "Analyzing Cost of Quality in Supply Chain Management", introduce supply chain, its management and the principles for optimizing it, then consider cost of quality and economic models for that purpose, and finally analyze cost of quality in supply chain management (SCM), and determine the importance and necessity of using it in organizational management programs. They elaborate that supply chain is the full process of providing products and services to the end-users, and its management includes coordinating between all the activities requisite for an operation that aims at maximum profit making. Since some of the advantages of cost of quality are lowering finished price of products, increasing competitiveness vis-à-vis commercial rivals, making investments and taking remedial measures to reach more standard conditions and optimize production, companies need cost of quality methods and increased efficiency in supply chain management if they plan to survive in the global market and provide products competitive with similar ones with lower prices and higher qualities.

In a research entitled "Cost of Quality and Its Impact on Organizational Costs" (2006), Mohammad considers, calculates and analyzes cost of quality reports, compares them with the total costs of the company, and determines the role and significance of controlling them. He states that cost of quality does not merely depend on the production process and the services of the company, and it starts from the decision to acquire raw materials and conduct marketing in the company and is continued even after the delivery of product or service to the customers. Considering the vast range of such costs, calculation and determination of their status in the current costs of a company become utterly important, and exert a degree of control on a part of costs afflicted on the organization.

Costs of Quality

Cost of quality is the total costs of a company dedicated to preventing low quality, ensuring and appraising quality requirements that need to be realized, or any other costs caused as an outcome of low quality. Cost of quality is a calculation system that translates management aspects into financial terms understood by all beneficiaries. Several studies show that cost of quality comprises around 30 percent of the total production costs (Srivastava, 2008).

Types of Costs of Quality

Cost of quality is generally classified into conformance and non-conformance costs. Conformance costs are those dedicated to providing products or services with the desired quality, and include prevention and appraisal costs, which are actually used for guaranteeing conformance of the output with the stipulated standards. Non-conformance costs comprise of those resulting from products or services provided without the desired quality, and include costs of internal and external failures. Therefore, cost of qualityis calculated as a sum of these two categories, and could be defined as the total costs spent by an entity in its various production, financial and commercial departments in order to attain a desired level of quality (Farsijani&Kiamehr, 2008).

Prevention costs pertain to activities conducted to prevent or minimize the occurrence of deficiencies or failures in products, in the different stages from arrival of materialsat the company to the delivery of the finished product. The sub-categories of these costs are:

- Quality planning: costs of preparing quality plans for production, quality master plans, quality data systems, preparing, publishing and distributing guidelines, pamphlets, and the like;
- Training: costs of identifying training demands, planning, preparing and implementing training courses required for maintenance or promotion of products quality level;
- Process design and control: costs of activities aimed at assessing potentials and capabilities of processes, and inspection of production line; and
- Reporting: costs of reporting quality, product quality status, inspection activities, and other instances of quality reporting required by medium and senior management (Dianati&Nikbakht, 2011).

Appraisal (inspection) costs are designated to determine conformance or non-conformance of product features with the desired quality level, and include the following sub-categories:

- Input inspection and testing: costs of inspection and testing of purchased raw materials;

- In-process inspection and testing: costs of inspection and testing activities conducted during the process in order to ensure conformance of output with the desired standards;
- Quality audits: costs of audits carried out to ensure validity of inspection and testing processes focusing on input, half-finished products and the final output;
- Inspection and testing equipment control: costs of controlling inspection and testing equipment, and maintaining them properly to ensure valid results;
- Service and material provision: costs of providing the services and materials required for inspection and testing; and
- Inventory quality survey: costs of quality survey of stock inventories in order to ensure their quality (Dianati&Nikbakht, 2011).

Internal failure (intra-organizational error) costsare spent for rectifying deficiencies, at various stages before the product is delivered to the customer. The sub-categories of these costs are:

- Wastes or scraps: costs of products not presentable to customers due to non-conformance with defined criteria, and cannot be used for other purposes;
- Repairs and repeated work: costs forproducts not useful due to non-conformance with defined criteria, which can be brought into conformance and be used as a result of repairs or repeating some activities;
- Failure analysis: costs of assessing and analyzing the causes of deficiencies, and implementing solutions to rectify and prevent them in the future;
- Repairs and repeated work for defective input: costs of preparing input items received from supplier, which do not possess sufficient quality and need to be resolved through repairs and repeated work;
- 100-percent inspection: costs of the 100-percent inspections neededif an unacceptably large number of defective items are observed among the output products prepared for delivery;
- Repeated inspection and testing: costs of separate inspection and testing of items that underwent repairs or repeated work to be brought into conformance with the desired quality criteria; and
- Below-level ranking: costs of selling products at a lower price due to their non-conformance with the desired quality criteria (Dianati&Nikbakht, 2011).

External failure (extra-organizational error) costs include those caused after the product is delivered to the customer, and were not identified at an earlier stage at the company, but by the customer during use, and include the following sub-categories:

- Guarantees: costs of replacing, repairing or substituting products under guarantee, including those of new products, transport and reinstallation;
- Customer complaints: costs of activities focused on responding to and satisfying customers, and the damages paid to them;
- Returned products: costs of replacing, repairing or substituting products that are returned after the expiry of their guarantee; and
- Discounts: costs of lower prices or other bonuses provided to customers for their purchasing products with lower qualities (Dianati&Nikbakht, 2011).

4. Economic Models for Cost of Quality

There are two following approaches to economic modeling of cost of quality:

Traditional Approach: In the past, traditional production processes and ideologies prevented companies from reaching a 100-percent quality and full conformance with desired quality criteria, since without prevention and appraisal activities, some degree of non-conformance always remains. In this approach, therefore, the optimum point of cost of quality is where balance is established between prevention and appraisal costs on one side and failure costs (internal and external) on the other. As depicted in Fig. 1, with the growth of quality conformance (or a decreasing number of quality deficient products), costs of prevention and appraisal rise, while those of internal and external failures fall. An increase in any of the four cost items would inevitably increase the total cost of quality, and the optimum point would be where this total amount is at minimum.

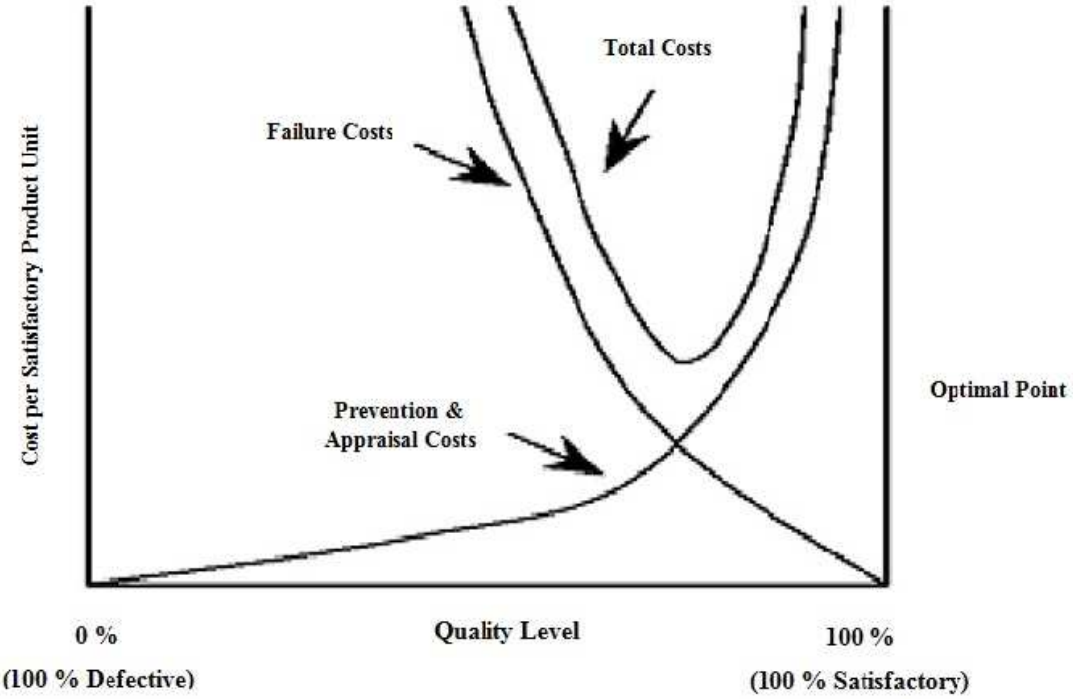

Figure 1: Traditional Economic Model for Costs of Quality

The interesting point is that the optimum point in this model would be the best economic level for the manufacturer, but that does not necessarily mean that the customer has been satisfied in every respect. Other points worth mentioning for this approach are:

a) Not investing on product conformance would increase non-conformance costs;
b) Investing on product conformance with customer expectations would improve quality and decrease non-conformance costs; and
c) Further quality improvement would increase conformance costs and decrease non-conformance costs, but it could also raise the price calculated for the product compared to the similar products in the market (Dianati&Nikbakht, 2011).

Fig. 1 also shows that low cost of quality (related to internal and external failures) decreases with promoting quality levels, and here, the costs of realizing desired quality (related to prevention and appraisal) rise. The total function of costs, comprising the two categories has a parabolic curve, and according to Juran, reaching minimum costs would mean optimal quality in economic terms. This cost-quality model generally fosters the understanding that the optimum point of quality would be located anywhere below the maximum (Freiesleben, 2004).

Contemporary Approach: With the technology advancements today, companies have acquired higher capabilities than the traditional processes, and are now able to reach a quality level 100 percent in conformance with the requirements. In this approach, therefore, the optimum point would be where failure costs are eliminated, and the total cost of qualityequals those dedicated to prevention and appraisal. Thanks to the 100-percent conforming quality provided in this model, the customers' expectations are also completely satisfied (Dianati&Nikbakht, 2011).

The new cost of quality model (Fig. 2) depicts a quantitative increase in appraisal and prevention costs, and designates a higher priority for new technical and preventive solutions, which minimize errors and enable efficient supervision of the processes. The total costs curve has a negative gradient, and the optimal cost would be moved towards the desired quality level (Freiesleben, 2004).

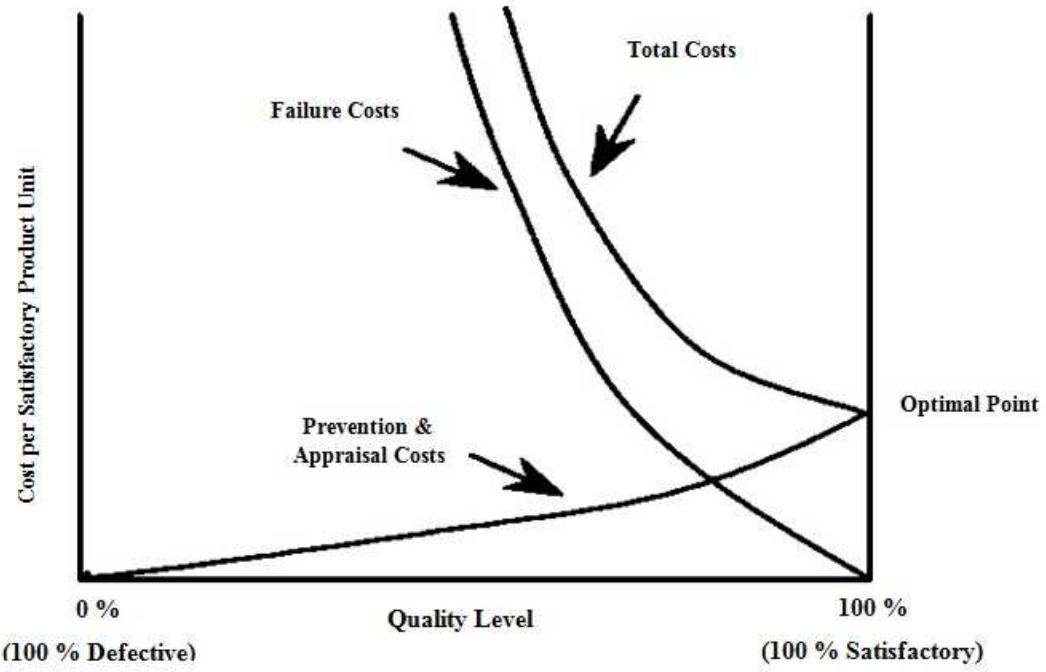

Figure 2: Contemporary Economic Model for Cost of Quality

Why Don't Companies Follow Cost of Quality?

The most common reason for not following cost of quality is absence of managerial support or willingnessto follow such costs, especially when the management is not informed about the volume and manner such expenditures. The company's management and culture philosophy may not support cost of quality, which is regarded as a bureaucratic process without any special use or value. A second reason would be poor economic conditions or status of the company, which would nurture the reluctance towards assessing cost of quality. This is typical of newly-founded companies of small size and low resources. Lack of information on how to follow cost of quality and the benefits of doing so can yet be counted as another reason. Studies show that lack of knowledge about elements involved in cost of quality, about quality principles among senior to lower levels of the organization, and absence of experienced work force to conduct these tasks could be counted as the most common reasons for organizations not following cost of quality. Other prevalent reasonsare absence of accounting and IT systems suitable for this purpose, (which makes gathering, organizing and reporting cost of quality impossible), absence of accounting mechanisms in the financial reporting systems to follow cost of quality, and the inability of accounting systems and available resources to conduct standard calculation of the cost of quality needed for that industrial sector (Quarles et al., 2007).

Quality Account Balance

Quality account balance shows cost of quality in Rials, and manifests the relation between them, which can justify the efficiency of a company's cost of quality system if compared with balances of consecutive years. Increasing prevention and appraisal costs would decrease internal and external failure costs, and vice versa. Therefore, internal and external failure costs are calculated on the right side of the quality balance, and those related to prevention and appraisal on the left. Since the costs on the right side are usually higher than those on the left, the quality account is balanced by displaying the difference between the two sides as "occurring controllable qualitative costs", and its decrease in the long run would be interpreted as evidence for efficiency of cost of quality system in place. The external failure cost, in Rials, is of utmost importance, since the problems occurring after the product has been delivered powerfully prove the quality control methods to be inefficient and inadequate, which could in turn be improved through following and increasing budgets for prevention, quality planning, design and control of inspection processes, and reporting. It must be noted that reporting cost of quality is useful only when the receiver of the report is able to understand it and make proper use of its contents (Dianati&Nikbakht, 2011).

Case Study and Research Hypotheses

Bearing in mind the interest of various industries, including gas industry, in using the latest standards, and their emphasis on establishing quality management systems in their organizations, improving quality and quantity indices, satisfying partners, beneficiaries and foreign customers, and thus promoting market share of Iran in exporting gas, the need is felt for a product with such a quality that would guarantee growing foreign revenues from selling gas to neighboring States and Europe, as well as the growth of gas industry. For this

purpose, it seems imperative to elaborate on the advantages of using this tool (cost of quality system) and publish the findings in order to inform executives and experts, which serves as a guide on how to implement it and enjoy the results. In order to consider the impact of using cost of quality system on cost management in the company under study, and identify the internal relationship between different categories of cost of quality, this paper proposes the following hypotheses:

1. There is a significant relationship between prevention costs and costs of intra-organizational errors in Fajr Jam Gas Refinery Company;
2. There is a significant relationship between prevention costs and costs of extra-organizational errors in Fajr Jam Gas Refinery Company;
3. There is a significant relationship between inspection costs and costs of intra-organizational errors in Fajr Jam Gas Refinery Company;
4. There is a significant relationship between inspection costs and costs of extra-organizational errors in Fajr Jam Gas Refinery Company;
5. There is a significant relationship between intra-organizational errors costsand cost management in Fajr Jam Gas Refinery Company; and
6. There is a significant relationship between extra-organizational errors costs and cost management in Fajr Jam Gas Refinery Company.

Research Analytic Model

This research includes independent variables (prevention costs and inspection costs), dependent variables (management costs, including revenues from selling products and services, finished price of products and services, and selling, official and general costs), and medium variables (costs of extra-organizational errors and intra-organizational errors that serve as dependent variables for prevention and inspection costs, but as independent ones for management costs). In the hypotheses 1 to 4, the relationship between different categories of cost of qualityis considered, using the model provided by Chopra &Garg (2011). Moreover, the relationship of the costs of extra-organizational and intra-organizational errors with cost management is taken into account, which is added by the hypotheses 5 and 6 to the mentioned model as new statements.

Materials and Methods

In order to do this research with the aim of identification of topics of hidden quality expenses in organization for an one – year term, quality expenses paper work was sent to units in order to completing the information. In this research correlation examination was used in order for testing theories. Furthermore software packages (EXCEL and SPSS) and descriptive statistics were used in order for analyzing data

Results and Discussion

Several studies have been conducted around the world on cost of quality systems. The findings related to the first four hypotheses agree with the findings of Chopra &Garg (2011), who had pointed in their article "Behavior Patterns of Quality Cost Categories" that increased efforts towards prevention and appraisal activities would decrease the costs of extra-organizational and intra-organizational errors. Moreover, the findings of hypotheses 5 and 6 agree with those of He (2010). In his article "Engineering Quality Systems: Cost of Quality", he had discussed the concepts of quality control and management, andhad concluded that the objective for implementing a quality system was to minimize total cost of quality in order to make the largest amount of profit. The present research also found out that the consequence of reduced cost of quality (namely, non-conformance costs) as a result of establishing a cost of quality management system in the company being studied would be increased profits.

Conclusion

The findings of the research depict the existence of a negative correlation among prevention and appraisal costs and organizational profit, and the costs of extra-organizational and intra-organizational errors, in the manner that increased efforts towards prevention and appraisal activities would decrease the costs of extra-organizational and intra-organizational errors. Furthermore, employing information systems and reporting cost of quality(cost of quality tables, reporting proportions, etc.) would facilitate managing costs in order to minimize errors in the organization, and thus reduce total costs while increasing revenues from selling gas at the same time.

Table 1: Research Findings

Month	Intra-organizational Errors Costs	Extra-organizational Errors Costs	Inspection Costs	Prevention Costs	Cost Management (profit)
Farvardin	7,623,486,877	4,740,540,436	2,012,191,168	15,465,701,839	17,506,817,124
Ordibehesht	7,903,762,130	4,894,118,873	1,936,417,876	14,912,350,234	15,472,077,738
Khordad	7,847,707,079	4,871,886,854	2,017,622,524	15,031,318,769	16,287,988,087
Tir	8,408,257,585	5,174,616,159	1,894,312,067	14,982,553,364	14,625,948,486

Mordad	8,316,531,138	5,124,427,365	1,906,977,214	14,729,778,311	16,398,790,727
Shahrivar	7,735,596,978	4,822,457,914	2,100,103,140	15,411,193,087	16,439,082,596
Mehr	8,464,312,635	5,247,235,417	1,922,372,412	16,030,668,040	15,069,159,047
Aban	8,520,367,686	5,255,728,085	1,828,874,865	14,669,572,196	15,955,580,167
Azar	8,071,927,281	5,004,211,619	2,059,185,920	15,483,105,636	15,290,764,327
Dey	8,744,587,888	5,367,027,433	1,945,495,946	13,936,264,661	15,623,172,247
Bahman	7,399,266,675	4,596,044,526	2,086,450,545	16,021,310,904	17,285,211,847
Esfand	7,827,323,425	4,855,594,801	1,854,719,967	15,641,695,032	15,512,369,607

Table 3: Cost of Quality& Profits of Organization in Iranian Year 1378 (April 1999 – March 2000)

Relationship between Cost of Quality Categories (Research Hypotheses)	Pearson Coefficient	Significance Level
Costs of prevention & intra-organizational errors (hypothesis 1)	- 0.597	0.04
Costs of prevention & extra-organizational errors (hypothesis 2)	- 0.623	0.03
Costs of inspection & intra-organizational errors (hypothesis 3)	- 0.618	0.032
Costs of inspection& extra-organizational errors (hypothesis 4)	- 0.628	0.029
Costs of intra-organizational errors & costs management (hypothesis 5)	- 0.653	0.021
Costs of extra-organizational errors & costs management (hypothesis 6)	- 0.646	0.023

(significance level 0.05)

Recommendations Based on Research Findings

- Reviewing items related to conformance and non-conformance costs periodically is crucial, since competitive conditions are changing continuously, and the organization requires a preemptive approach for being prepared for such changes, in order to survive and prosper in the market;
- By employing an appropriate reporting system to gather data for the cost of quality system and report the operation results to the management, executives would become aware of waste and areas of improvement, easily plan and execute their remedial measures according to priorities, and gradually bring errors and waste to a minimum; and
- Under a dexterous preventive system, the organization could advance towards comprehensive quality and zero defects (100-percent quality) in its products and services, since preventive measures promote the quality level and thus minimize appraisal and failure costs.

Recommendations for Future Research

- Research on how successful companies make decisionsrelated to promoting quality, and reducecost of quality. More comprehensive studies are specially needed to gather and assesscost of quality in practical areas, in order to collect useful data on the best practices for cost of quality. This will encourage companies to report their cost of quality data, and assist them in implementing comprehensive cost of quality systems; and
- The resource planning system and activity-based costs assessment systems provide for appropriate data systems for companies in order to follow their cost of quality. The impact of running such systems on the willingness of executives to establish cost of quality system is another important issue that needs to be considered and studied in future research.

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