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Cost of quality: findings of a wood products' manufacturer

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Abstract

Purpose – Today substantial investments are made to improve the bottom line and cost of quality (CoQ) is a tool that identifies weaker areas where these investments should be directed. In literature, the authors find various CoQ models and their applications but it is deficient in providing a standard format of a "Quality Cost Procedure" for a CoQ program's company-wide deployment. A procedure was thus developed and its effectiveness was evaluated implementation. The paper aims to discuss these issues.
Design/methodology/approach – CoQ program was implemented in the production department of a wood products' manufacturer using the action research approach. Prevention, Appraisal and Failure Cost model was employed. Data collection was challenging, however, stakeholders were interviewed, data were acquired from Management Information System and various reports were reviewed for cost elements.
Findings – Total CoQ as a percentage of sales was found to be 11, while as a percentage of material cost was 15 percent. It was found through the implementation that development of a quality cost procedure is highly iterative in nature and a standard format is proposed in the Appendix. This procedure worked satisfactorily and the company is confident in moving to the next phase of company-wide deployment of CoQ Program.
Originality/value – A robust "Quality Cost Procedure" is developed, which not only helped the company but will serve CoQ implementers in their operational as well as tactical levels of management. CoQ implementation prior development of procedure brought conviction and accredited it. Practitioners can mold this procedure as per need, which will further enhance the body of knowledge on CoQ.

Keywords Pakistan, Manufacturing, CoQ, Cost of quality, Quality cost procedure, Quality costing
Paper type Research paper

1. Introduction

In this increasingly competitive world, companies would like to improve the quality of their products and services for their customers while keeping a cautious eye on the cost factor. It is the trade-off that practitioners and researchers are interested in and one tool – "cost of quality" (CoQ) – has the functionality to focus on this trade-off. The accumulated dollar value of all the costs incurred on quality improvement programs can be considered as investment in quality. This investment is a company's resource and must be utilized in an effective way to get the most out of it. Hence, it is essential to identify the key areas that need the deployment of quality investment, and CoQ identifies these areas. To implement CoQ, throughout the company, requires the development of a "Quality Cost Procedure" which makes this a straight forward activity.

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In literature, we find various CoQ models and their applications (Chopra and Garg, 2012; Hwang and Aspinwall, 1996; Moen, 1998; Plunkett and Dale, 1988; Schiffauerova and Thomson, 2006), however it is deficient in providing a clear-cut standard format of a "Quality Cost Procedure." There are pointers and indicators though for its development (Campanella, 1999) but not a standard that can be used at the operational and tactical level of planning. The lack of a readily available standard procedure makes it difficult for the implementers to focus on the key aspects of a CoQ project.

This study aims to develop and evaluate the effectiveness of a "Quality Cost Procedure." It is previewed that such a procedure will aid practitioners and researchers involved in CoQ implementation to better plan this effort and which will become a guide in every step of this exercise. To better achieve this objective, i.e. to develop a practical procedure, it was necessary to first implement CoQ in a company or in one of its departments using the action research approach and then develop a universal quality cost procedure after iterations. If the CoQ program will be unsuccessful then it will create doubts about the procedure developed during its implementation, and vice versa. CoQ implementation prior development of procedure brought conviction and credibility about the established procedure for the case company. Therefore, first the findings of CoQ implementation in a wood products' manufacturing company are presented and then the established procedure.

2. Literature review

2.1 CoQ

Different definitions of CoQ exist in different industries and among researchers. Hwang and Aspinwall (1996) argued that these definitions can be classified into four classes: zero failure, quality assurance, quality standards and social element. These definitions change the scope of CoQ from limited to failure costs to a definition where operations' costs are also part of CoQ. Machowski and Dale (1998) and Roden and Dale (2000) reported through surveys in manufacturing companies that there are confusions about its basic definitions and terms throughout the hierarchy. Surprisingly, most senior managers failed to define the terms correctly. Comprehension and definitions of CoQ have changed over the years. This is an evolutionary process, as there were criticisms in the past on some CoQ concepts, which transformed to develop the connotations that we have today (Hwang and Aspinwall, 1996; Williams *et al.*, 1999). However, the authors prefer the definition proposed by Campanella (1999): CoQ is "any cost that would not have been expended if quality were perfect."

CoQ is a comprehensive program that encompasses the activities performed in the organization as a whole, therefore Lari and Asllani (2013) suggested to use it as an overall measure of organizational performance. It reveals weaker areas in terms of monetary value – language of top management. CoQ, as a performance measuring tool, is a growing need due to its direct relation with continuous improvement (Hyland *et al.*, 2007) and organization's financial goals. So, implementation of the CoQ system can bring bottom line improvements (Chopra and Garg, 2012; Srivastava, 2008). Eben-Chaime (2013) and Al-Dujaili (2013) have discussed the impact of quality improvements on cost and productivity. This discussion is important as far as the basic notion of – "quality enhances productivity and reduces cost" – is concerned. In total quality management process, CoQ program has focussed on customer satisfaction while tracking the cost to achieve it. A CoQ program is not responsible for quality improvements; rather it provides input and feedback to quality management program which is responsible for improvement (Campanella, 1999; Chiu and Su, 2010).

2.2 CoQ models

After Juran proposed the concept of quality cost in 1951, substantial work on CoQ has been done by numerous researchers and practitioners who developed different approaches to measuring CoQ. Schiffauerova and Thomson (2006) classified CoQ models into four basic groups: Prevention, Appraisal and Failure Cost (P-A-F) model or Crosby's model, opportunity cost models, process cost models and Activity Based Costing models. Hwang and Aspinwall (1996) has added cost-benefit and Taguchi loss function to the list of CoQ models. Dahlgaard *et al.* (1992) gave another classification of CoQ in terms of its visibility, as: visible and invisible costs. An authoritative critical account of the basic models was presented by Plunkett and Dale (1988), which also highlighted the shortcomings. These models guide in developing cost categories and then finding and placing cost elements in suitable categories. Johnson (1995) presented a list of cost elements (for "Price of Conformance" (POC) and "Price of Non-Conformance" (PONC) categories) found in literature.

Numerous case studies are found in literature where one or more of the above defined CoQ models were implemented. Schiffauerova and Thomson (2006) analyzed various CoQ models and their implementation along with results (using an extensive literature survey). These implementations are both in manufacturing and service industries, as discussed in Kaplan (1988), Sandoval-Chávez and Beruvides (1998), Cheah *et al.* (2011), Beecroft and Moore (1997), Xenakis and Dunn (1997), Sudirman and Immanuel (2012), Moen (1998), Rosenfeld (2009), Mukhopadhyay (2004) and Shaw (1987). Next sub-section discusses the P-A-F model as it was used in this study.

2.3 P-A-F approach

Feigenbaum first classified quality costs into: prevention, appraisal and failure (in 1956), which is known as the P-A-F model. Failure cost is further classified into two subcategories as: internal failure and external failure costs (EFCs). Crosby (1979) proposed a similar model with two categories: POC and PONC (Hwang and Aspinwall, 1996; Schiffauerova and Thomson, 2006). P-A-F costs are described as (Campanella, 1999):

- prevention costs: planned costs and are incurred to prevent the poor quality such as: R&D, certification and innovation, etc.;
- appraisal costs (ACs): incurred due to measuring, evaluating and testing for conformance to specified requirements;
- internal failure costs (IFCs): incurred when the defective product is caught prior shipment; and
- EFCs: occur when defective products are delivered to customers.

P-A-F model is a widely used model because it is applicable in most of the companies where the required systems for data collection are more or less available. However, there are some barriers too, such as: data confidentiality and time lag between cause and effect (Plunkett and Dale, 1985).

2.4 Quality cost procedure

Campanella (1999) has suggested a sequential process to implement CoQ program. In this program, it is emphasized to develop a quality cost procedure – that serves as a guide for standardized company-wide CoQ program deployment. A customized internal quality cost procedure helps management focus on quality cost data. It becomes such a standard that guarantees year to year consistency in data (Wood, 2007). A quality cost procedure defines: cost elements to be included; when and how the cost data are collected?; comparison bases to be included; who should authorize the procedure?; chart of accounts and new cost elements with coding. During its development, the CoQ team goes through numerous brainstorming sessions that provide an opportunity to find flaws hidden in the daily business operations and accounting system of the company (Campanella, 1999). Traditional accounting system does not report these elements; the situation is similar even in implementing other improvement initiatives such as lean (Li *et al.*, 2012).

Ingredients of a quality cost procedure are identified in literature along with its importance in a CoQ implementation project. However, the literature is deficient in providing a standard template. This lack of available clear-cut standard format has resulted in problems for practitioners and researchers such as: quality cost program is hindered if the procedure is not available or is incomplete (Michalska and Tkaczyk, 2002); the team usually comes up with a variety of quality cost procedures – which in one way is beneficial – but wastes a lot of time (Crank, 1995). Campanella (1999) has proposed a quality costing report format though still it is basic. Lari and Asllani (2013) has proposed a quality cost management support system that enables an organization to better collect and analyze quality cost data. Such a support system can also be benefited if a standard quality cost procedure is available.

3. Research methodology

3.1 The case company

This study was conducted at a wood products' manufacturing company at Karachi, Pakistan. The case company manufactures and exports a wide range of wood products such as: doors, office /home furniture, and kitchen cabinets, etc. It has an annual sales of around PKR 160 M. Competition is on the rise as now the company is facing huge pressures to reduce its products' price tags. This situation asks for cost cutting, and thus motivated the company for a quality costing exercise. Meanwhile, the authors were pursuing to develop a standardized quality cost procedure. The efforts were combined through action research approach. A cross-functional team was then developed comprising of representatives of: accounts, finance, production and quality departments. Production department was chosen for this exercise. Awareness sessions were also delivered to this team by one of the authors. After iterations, the team came up with cost categories, elements and bases.

To expedite this process, data were collected from various sources: sometimes complementary data were acquired; for others same data were collected from different sources for triangulation. Using this and prior experience, authors documented: how and when to determine the cost elements, categories and bases, in the quality cost procedure. As the team selected the P-A-F model, therefore its four categories were taken as standard. One of the authors guided the team in every step; this was not an effortless task however. For instance: a particular cost element was first described in a meeting, then a number of phone calls with a chain of e-mails were exchanged only to decide its suitable category. CoQ program was implemented as an action research, as the authors and company's management collaborated in all the phases, which is different from a management consultancy (Kaplan, 1998).

3.2 Data collection

The case company, besides having a Management Information System (MIS), did not have a thorough data collection procedure and it depicts the classic case where CoQ is buried in the total cost of producing goods. Therefore, data collection was challenging.

Major stakeholders were interviewed, data were acquired from MIS and various reports were reviewed for cost elements and their values. Due to awareness sessions, the team gradually bought the idea of CoQ but other stakeholders (team met for data collection) resisted the very same idea. Production department's personnel played a crucial role here as they understood the technical requirements of their processes responsible for manufacturing a certain product. They helped in measuring costs especially associated with those activities which were never accounted for. Team members from finance and accounting helped in allocating cost elements to specific cost heads, which eventually rolled up to bring the measure of certain cost categories. Expense statement of last quarter was carefully examined, which showed various cost elements such as: training, audits, traveling to resolve product failures, and complaints from customers. Internal records such as scrap reports, and payrolls, etc. were also reviewed. This experience provided inputs at every step in developing the quality cost procedure. Based on this effort, taxonomy of quality costs was developed as in Figure 1. A brief description of these elements is now presented.

3.3 Total prevention costs (PCs)

First, quality development expense represents two departmental salary accounts: quality development department (prevents manufacturing of poor quality products), and product development department (produces product samples). Second, cost incurred in quality-related training is the sum of two cost heads: worker education and expense in conducting quality awareness programs. Third, preventive maintenance

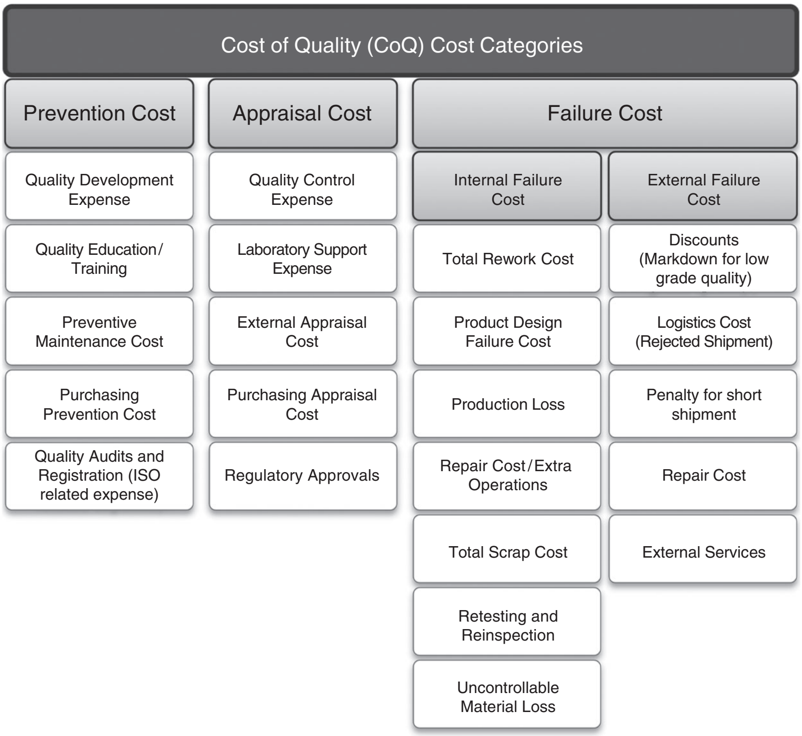

Figure 1.
Taxonomy of cost of quality (CoQ)

cost is estimated by considering: production loss due to preventive maintenance and the maintenance expenditure itself. Fourth, "Purchased" prevention cost is incurred due to random inspection of purchased goods. Fifth, quality audits and registration expenses are ISO or other certifications' related expenses.

3.4 *Total ACs*

First, quality control expense is the salary of Quality Control department. Second, laboratory support expense consists of: salaries of laboratory personnel, cost of chemical tests and fee of equipment calibrations. Third, external ACs are third party (external agencies) inspection costs; however these costs are only considered when a lot fails the test. Fourth, purchasing AC is incurred while inspecting the purchased goods. Fifth, expenses in acquiring various governmental and non-governmental approvals come under "regulatory approvals."

3.5 *Total IFCs*

First, final inspection is carried out before goods are dispatched to customers. Lots that fail the inspection need reworking. Second, a sample is developed for getting customer approvals before indulging in mass production and if it gets rejected, then its cost comes under "product design failure." Third, cost of production loss is computed from: labor and machines engaged in rework; machine malfunctioning while rework; and unavailability of raw material for rework. Fourth, repair cost is incurred in repairing defective products when low quality wood is supplied. Case company inspects wood from outside and few samples go through destructive testing. Once it is machined its internal properties are then revealed. Fifth, scrap cost is the cost of scrap produced during the manufacturing of products. It was directly taken from the company's monthly expense statement. High-scrap cost is again because of using low quality raw material. Sixth, retesting and re-inspection cost is incurred when the production lot – that failed the inspection earlier and was reworked – goes through third party inspection. Seventh, since the company transports furniture (unassembled) to customer, some delicate parts breakdown due to excessive transportation and handling. This cost is charged under "uncontrollable material losses."

3.6 *Total EFCs*

First, discounts are offered to customers whenever there is a shipment of sub-standard products. It is estimated as the difference between actual and adjusted value after negotiations. Second, costs related to reverse logistics occur when the defective product reaches customer and comes back after rejection. It is the freight cost paid by the company. Third, if shipment is incomplete then the company can face penalty (estimated from the value of debt note). Fourth, rework cost incurs while reworking a returned product. Fifth, sometimes the product is not returned by the customer rather repair /rework is required. For this, repair operations are performed at customer site. These costs are charged under "external services."

4. Results and discussion

Quality cost elements were summed up to give the total cost of each category, as shown in Table I. The pie chart (Figure 2) of total CoQ categories reveals that IFCs account for approx. 51 percent of total CoQ, which is alarming. It is interesting to note that the next higher factor is preventive cost, i.e. 19 percent that manifests company's efforts in prevention though it is unable to keep the failure costs low. EFC is the least with less than

Table I.
Total cost of categories

Category	Activity description	Amount (PKR, thousands)
Prevention	Quality development expense	399.45
	Quality education/training	149.10
	Preventative maintenance cost	123.29
	Purchasing prevention cost	54.83
	Quality audits and registration (ISO-related expense)	146.45
	Total	873.12
Appraisal	Quality control expense	259.97
	Laboratory support expense	112.49
	External appraisal cost	135.04
	Purchasing appraisal cost	83.32
	Regulatory approvals	110.12
	Total	700.94
Internal failure	Total rework cost	568.14
	Product design failure cost	159.92
	Production loss	302.48
	Repair cost/extra operations	450.72
	Total scrap cost	429.06
	Retesting and re-inspection	334.23
	Uncontrollable material loss	92.68
	Total	2,337.23
External failure	Discounts offer due to low grade quality	145.04
	Logistics cost (of rejected customer shipment)	169.86
	Penalty for short shipment	102.37
	Repair cost	194.32
	External services	72.16
	Total	683.75

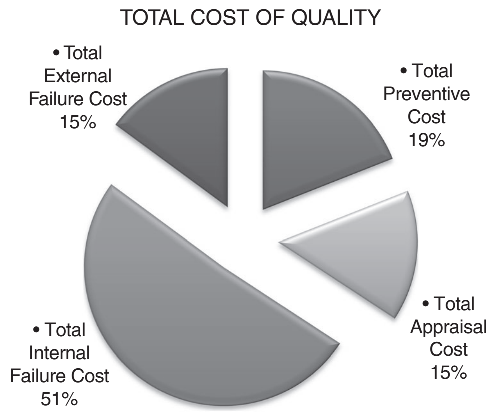

Figure 2.
Pie chart of cost of quality (CoQ)

15 percent of total CoQ. As the literature suggests, that IFC and EFC are the major costs and it is also true for the case company (Defeo, 2001). Low EFC is because of the thorough inspection of outgoing finished products as most are exported. This in turn increases IFC.

The bases monitored were sales and material cost, as the team found them more stable as compared to labor and unit based. For the company, these bases made the

CoQ numbers comparable along different time periods. These bases are referred to as "Quality Cost Indices (QCIs)" in the company's "Quality Cost Procedure" (the Appendix).

4.1 CoQ sales base analysis

According to the data presented in Table II, total CoQ is 11 percent of sales. However, experts in the field of quality suggest that optimal CoQ should be between 2 and 4 percent of sales (Crosby, 1979; Ostrenga, 1991; Hansen *et al.*, 2009). High CoQ gave a chance to company's management to reevaluate and think over the quality of their products, manufacturing processes and the performance of their company as a whole. Table II shows that high IFC, i.e. more than 5 percent of sales, is the weakest link the team had to focus on. Quality cost procedure helped the team in setting a target for this QCI for next quarter. Along with this, it is also suggested to define and monitor Direct Measures of Quality (DMOQ) which the middle and lower management understand but they are supplementary in nature (Kaplan, 1988). Subsequently, the reporting format developed in the quality cost procedure (step-7) came in handy which the team used and improved.

4.2 CoQ material base analysis

CoQ as the percentage of material cost is found to be 15 percent, as shown in Table II. In 15 percent, IFC is again found to be the highest, i.e. around 8 percent of the material cost. This further confirms that the IFC is the main category for reducing overall CoQ.

For reducing total IFC, team performed Pareto Analysis as in Figure 3. It can be seen that close to 80 percent of total IFC is because of: rework cost; cost of repair and extra

Quality cost categories	Amount (PKR, thousands)	Percentage of sales (%)[a]	Percentage of material cost (%)[b]	Percentage of total CoQ (%)
Total preventive cost	873.12	2.09	2.87	19.00
Total appraisal cost	700.94	1.68	2.31	15.25
Internal failure cost	2,337.23	5.60	7.69	50.86
External failure cost	683.75	1.64	2.25	14.88
Total	4,595.04	11.01	15.11	100.00

Notes: [a]Total CoQ (PKR): 4,595.04 and sales (PKR): 41,749.75; [b]material cost (PKR): 30,404.66

Table II. Total CoQ as the base of sales turnover and material cost

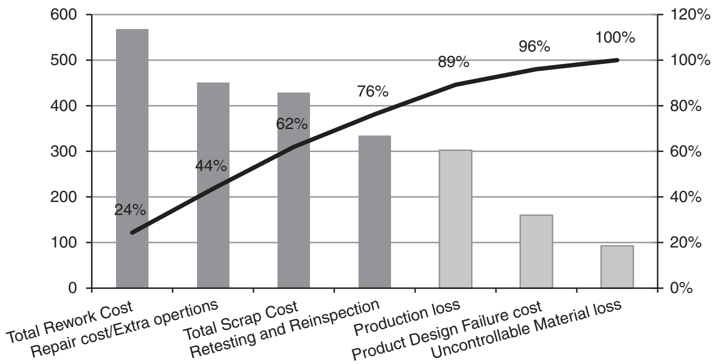

Figure 3. Pareto analysis of cost elements of internal failure costs

operations; scrap cost; and retesting and re-inspection cost. Investigation by the team revealed that company was experiencing high-material losses due to poor quality of purchased raw material. However, company's policies do not support the manufacturing of products from low quality wood; there were flaws in the implementation of these policies. Top three costs in total IFC are due to this reason. It is a reminder that the company is manufacturing in a developing country where satisfactory suppliers are scarce; conglomeration and vertical integration is more common as compared to specialization as in developed countries. This lack of good suppliers forces the company to buy from locally available suppliers, where suppliers' psychology is of more profit than profitability, i.e. more profit by mixing low quality raw material in their lots. Management also realized that few staff members inspected this incoming material, and it can be noted through the low AC for qualifying suppliers' raw material in Table II. This completes the development of "step-8" of the quality cost procedure (the Appendix).

Top management appreciated the efforts of quality cost team and committed to further refine and properly implement the policy of purchasing raw material. Top management welcomed the idea of investing in a supplier development program in the next phase. Furthermore, human resource department was suggested to recruit one person each for purchasing department (to evaluate the suppliers' products) and laboratory (to increase product testing). These factors will increase the PC and AC, thereby more decreasing both IFC and EFC, which is in line with the conventional wisdom of "prevention is better than cure." This is also consistent with the literature (Juran and Gryna, 1988; Plunkett and Dale, 1987; Porter and Rayner, 1992) that suggests: investment in prevention and appraisal activities would help increase profitability and gain competitive advantages. Investment in preventive maintenance of plant and equipment decreased IFC by reducing machine downtime. This focus on EFC with IFC is correct because if only IFC is reduced then it can be on the expense of EFC. This is in agreement with the fact that the whole has to be improved and not pieces at a time (Kaplan, 1988). This phase helped the authors develop the last step of quality cost procedure which is a cross between quality management and project management. All of the above improvement suggestions have to be implemented as projects.

It is found through CoQ Program's implementation at the case company that development of the "Quality Cost Procedure" is highly iterative in nature. The team had to do and undo numerous aspects of the procedure and then finally came up with a proposed standard format (the Appendix). This format shows that nine steps are required, as a good practice, to develop a quality cost procedure and related report. This procedure worked well for the case company and on its basis the CoQ team and management is confident in moving to the next phase of company-wide deployment of CoQ Program.

This procedure will serve as a reference for practitioners and academicians who are involved in the implementation of CoQ in other industries also (such as services). It is notable that the procedure has the flexibility for a wider application, as there are various fields that the implementation team can opt for according to their situation. It also has a cross in the later phases with project management – as depicted by the Gantt chart tool – when it comes to quality improvement initiatives. This is in line with Jurans' statement that: "all quality improvement occurs on project by project basis" (Juran, 1964).

5. Conclusions

To develop the quality cost procedure, CoQ program was implemented at the case company. IFCs comprised the major portion of total CoQ. QCI having sales base is 11 percent which lies in the range reported in literature (15-20 percent by Crosby, 1979 and 5-25 percent by Dale and Plunkett, 1999). To reduce this QCI, recommendation were given which were accepted and mostly implemented by the management. After this implementation of P-A-F model, the team – to continue its kaizen effort – will implement the process cost model, as P-A-F model will start diminishing returns. Eventually, a robust "Quality Cost Procedure" was developed by the CoQ team, which not only helped the company but will serve CoQ implementers at the operational as well as tactical level of management. After having this procedure, the case company is now ready for a company-wide deployment of CoQ program. Practitioners can mold this procedure according to their needs, which will further enhance the body of knowledge on CoQ.

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(The Appendix follows overleaf.)

Appendix. Quality cost procedure

This is a template which helps in establishing the Quality Cost Procedure in a step by step manner. It is simple and straight forward. It is preferable to follow the sequence, however, the user can move back and forth as it is developed in an iterative manner.

Step-1: Company Information

Company Name:	
Founded Since:	
Annual Sales:	
Type of Industry:	
List some major Products /Services:	

Cost of Quality (CoQ) Deployment: (check only one)

Company-wide: ☐

Department: ☐ Mention Name: ______________________

Step-2: Identify the Business Process

Identify the process or department for which CoQ needs to be measured. Clearly mention the boundaries of the department or processes or company as a whole to measure quality cost.

Example:

Take all the functions of a company, from raw material purchasing to manufacturing and shipment of goods till the after sale services.

Following areas are taken for in depth study:

1. *Manufacturing Processes*
2. *Data and information flow processes*
3. *Inspection and Testing Stages*

Step-3: Develop Quality Cost Team

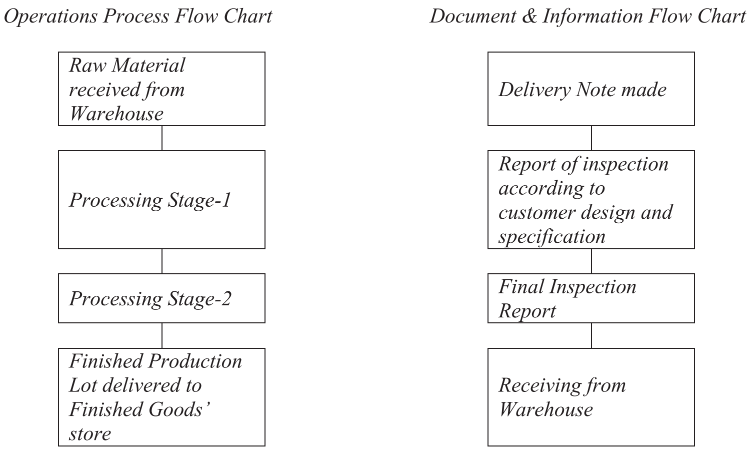
The Quality Cost Team is established by the consent of In-charge /Departmental Head. Preference will be given to members with CoQ /Quality Awareness.

S. No.	Name of Team Member	Designation	Departme nt	Last Qualification	Contact (Email & Cell)	Training Requirements
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Step-4: Prepare a Process Flow Chart

The above mentioned areas are needed to be broken down into various steps and develop flow chart for each category under consideration to measure quality cost.

Example:



Step–5: Classify the Cost Elements

Categorize the activities or work that is performed by the process under study or department or company which can be considered as Quality Costs after brainstorming sessions. Taxonomy of quality cost is then developed with coding and major department where this cost element usually occurs:

1. Prevention	2. Appraisal	3. Internal Failure	4. Internal Failure
1.1: *Department:*	*2.1:* *Department:*	*3.1:* *Department:*	*4.1:* *Department:*
1.2: *Department:*	*2.2:* *Department:*	*3.2:* *Department:*	*4.2:* *Department:*
1.3: *Department:*	*2.3:* *Department:*	*3.3:* *Department:*	*4.3:* *Department:*
1.4: *Department:*	*2.4:* *Department:*	*3.4:* *Department:*	*4.4:* *Department:*
1.5: *Department:*	*2.5:* *Department:*	*3.5:* *Department:*	*4.5:* *Department:*

Attach as many sheets as required for various adjustments, their justifications with implications, made in the accounting system of the company to accommodate cost elements in chart of accounts.

Step–6: Quality Cost Details

Quality Cost Data Collection:
(check only one)

Perpetually: ☐ Monthly: ☐ Quarterly: ☐
Semi-Annually: ☐ Other: ☐ ____________________________

Data Collection Sources:

Bases and their Reporting as Quality Cost Indices (QCIs):
(check as many required)

Sales: ☐ Reported Where & When:____________________
Material: ☐ Reported Where & When:____________________
Labor: ☐ Reported Where & When:____________________
Unit: ☐ Reported Where & When:____________________
a.______: ☐ Reported Where & When:____________________
b.______: ☐ Reported Where & When:____________________

Maximum Duration for Quality Improvement Targets:

Quality Cost Reporting:
(check only one)

Monthly: ☐ Quarterly: ☐ Other: ☐ ___________________

Manager Quality **Manager Operations** **Manager Finance**

Step–7: Quality Cost Report (Template)

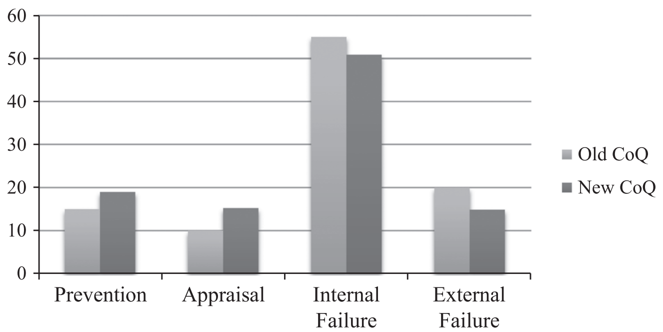
1. This report is developed periodically i.e. ______________________. (specify Monthly/Quarterly etc.)
2. This report presents the data collected in previous period, which is: ______________. (specify Period)
3. Data are collected around the cost elements defined in the Quality Cost Procedure and are presented as categorized in the P-A-F Model in the following table (in thousands of PKR):

S. No.	Activities	Prevention Cost (PC)	Appraisal Cost (AC)	Internal Failure Cost (IFC)	External Failure Cost (EFC)	Total
1.						0
2.						0
3.						0
4.						0
5.						0
6.						0
7.						0
8.						0
9.						0
10.						0
11.						0
12.						0
	Total CoQ	0	0	0	0	0

4. Summarized Quality Cost data and the Bases calculated are shown in the following table (*example*):

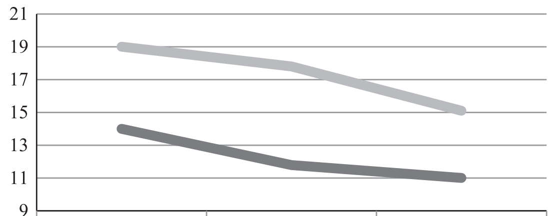
S. No.	Quality Cost Indices (QCIs)	PC	AC	IFC	EFC	Total
1.	Total CoQ	873.12	700.94	2,337.23	683.75	4,595.04
	Percentage of CoQ	19	15.25	50.86	14.88	100
2.	Total Sales					41,749.75
	CoQ as Percentage of Sales	2.09	1.68	5.6	1.64	11.01
3.	Total Material Cost (MC)					30,404.66
	CoQ as Percentage of MC	2.87	2.31	7.69	2.25	15.11

5. Percentage CoQ is shown in the following chart: (*example*):



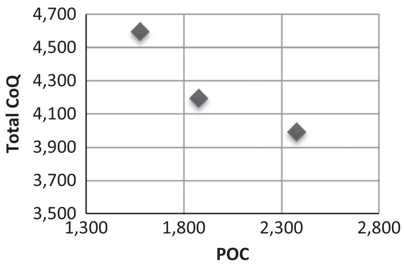
6. Comments on the previous chart of Cost of Quality (depicting Old and New CoQ):

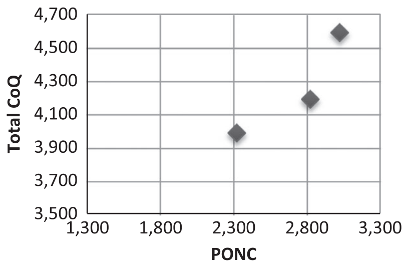
7. Trend chart is developed that depicts the trend of QCIs selected in quality cost procedure. (*Example*)



	Period 1	Period 2	Period 3
CoQ as % of Sales	14	11.8	11.01
CoQ as % of Material Cost	19	17.8	15.11

8. Relationships between: Price of Conformance (PCs+ACs) and Total CoQ; Price of Non-Conformance (IFCs+EFCs) and total CoQ.





9. Comments on parts 7 and 8:

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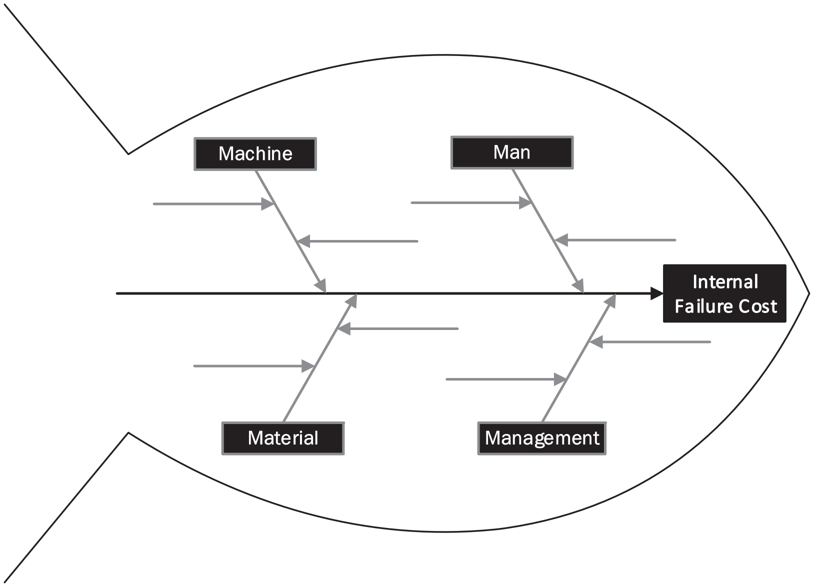
Step–8: Identifying and Analyzing Process Areas for Improvement

To identify and analyze the process areas for improvement, various tools from Quality Management body of knowledge may be selected. For this report a Pareto Chart (Figure 3) is used to identify the areas which can bring significant improvement in the bottom line. Once areas are identified, root cause analysis is done using Ishikawa (Cause and Effect or Fishbone) Diagram or any other tool such as Failure Modes and Effects Analysis (FMEA) etc. These are presented as follows:



Step–9: Develop Action Plan for Quality Improvement

Cost of Quality will never go down on its own; rather it will need a quality management program that focuses on eliminating the identified areas in the previous step. Therefore, a plan is needed for the implementation of quality management efforts. Here, a Gantt chart will serve the purpose, once the activities are finalized. Along with setting a target for QCIs, it is also suggested to define and monitor Direct Measures of Quality (DMOQ).

Activities\Weeks	1	2	3	4	5	6
Activity 01						
Activity 02						
Activity 03						
Activity 04						

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