CHAPTER II

LITERATURE SURVEY

2.1 COST OF QUALITY SURVEY 1:

Kalagnanam, Suresh S., and Ella Mae: Cost of quality in an order entry department, Journal of quality management, Vol.9 Issues 3, 1999

This article discusses the quality cost study in an order entry department of a manufacturing company, Precision system Inc. Typically, an order entry department receives customer orders from sales, records them in the computer and forwards them to either manufacturing or stockroom for further processing. Consequently, the quality is depended upon time.

However, it usually founded that the order may back and forth from one person to person after sale issues an order documents to the order entry, as s result the time was up to 2 days, while the actual would be done by 15 minutes only. These makes a lot of money spends on it, so called a poor quality. In addition, poor quality refers to poor information for further processing of order or quotation

For example:

1) Part number or price does not available on the quote request.
2) Freight or payment term s missing on the customer's purchase order.
3) Credit approval not obtained.

The cost incurs to time spent by order entry staff and concerned employees in other departments to correct quality error. A typical error is an incomplete customer address on the order statement, which customer that do find errors on their invoices often use the errors as an excuse to delay payments and return the goods under 30-day return right. Interestingly, over 66% percent of time are this kind of errors. The cost is around 15.7 percent of the order entry department's annual budget exclude the cost of items such as telephone, opportunity costs as well as loss of sales and loss in goodwill. Note that according to estimates by a leading Japanese industrialist, the true losses can be up to six times of the measured losses as mentioned.

Consequently, the quality cost information is essential to develop a system for identifying order entry errors and to determine how much an order entry error

costs. The effort is a catalyst to accelerate the further improvement processes. The information was collected through:

1) Discussions and interviews with employees, who are in and outside the order entry department. The order entry staff or supervisors may identify this kind of error.

2) Documentary evidence

3) A two-week sample data

The cost of quality results to significant changes in order entry processes such as:

1) The preparation of order or quotes and order for demonstration systems. The company established a on-line configurator that their staff will no longer key in part numbers, product name and other essential information. And, To prevent the duplication of quotation number and this redundancy also effects to the duplication of purchasing documents, which are issued by manufacturing. A quotation numbers would be provided into the purchase order though the computer program.

2) Establish tools for order entry's working standard such as Procedure manuals and guidelines for sales discounting.

These tools provide a standardization of procedures and help to reduce the cycle time of preparing quotes or orders.

Implementing cost of quality system, the company benefits to provide a good starting point for improving the process quality and ending out to evaluate managerial performance. The quality cost is important tools for cutting across departmental boundaries, since COQ information provides a pinch effect of improvement effort.

2.2 COST OF QUALITY SURVEY 2:

Gee-Hyun Hwang & Elaine M. Aspinwall: The development of a quality cost model in a telecommunications company, Total Quality Management, Vol. 10, No. 7, 1999

The paper explains the establishment of the quality cost model in a company, which produces telecommunication facilities. Because of the telecommunications today, the market environment changes. Both international and nationally company presents higher quality of services with lowest cost to their customers, as a result the company have to investigation both cost and quality at the same time through their

working activities such as R&D, re-engineering, benchmarking and others. In addition, the study is introduced under a continuous improvement policy, which approaches to both Kaizen and Deming PDCA cycles.

The study was based on British Standard, BS 6143: Guide to the economics of quality. The British Standard Institution introduced this standard in 1990. The BS 6143 is classified quality costs into 3 main categories: Prevention, Appraisal and Failure so called PAF model. The model can be viewed as both macro and micro that the former is focused on the relationship between external customer and suppliers whereas the latter is focused on internal customer and suppliers within the organization. The researcher also explained that the advantages and disadvantages of both macro and micro PAF model. The macro PAF is weak in identifying the causes of quality problems, whereas the micro PAF can do. However, both of micro and macro models are required to determine key quality problem areas in the company.

The primary part of the study focused on collecting the necessary information and interviewing employees to build up more comprehensive view of cost and quality for preparing the quality cost checklist. The checklist comprise of:

1) Business or quality management policy and strategy
2) Structure of manpower
3) Type of product produced
4) Organizational structure
5) Brief accounting information
6) Quality management system
7) Application of quality improvement techniques
8) Quality problems on the production line
9) Working and quality activities in each department
10) Inspection and test type
11) Scrap management
12) Trouble shooting and failure analysis
13) Warranty policy
14) Supplier management
15) Delay and waste elements
16) Complaints due to defective products or faulty installation

This first data collection establishes useful quality cost information. The followings are the example results from visits.

1) The costs of quality management system had not been properly identified, and the manpower, system and facility management, etc generated the overhead costs.

2) All quality activities and their associated costs related to the production and inspection activities.

3) The quality improvements were not restricted to the Quality departments, but were carried out by several departments such engineering and purchasing.

From the organizational viewpoint, the quality costs were divided into 2 categories: direct and indirect to production as shown in Figure 2.1. The direct relation to production was defined as production quality costs, while the indirect relation to production was defined as quality system management costs. Consequently, the checklists would be developed on the basis of a department or function to include hidden quality costs.

In figure 2.1, the cost of quality should be carried out in 3 categories: Total organization, department and specific processes. At the department or process level, the quality costs are applied majority by production department, so called specific cost, while the reminder the quality costs lean on sharing of common activity, so called micro PAF model. However the micro model is sophisticate depended upon cost interaction, IDEF0 is recommended in the paper as a useful tool for developing the quality cost model, since they allows all working activities in a department to be summarized on one diagram.

The model composes of:

2.2.1 Quality system management costs, QSM

The costs are spent on managing, updating and maintaining a quality management system, which are not directly associated with the production and can not be attributed clearly to a particular product. Consequently, they are recorded in a common area, not production; as a result their cost allocation to individual products is depended upon time-consuming. The cost involves the effectiveness and efficiency of documentation processes, training, and manpower management. This cost effect is long term and most of them are evaluated by using macro PAF, while the rest is using micro PAF. The elements of QSM costs are shown in table 2.1.

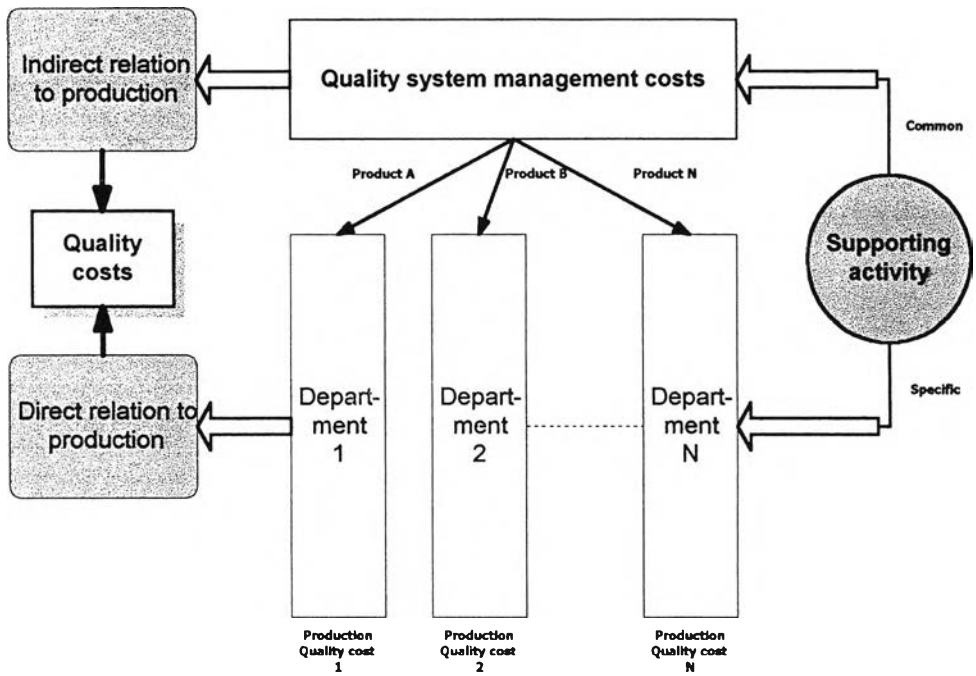

Figure 2.1: Structure of the quality cost model

Source: Total quality management, vol. 10, No.7, 1999

Table 2.1: Quality system management costs

Source: Total quality management, vol. 10, No.7, 1999

Category of quality costs	Detailed elements
Inspection or test of parts and material	● Normal or authorized inspection
	● Clearing anomaly in supplier's goods
Quality audit of supplier	● System, process, or follow-up audit
	● Product audit of new or subcontract suppliers
Internal quality and system audit	● Quality, follow-up and system (health, safety and environmental systems) audit
Customer's quality audit	● Mercury, BT, BSI, etc.
Material management or handling	● Material scheduling (coding) error correction
	● Design change-related activity
	● Material rejected from inspection or test
	● Analyse a pre-shortage report (material demand error)
	● Update the material management programme due to scrap
	● Stock verification review
	● Deliver and receive warranty repair meterial
	● Unplanned order for warranty repairs
	● Unplanned order for repacement due to scrap
	● Unplanned order due to obsolete/excess write-off
Supplier management plan and analysis	● Planning activities (instructions, task)
	● Identify the correct routing of materials
	● Analyse vendor's performance report
	● Liaise with suppliers on quality issues
	● Technical assistance
	● Claim warranty
	● Concession on non-conforming goods
Packaging inspection	● Inspection of packaging of materials or products
Supporting activity	● Hold meetings with customer representatives
	● Assist customer or external audits
	● Notify each department about customer's complaints
	● Investigate and analyse quality problems and field failure
	● Investigate and approve concessions and change notes requested
	● Monitor and analyse results of tests and inspections
	● Identify and monitor corrective actions for field failure
Documentation working process	● Plan and update tasks, procedures and instructions
	● Evaluate or validate new procedures or task plans
	● Meeting to review working procedures or plans
	● Analyse/check performance data against targets
	● Evaluate or approve individual tasks and works
	● Report quality or performance data
	● Correction and rework
Education or training	● Establish and analyse plan for education and training
	● Investigate the demand for education and training
	● Evaluate the effect of education and training
	● On-the-job training
	● Difficult test and inspection skill
	● TQM (teamwork, leadership, etc.)
	● Statistical tools (statistical process control, Taguchi, Sampling, etc.)
	● Human resources management
	● Technical reading for self-improvementj on the related job
	● Strategic management (mission and statement)
Quality improvement activity	● Quality improvement activity

Table 2.1 (Continue)

Category of quality costs	Detailed elements
Quality information management	● Developing or reporting software
	● Purchasing software system and supplies
	● Maintain and check the system regularly
	● Review and analyse inspection or test data
Manpower management	● Reschedule work due to staff shortage
	● Resolve staff problems
	● Survey employee's attitude/satisfaction
	● Discussion with union
System/procedure management(failure)	● Production and test facility
	● Supply or materials
	● Document/standard
	● Computer system or software
	● Information/data

2.2.2 Production quality costs

As mentioned earlier, some quality costs are directly related to the production, inspection and configuration certainly the cost majority comes from the production and inspection areas, additionally the costs are also include the costs of supporting activities such as quality improvement, which occur from other departments not production. For example: engineering change, warranty, scrap and maintenance as well as calibration as shown in table 2.2. This kind of quality cost collection is purposed to investigate the production system dealing with many products. The quality cost elements is translated into production-related elements.

2.2.3 Departmental quality costs

This cost collection is based on micro PAF model, which provide the detail of quality cost, while still use the same failure categories, except prevention and appraisal are broken down into prevention, appraisal and failure again using internal customer and supplier relationships. For example: Both material management and supplier audit are applied to the material department only, while the costs remain hidden between material department and quality control such as waiting time, approval process and etc.

Table 2.2: Production quality costs

Source: Total quality management, vol. 10, No.7, 1999

Category of quality costs	Detailed elements
Sequencing, Kiting and board preparation, Screen print and Surface mount placement	• Operation and prevention
Surface mount solder	• Checking and inspection
Auto, pin, radial or manual insertion	• Rework and repair
Flow solder operation by manual and In-circuit test, Build and test	
Final inspection (100%), Audit and	
Configuration	• Review customer's requirements/sppecifications
	• Inspection before configuration/test
	• Configuration/test
	• System test (test of completed unit)
	• Quality audit
	• customer acceptance test
	• Make damage/defect lists
	• Rework after configuration and system test
	• Rework after qualtiy audit
Delay	• Delay due to machine, system fault and material shortage
Change control	• Analyse or review the purposed change notes
	• Plan and check the implementation of changes
	• Management of the order and material management programme
	• Ensure all necessary build levels and documentation
	• Total material purchased
	• Rework on items in WIP and finished goods and units shipped.
	• Tooling, new or modified
Warranty costs	• Repair, inspection and quality audit
Scrap	• Modular scrap
Clibration	• Planning calibration
	• Calibration of automatic test equipment
	• Calibration of electrical test equipment
Maintenance	• Planning maintenance
	• Preventive (scheduled) maintenance)
	• Preventive (unscheduled) maintenance)
	• Technical assistance to product engineering
	• Assist with commissioning of new test facilities
	• Identifying and disposing of obsolete equipment
Others	• Failure analysis and correction of the multiplex system
	• Process (in-liine) audit
	• Design and development of measurement equipment
	• Rework due to engineering or design changes
	• Re-establish production schedule due to miscarried material parts material parts
	• Re-establish production schedule due to insufficient stock

2.3 COST OF QUALITY SURVEY 3:

McGuire, Brian, Kocakulah and Mehmet: Determining the cost of quality in the poultry industry, Journal of Cost Management, Vol.12 Issues 2, 1998

This article examined the cost of quality of palletized feed in the poultry industry, since the cost of quality activities distributed into the company's operation such as equipment, labor, inspection and rework costs.

Determining the quality, the company has the opportunity to decrease its feed costs by improving pellet quality. This paper is an excellent case study on how to the costs of quality can be examined various alternative strategies to improve quality and capacity. Typically, the study is based on Valley Farm, which was the third largest poultry company in the nation, palletizes all feed that is fed to chickens and turkeys. Especially, 95 percents of the feed manufactured are pelleteded and fed to those creatures.

To decrease feeding cost, the pellet quality is significant important because it effects to a balanced diet of the bird. Furthermore, pelleting the feed will reduce the microbial population in the feed due to cooking process of making the pellet. Diseases are such as Salmonella, which is causing of the food poison and typhoid as well as paratyphoid fever both in human being and domestic animals. The Salmonella will be killed during this process that makes the meat safer for the customer. Because the feed is cleaner than traditional method, Mash feed.

The mash feed has tendency to be wasted by falling out of the feeders, and it can get stuck in the storage bins, which causes feed to not be dispensed to the birds. The animal may dead from this dangerous crisis. In addition, the new feeding techniques benefit to reduce the infections to the animals themselves and improve the betterment of animal health and their extinction rate.

Moreover, the company has an investment in quality assurance department as well. A quality assurance supervisor, QA, audits each batch of feed after the pelleting process that helps to ensure the pellet quality. The quality test also removes all of fine dust from the feed that caused of old milling equipment affecting to pellet quality as well.

In short, the purpose of the study is to determine the cost of pellet quality and to suggest some reasonable economical approaches to increase its quality; as a result the bird performance is better with high profitability.

2.3.1 Analysis of Quality and costs

The company's profits are depended upon the health of the animal flock during the production process. If the bird is unhealthy, costs increase and resulting to profits decrease. Nowadays, the feed cost is most expensive of the three basic costs, which compose of Medication, Feed and Poult costs. The feed cost is affected by following factors.

1) Waste in the building
2) Spoilage due to bacterial growth on the fines
3) Bird not converting the feed as well due to an imbalanced diet
4) Bird mortality

These factors relate directly to pellet quality and cost. This results no ways to achieve over 95% of a pellet quality. Higher quality problem greater cost Currently, the company is milling at 75% level of pellet quality, and the production cost is $6.347 per ton manufactured, while the 85% of pellet quality the production cost is saving around $0.225.

The best option for the company should be use 85% level of screening method. The cost would be $5.805 per ton as compared to the current cost is $6.347, and the company will save over $24,200. This gaining would be helped to return on quality in less than two years.

2.4 COST OF QUALITY SURVEY 4:

Sandoval-Chavez, Diego A.: Using opportunity costs to determine the cost quality: a case study in a continuous-process industry, Engineering Economist, Vol.43 Issues 2, 1998

The study focuses on cost of quality in a firm in production process of concrete blocks for continuous improvement by using the Cost of Quality model, COQ. In the study, the COQ composes of 2 main components: Traditional prevention-appraisal-failure expenses, so called PAF model and opportunity losses, which were broken down into three components: Underutilization of installed capacity, inadequate material handling and poor delivery service.

In addition, the company has to pay a lot of expenses to recover the quality of its product from failures or to assure the quality of products. Especially, the extra expenses are also incurred to the product cost.

The author conducted six-month study with purposing to evaluate the strategic and economic for COQ to achieve continuous improvement. Identifying opportunity for improvement, the product quality is a significant improvement.

In the continuous process, a mix of calcareous material, gravel, cement and water is blended in a rotating container and transported via conveyor to a die. Forming the mixed material, the pressure is applied to be the blocks and then transported on pallets to a hardening chamber. Lastly, a forklift transports the hardened blocks to trucks for delivery to construction sites.

Even though the process is somewhat easy, the problems are usually happen for instant: Delays on payments and unplanned shortage of cement. these problems affects the company's operation and its liquidity.

2.4.1 Identification of opportunity factors

The preliminary study of the manufacturing process assumed that all the blocks achieve specifications, delivering 100% of quality of conformance and No defective blocks to identify the core quality characteristic. The quality characteristics that are explored is block height and compression load.

Consequently, the core design is the mold because no way of block height different from the mold. Besides, the ingredients, mixing process and compressive load specification including time consumption effects to its compression. From these factors: Mold, ingredients, mixing process, compressive load and time consumption are the cause of lost opportunity.

The study also focused on the accounting term, the author analysis those elements in which the company potentially could have made more income and revenue if it could take full improvement to them.

2.4.2 Quality cost model for the company

The author also developed the company's total cost of quality model based on the detail information in the company. As recommended in the standard BS6143, opportunity losses were embodied in the traditional COQ expenses. The study presents 9 models of new COQ. The following is a sample of 2 models.

2.4.2.1 Model 1: Total Cost of quality

This model is the summery of total COQ.

$$C[Sub\ T] = C[Sub\ P] + C[Sub\ A] + C[Sub\ F] + C[Sub\ O]$$

1) C [Sub T] is Total COQ expressed as revenue lost and profit not earned.

2) C [Sub P] is Total expenses in prevention items.

3) C [Sub A] is Total expenses in appraisal items.

4) C [Sub F] is Total expenses in failure items.

5) C [Sub O] is losses caused by opportunity factors.

2.4.2.2 Model 2: Opportunity cost, not earned in profit caused by inadequate material handling

This model describes how to measure the opportunity cost of inadequate material handling support.

$$C[Sub\ OM] = Q[Sub\ BI] + Q[Sub\ BD] * S[Sub\ W]$$

1) C [Sub OM] is opportunity cost caused by insufficient material handling.

2) Q [Sub BI] is total units broken because of in inadequate material handling.

3) Q [Sub BD] is total units broken because of inadequate material handling during delivery.

4) S [Sub W] is weight average profit per unit