

Costing based Quality Control System (case study: Automobile Manufacturing Industries in IRAN)

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Abstract

Cost of quality is a radical action for reducing production costs. This method improves quality level and increases organization's profit. Also provide a guideline to how an organization can focus its activities for better improvement. In this article, a model has designed for detection and calculation of costs of quality in one of saloons in irankhodro's industrial company, (IKCO). At first four elements of costs of quality: prevention costs, appraisal and testing costs and failures caused by internal and external costs, are classified separately. A first step start by identifying the costs of quality in related unit and cost of quality of unit have been classified by observation method and presents the specific worksheet within the particular codes. Refer to accounting records, the costs associated with each activity measured and at last for improving the status report, the action was taken by using three methods: trend analysis, Pareto analysis and fish bone diagram. What comes as a results of the implementation of this system, identify the non-value added activities and hidden costs. Finally, the system allows managers more accurate decisions to improve the quality system of organization.

Key Words: Cost of quality (COQ), Preventive Costs, Appraisal Costs, Failure Costs

1. Introduction

In today's industrialized world, we are looking for producing better quality and lower cost. In this competitive world, just companies and organizations which are able to identify elements of costs with managing them to reduce overall costs and finally reducing cost of their product are able to survive. The highest price that a company may be paid and exorbitant expense to pay for it, is the cost of low quality, therefore in this competitive world, it caused losing customers and market sharing. In this paper meanwhile the classification of costs into four main groups also identifying areas caused the main cost of quality in irankhodro co, presenting data collection system and designing cost of quality system in press saloon is proceeds. One of the concerns of organizations managers are reducing costs and increasing product quality. In fact evaluation and cost

analysis of companies, leverage to reduce costs, in order to identify the main sources of cost arisen activities to achieve a certain level of quality. The classification of quality costs, into four categories: prevention costs, cost of inspection and testing, cost of external and internal failure and value of each components, are giving suitable outputs to the managers.

2. Research Methods and Tools

Necessity of administrative accounting system implementation with cost of management approach is one of important things that leads managers made strategic decision in organization. Since this paper is type of application and system design, certain assumptions, is not considered because according to different working conditions and difference between operating system in different industries, cannot prove a hypothesis

in a specific environment or process related to it , or extended exactly to other units. This research is application oriented in terms of use, with method of system design. Also the location of it was in Iran Khodro co and the sample for study is intended in press saloon 3.this research has been done in year 2012 and data used at first 6 months of this year. Territory subject of this study include: hidden costs, total quality management and quality control issues. This study is a kind of system design and applicable. For cost of quality data collection, in addition of study the identified cost in unit of case study, it used from information and the data contained in the financial part. Basic concepts of cost of quality developed by giants like professor Juran in the early 50s that Juran was mentioned cost of quality in one of the chapters of “Quality Hand book”. In early 1950 an article published by Mr. Fingen bam that classified the costs to 3 groups: prevention, evaluation and failure. In 1967 a booklet entitled (cost of quality and whatever) was published by society of quality control in USA .In 1981 bs6143 standards to guide the determination and use of cost of quality was published in England.

Since the quality, necessary for production and service provision, the question was that, how can we separate cost of production with costs of quality?

3. Economic model of COQ in approach of (P.A.F)

Based on his model we are able to divide the costs of quality into three separate parts. (BRINKER, 2000, 326)

- Prevention costs: these are the costs that can help us to prevent from mistakes and can distinguish the main reason of them. This cost generally include the following:

1) *Education of prevention*: all training related to the proper conduct of each activity, to prevent errors by inside individuals or outside consultants of organization that is done.

2) *Quality designing*: activities will include the following standard definition and product design in order to change them in to produce a high quality product, due to the special conditions.

3) *Calibration*: calibration and adjustment unit cost of production, the aim for this work is to maintain the product quality.

4) *Preventive maintenance*: activities that prevent the error of the machine during production and adverse effect on quality of product.

- Evaluation cost: the costs for quality testing to ensure they meet the quality demands or in another word these are the qualitative status of cost. It is noted:

1) *Entrance exam*: testing of raw material and initial parts, for acceptance or rejection.

2) *Inspection during process*: continuous activity that occurs during process and this costs including: all personnel costs and tools used for this reason, the percentage of staff times that spend on controlling actions.

3) *Ultimate test*: activities get out for ultimate test.

- Internal failure: costs related to products, parts and material and services that have failed to meet the quality demands. The cost of such failure can be detected in organization before they reach the customer. If the product is perfect, it will cost nothing in this section. these elements include

1) *Costs of waste and discard*: due to a defective product that no longer work is created.

2) *Costs of rework*: cost related to amend non-standard products into healthy products.

3) *Cost of production stoppage*: lost production because stopping the production line of quality loss.

4) *Reduce the value of product*: cost of products that rework on them and generally lower quality that desirable finds. Generally these products sold with lower price than original price. This price differences called reduce the value of product.

- External failure: This cost appears when the Product or service is not provided customers benefit or desired quality.

1) *Cost of customer complaints*: including cost like: assessment, prevention and management

of customer complaints of non-standard products.

2) *Cost of return products*: including costs of: receiving, shipping, replacement of return products.

3) *Warranty cost*: all costs for after selling services postured to the costumer. This cost includes; loss of customer confidence, loss of market share, loss of reputation.

4) *Replacing the product*: sometimes errors can be observed to the extent that the organization would have change.

Firms with traditional process

The total cost of quality is a function of investment cost and error cost and increase in appraisal costs and prevention cost cause to decrease failure cost, as a result decrease total cost of organization but companies with traditional process cannot be achieved purely qualitative adaptation.(Juran,1998:p72)

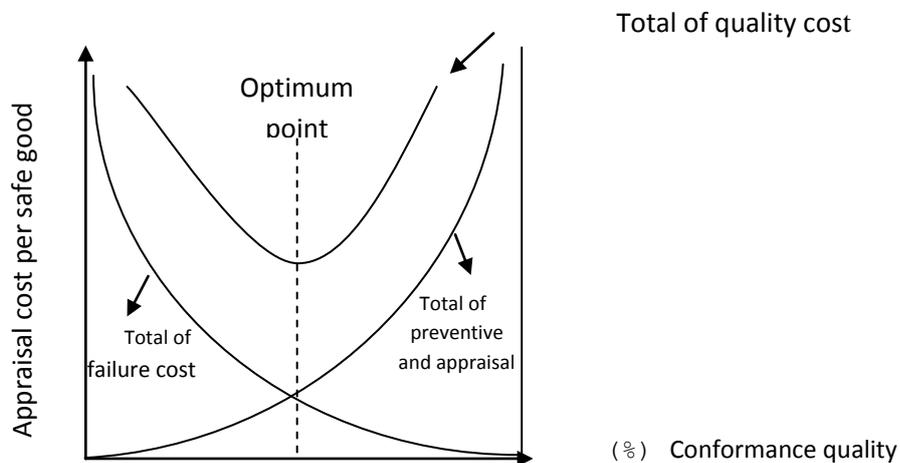


Figure 1-COQ model in traditional companies

Optimum point is the conjunctions of two curves, cost of investment and failure. This is the optimum point for both the organization and the customers.

Companies in process of developing

These companies have higher capacity than traditional process and reaching to 100%, according to what is needed is possible.

In the bottom diagram, internal and external failure costs are zero, as result the total cost of the optimal point, equivalent to the cost of the assessment and prevention. (BRINKER, 2000:325)

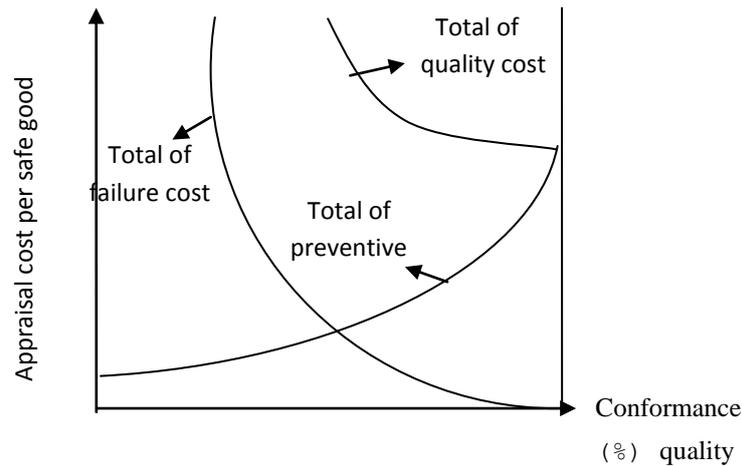


Figure 2-COQ model in process of developing companies

According to usefulness of the (P.A.F) model and classified into 4 categories of cost (prevention, evaluation, internal and external failure), it was decided to use above method for designing this system. Thus designing this system includes: process of collecting, reporting, and implementing of cost of quality. In this research, for reporting cost of quality four were used: percent of prevention cost to total cost, percent of evaluation cost to total cost, percent of failure cost to total cost and percent of external cost to total cost.

Establishment of cost of quality system include four procedures:

- 1) Preparation
- 2) Identifying elements of quality cost in each section
- 3) provide an efficient method for collecting and calculating data in each section.
- 4) Analyze the information with using statistical tools required.
- 5) Conclusions and recommendations for corrective actions to improve

- **Preparation**

Since the manager's attention is necessary to implement of cost of quality system, after enticing the manager attention, the project steering team identified. The next action is, training key people in various units of the organization. Ranges of programs for people involved in project were cleared. Necessary commitments of human and financial resources for system were conducted by the manager.

Identifying elements in each section

After ranking the elements of cost of quality, as noted in P.A.F model, for classification and reporting of those cost, table 1 were designed.

Table1-report of COQ with the end of (Because of some security issues the numbers is not shown)
1-Preventive costs 1-1 Education costs 1-2 Quality designing costs 1-3 Calibration costs 1-4 Preventive maintenance costs
Total of preventive costs
2-Evaluation and testing costs 2-1 Inspection of initial materials 2-2 Inspection during process 2-3 Final inspection
Total of evaluation & testing costs
3-Internal failure costs 3-1wasting costs 3-2 Reworking costs 3-3 Production stopping costs 3-4 Reducing value of product costs
Total of internal failure costs
4-External failure costs 4-1 Costumor complains costs 4-2 Return product costs 4-3Warranty costs 4-4 Replacing product costs

Total COQ

4. Providing an efficient way to collect and calculation data:

Easy tracking of each expenses and avoid a repetitions of the name of each of them is designing a simple system of coding each of the necessary costs.

Of course the accounting system cots code and financial system must comply with code but since the beginning of labor organization to implement the system, is not considered a special place and after many problems organizations consider the use of these systems, generally considered to be separate coding system. Cost of quality analysis used by statistical tools like:Trend analysis, Pareto analysis and fish bone diagram In table 2 the coding cost, in table 3 and 4 compliance issues, includes: cost of assessment and prevention and cases of non compliance in press room 3.

Table2-Coding of COQ

Code	External failure costs	Code	Internal failure costs	Code	Inspection &testing costs	Code	Preventive costs
EO1	Costumers complain	IO1	Wasting	AO1	Inspection of initial material	PO ₁	Training
EO2	Return products	IO2	Reworking	AO2	Inspection during process	PO ₂	Quality designing
EO3	Warranty	IO3	Stopping & Failure	AO3	Final inspection	PO ₃	Calibration
EO4	Replacing products	IO4	Reducing value of product			PO ₄	Preventive maintenance

Table 3- conformance costs	
Preventive Costs(million Rial)	
Training Quality	PO1
Quality designing costs	PO2
Calibration	PO3
Preventive maintenance	PO4
Total of preventive costs	ΣPO
Inspection costs	
Inspection of initial material	AO1
Inspection during process	AO2
inspection Final	AO3
Total of inspection costs	ΣAO
Total conformance	

Table4-Nonconformance costs	
Internal failure Costs(<i>million Rial</i>)	
Wasting	IO1
Reworking	IO2
Stopping &Failure	IO3

Table 5-Comprehensive report of total COQ	
Type of costs	percent of total COQ
PO	29,23
AO	20,6
IO	50,15
EO	--
Total	100

Reducing value of products	IO4
Total of internal failure costs	Σ IO
External failure costs	
Customers complain	EO1
Returned product	EO2
Warranty	EO3
Replacing product	EO4
Total of external failure costs	Σ EO
Total conformance	

5. Data analysis

Unit of production is no internal failure costs because the final product is a perfect unit to other parts and if there is a problem in parts, lead to customer complaints, it is responsible for other sectors. The information gathered from table 5 is transferred to press room, for information that is readily available to management.



Trend analysis

Monitoring indicators and amounts of expenses during the time of this graph is possible. Usually trend analysis, process improvement or declining quality of organization are illustrate during time. Results of trend analysis, cost of compliance, and cost of non-compliance are shown in Figure 3&4.

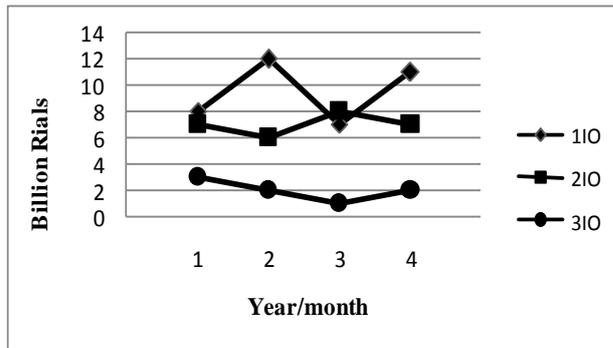


Figure 3-Trend analysis of conformance costs

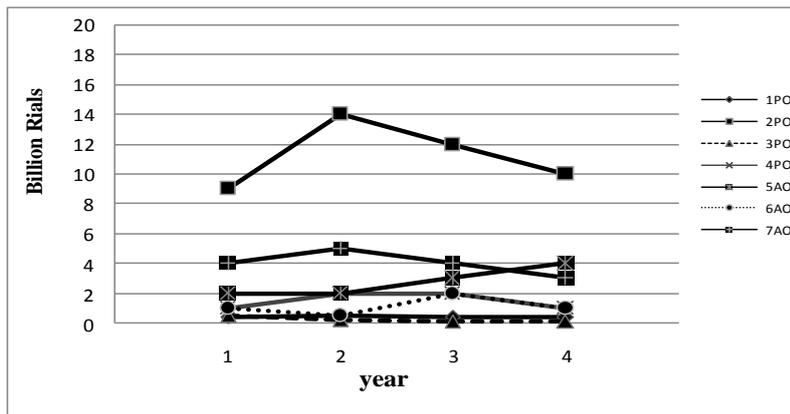


Figure 4- Trend analysis of nonconformance costs

Pareto analysis

Pareto analysis is including lists of factors underlines issue and ranking them in terms of factors wih contributed to its establishment. In most cases, a small percentage of agents or resources, relatively large percentage of total cost is allocated. For the greatest improvement, further efforts should focus on reducing costs, which could arise in the most important factor. In figure 5, rate of cost of quality is shown in IKCO.

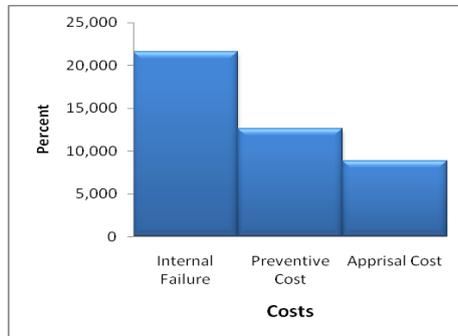


Figure 5-Pareto analysis related to COQ

According to chart provided the most internal break down of costs, the organization has been imposed so if corrections need to be made in this sector, more financial benefits will occur to the company. Therefore, the cost of this part process the cost related to failure of internal components, diagrams are provided.

Fish-bone diagram

Use cause effects diagram for better analysis because the main causes of weaknesses have been identified and back ground for improvement of projects and take corrective measures can be provided. In table 6 causes of minor damage cost are cleared.

Table 6. Data for Internal Failure							
Wastes at the first of products	Amount	Returned wastage	Amount	Wastes related to working-out the machines	Amount	Wastes related to operators mistake	Amount
Differences in size of the Coils	0.5	Scratched Coils	0.3	Coils	0.4	Mould	0.25
Transport	0.2	Rusting	0.25	Dimension Contradiction	0.5	Transfer Equipment	0.25
Mould	0.3	Chipped coils	0.1	Refused Coils	0.1	Straining	0.5
		Veined Coils	0.25				
			0.1				
Total _		Total		Total _		Total _	

As can be seen, approximately 45% of waste, the waste is returned.

Losses due to operator error, almost 35% of total expenditures allocated to waste of production and break down the machines. Each accounted for 10 % of costs are given to better understand the causes. We draw fish-bone diagram after drawing fish bone diagram in waste section. The reason for occurrence of these cost, have been determined.

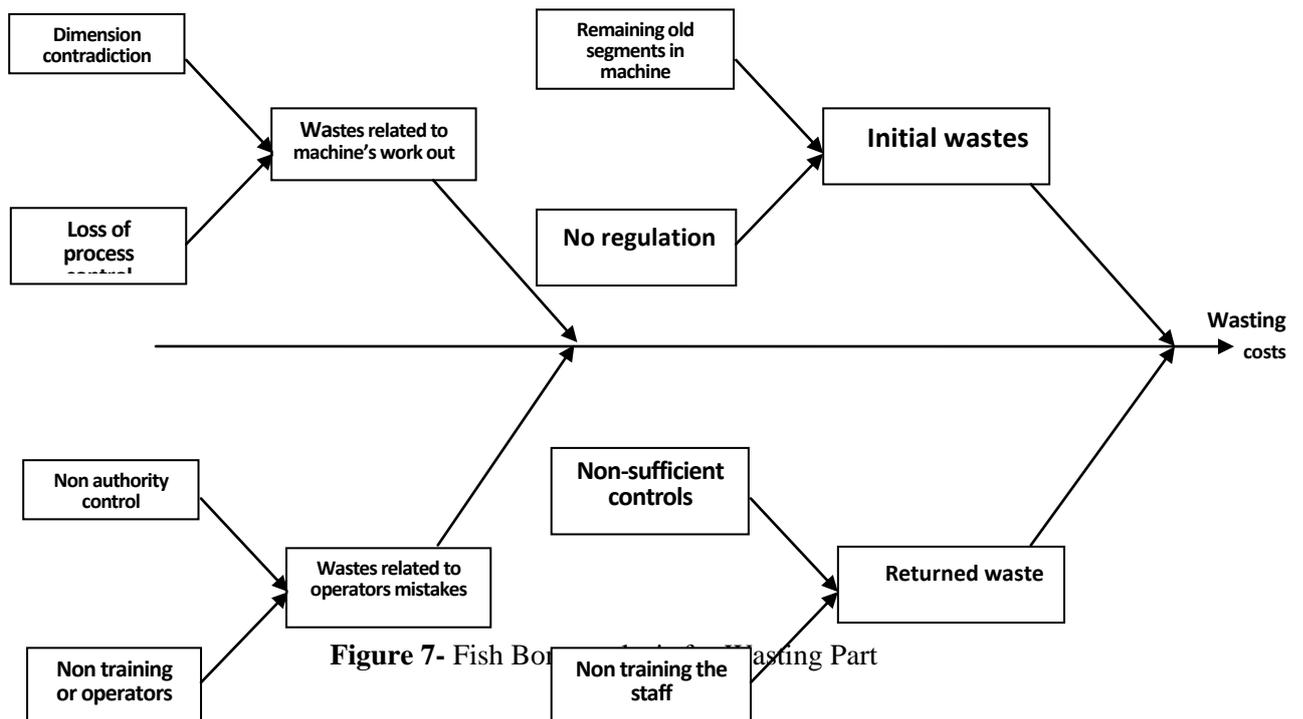


Figure 7- Fish Bone Diagram of Wasting Part

6. Conclusion and Suggestions

1) Pareto curve analysis in three areas: appraisal costs, internal failure and prevention have shown that approximately 50% of total costs in the press hall are the cost of failure.

2) Cost of prevention, appraisal and compliance costs constitute about 50% and due to the high costs of compliance, are an investment in company; we can say that the company is in good situation.

3) Internal failure, analysis shown that, the major parts of cost of salon is waste of money and top with cost of back injuries.

4) The cost of system design and analysis, identify areas with greatest cost to the organization imposes.

The administrations efforts to improve quality and reduce costs, the share of those making the cost of quality and finding the root causes and eliminate them.

Golden opportunity for the organizations is to deliver products and provide customers with more affordable price.

According to the study, at press salon 3 of IKCO, identify wastage cost as part of the cost of internal failure costs and analysis was performed. These are suggestions:

- Prepare operational guidelines for worker to prevent operation out side standard.
- To avoid leaving the previous parts of the machine frame, before entering a new segment.
- The operator must check the machine to found to found the new format to prevent damage to the device.

To solve the problem of breaking down the machine these are suggestions:

- In terms of process control and monitoring plan, periodically to ensure break downing the machine.
- To calibrate the machines for cutting templates to standard form and its dimensions accur.
- For wastage in returns, must be done with adequate training to personnel. So the activities without any defect and prevent defective parts from sending to another part.
- Also a full recipe, instruction and information must be provided to the operator.

References

1. Adefeo, Joseph, (1997), "The Tip of the Iceberg", Quality progress.
2. ANSI/ASQC Q 9004-1-1994, (1994), "Quality management and

Quality system Elements- Guide lines".

3. Brinker, Barry. J, "Guide to cost management", (2000), New York, Johnwiley & Sons.
4. Juran.J.M, and Frank, (1988), "Quality Control Handbook", 4th Ed, New York, Hill Book Company.
5. Rune, M. Moen, "New Quality cost model used as a top management tool", TQM magazine, Vol. 10, No.5.
6. Tan Swan San- Johnson, (2000), "Applying Cost of Quality to total Quality Management", Pakistan Institute of Quality Control.
7. Thomason, Schiffauerova, (2006), "A review of Research on Cost of Quality Models and Best Practices", Department of International Journal Quality and Reliability Management, Vol. 23, No 4
8. The Coq development team, The Coq proof assistant reference manual, <http://coq.inria.fr/refman/>.