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# Tracing Quality Cost in a Luggage Manufacturing Industry

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***Abstract*—**Quality costs are the costs associated with preventing, finding, and correcting defective work. Since the main language of corporate management is money, quality-related costs act as means of communication between the staff of quality engineering departments and the company managers. The objective of quality engineering is to minimize the total quality cost across the life of product. Quality costs provide a benchmark against which improvement can be measured over time. It provides a rupee-based report on quality improvement efforts. It is an effective tool to identify, prioritize and select quality improvement projects. After reviewing through the literature it was noticed that a simplified methodology for data collection of quality cost in a manufacturing industry was required. The quantified standard methodology is proposed for collecting data of various elements of quality cost categories for manufacturing industry. Also in the light of research carried out so far, it is felt necessary to standardise cost elements in each of the prevention, appraisal, internal failure and external failure costs. . Here an attempt is made to standardise the various cost elements applicable to manufacturing industry and data is collected by using the proposed quantified methodology. This paper discusses the case study carried in luggage manufacturing industry.

***Keywords*—**Quality Costs, PAF model, quantified methodology, Case study.

## I. Introduction

MANY companies in the world promote quality as the central customer value and regard it as a key concept of company strategy in order to achieve the competitive edge. There is one factor that makes the difference between the costly way and beneficial way of achieving quality. This factor is quality costs. Quality costs information can be used to indicate major opportunities for corrective action and to provide incentives for quality improvement. Quality costs can help to quantify specific quality levels and ultimately improve productivity. According to American Society for Quality Control (ASQC), quality costs are a measure of costs specifically associated with the achievement or non-achievement of product or service quality, as decided by the company. The idea of quality costs was first introduced to the world in Juran's (1951) Quality Control Handbook [1,2].

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## II. Importance of Quality Costs

Quality costs are very large. There is no reason to suppose that they are any less now. Secondly, 95% of the quality cost is usually expended on appraisal and failure. These expenditures add little to the value of the product or service, and the failure costs, at least, may be regarded as avoidable. Reducing failure cost by eliminating causes of non-conformance can also lead to substantial reductions in appraisal costs. The authors' research evidence suggests that quality-related costs may be reduced to one third of their present level, within a period of three years, by the commitment of the organization to a process of continuous quality improvement [1,2].

## III. Quality Cost Categories

According to Feigenbaum(1956), there are four quality costs categories such as prevention, appraisal, internal failure and external failure [2].

### *A. Prevention Costs*

They are associated with activities that keep failure from happening, and keep appraisal costs to a minimum. Examples of prevention activities are Quality Planning, Quality circle meetings, Training programs, written procedures, Analysis of quality information, and Quality improvement projects.

### *B. Appraisal Costs*

They are incurred to ascertain the product or service whether it conforms to quality standards. Examples of Appraisal activities are inspection of incoming work, supplies and materials, periodic inspection of work in process, final inspection and collecting quality data.

### *C. Internal Failure costs*

They are incurred in order to correct non-conforming work prior to delivery to the customer. Examples of internal failure are scrap, rework, machine downtime.

### *D. External Failure Costs*

They are incurred to correct non-conforming work after delivery to the customer, or to correct work that did not satisfy a customer's specified standards. Examples of external failure are warranty, Complaint Administration, Sales return, Product Liability.

## IV. Quality – Costing Approach

Quality – costing is the conventional approach of categorizing quality costs as prevention, appraisal, internal failure and external failure costs. Prevention and appraisal

(costs of conformance) are considered investments, while failure costs (costs of non-conformance) are considered as losses. Applying this approach normally involves investing in a relatively modest increase in the cost of prevention to realize a more significant reduction in the cost of failure, and ultimately a reduction in cost of appraisal as well, there by substantially reducing the total of cost of quality. In this approach, those costs are excluded which is part of the normal operation of the plant or service.

## V. Development of Quality Cost System in a Luggage Manufacturing Industry

The case study has been carried out in Luggage manufacturing industry with following objectives:

- **A.** To study the various elements of quality cost as applicable to concerned industry.
- **B.** To propose a simplified methodology for data collection in a manufacturing industry [3].
- **C.** Data collection of various cost elements of prevention, appraisal and failure categories.
- **D.** To develop a quality cost system.

## VI. Methodology

The methodology adopted is as follows:

- Questionnaire technique was used to obtain an indication of the knowledge of quality cost within the industry [5,6].
- Departmental interviews were carried out with the various staff of engineering, quality control department, marketing heads, etc to find out which element of quality cost occurred within each department [5,6].
- Quality cost checklist consisting of list of cost elements detailed as per IS : 10708 – 1985 was used [2]
- Suitability and acceptance of various cost elements by the industry was studied.
- Using the proposed quantified methodology, the data is collected for each cost element under various cost categories.
- Collected data for November 2003 is shown in Tables I, II, III & IV. The data is compiled from April 2003 to November 2003 in the summary sheet shown in Table V.

TABLE I
Internal Failure Cost for November 2003

| Element | Definition | Quantified Formula | Source of data |
|---|---|---|---|
| Rework ( LA, IMD) | Sweeping of raw material, Deflashing, Flame treatment, | ∑[No. of manshifts x Avg salary per manshift (permanent+ casuals+ apprentices)]=0.16 Lacs | Extra manpower deployed for rework/salvage. Data for Wage rate is available from accounts |
| Dismantling (LAD) | Separation of components of luggage not usable. | ∑[No. of each type of luggage rejected x (luggage price-shell cost)] = 0.07 Lacs | Defectwise dismantling analysis report. Luggage price and shell cost taken from accounts. |
| Breakdown Maintenance | Machine is not available for work i.e machine is down. | ∑[Machine Hours x Avg hourly wage rate]=1.29Lacs | PE Dept. workers, officers and IMD workers salary. Machine hours lost obtained from PE Dept./ System reports available on computer. |
| Spares and Consumable | Spare and consumables for replacement of some component of m/c for quality improvement. | Sum of the cost of spares and consumable used for the month = 1.45 Lacs | From stores in the form of issue register. |
| Interest on Non Moving Inventory | Interest on Stock in hand which otherwise would have been sold could generate the income. | (Interest on cost of inventory in stock @14%)=0.02 Lacs | System reports available on the computer. 14% interest is taken on the cost of inventory in stock |
| Standard Scrap | It is the Scrap due to process itself. | Scrap in Kg x Cost per Kg = 0.11 Lacs | Scrap ticket (Injection Moulding dept.) |
| Non Standard Scrap | Scrap, which is not part of the process. | Scrap in Kg x Cost per Kg = 0.15 Lacs | Scrap ticket (dept. wise) |

TABLE II
External Failure Cost for November 2003

| Element | Definition | Quantified Formula | Source of data |
|---|---|---|---|
| Warranty Adjustment Part 1 Luggage replacement Part 2 Repair | Replacements done within guarantee and warranty period | ∑(No. of Luggages replaced * MRP) + ∑(Quantity of components replaced * Cost of each component) = 2.29 Lacs | Condensed market complaint analysis report given by customer service. Transit damage report. Replacement of luggages at various branches. |
| Accessories to branch (70% of dispatch) | Demanded since transit damages are possible. | ∑(Qty of each accessories * Unit Cost) = 0.09 Lacs | Accounts. |
| Mechanics salary at branches | Salary paid to the mechanics. | 0.34 Lacs | Branches give the information of customer service. Salary of customer service dept. |
| Penalties Levied (CSD) Canteen service department | Cost of delay in delivery on targeted date. | 0.41 Lacs | Branches give the information. According to the contract/agreement (clause mentioned). |

TABLE III
PREVENTION COST FOR NOVEMBER 2003

| Element | Definition | Quantified Formula | Source of data |
|---|---|---|---|
| Training cost | Quality awareness, Quality system, ISO 9000/ ISO 14000 training. | Administrative expenses incurred = 0.08 Lacs | Accounts |
| Man Hours Spent on Preventive maintenance | This is done for increasing the life, from quality improvement point of view. | ∑ [Man hours * No. of Persons * Wage rate] =0.06Lacs | Time is booked, Persons involved, Avg. salary/Hr, Spares and consumables, Breakdown slips,Preventive maintenance schedule & report. |

TABLE IV
APPRAISAL COST FOR NOVEMBER 2003

| Element | Definition | Quantified Formula | Source of data |
|---|---|---|---|
| Dismantling for quality testing | Cost incurred for destructive testing of the product. | No. of luggages dismantled * Cost of that luggage =0.07Lacs | Dismantling report. Quality Assurance Lab. |
| Wages & Salaries paid for inspection | Inspectors, QA dept. personnel. | Salaries of Inspectors + QA dept. personnel = 0.81 Lacs | Accounts. |
| Calibration | Cost incurred for calibration of testing/measuring instruments. | Cost of calibration by outside agency = 0.01 Lacs | Quality Assurance department demands the information from respective depts. In the form of report. |

TABLE V
SUMMARY OF TOTAL QUALITY COST FOR EIGHT MONTHS DATA OF 2003-2004

| Particular | Apr 03 | May03 | Jun 03 | Jul 03 | Aug03 | Sep03 | Oct 03 | Nov03 |
|---|---|---|---|---|---|---|---|---|
| Internal Failure Cost | 0.21 | 0.21 | 0.25 | 0.16 | 0.14 | 0.17 | 0.13 | 0.16 |
| Rework(LA,IMD) | | | | | | | | |
| Dismantling LAD | 0.08 | 0.10 | 0.10 | 0.08 | 0.07 | 0.08 | 0.05 | 0.07 |
| Breakdown Maint | 0.86 | 1.28 | 1.03 | 2.50 | 1.40 | 1.22 | 1.05 | 1.29 |
| Spares & Consumables | 1.66 | 2.23 | 2.49 | 1.16 | 1.98 | 1.59 | 1.30 | 1.45 |
| Interest on non-moving inventory | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.06 | 0.02 |
| Standard scrap | 0.14 | 0.25 | 0.16 | 0.14 | 0.14 | 0.17 | 0.04 | 0.11 |
| Non-standard scrap | 0.14 | 0.06 | 0.93 | 0.28 | 0.05 | 0.03 | 0.08 | 0.15 |
| **Total Internal Failure cost** | **3.11** | **4.15** | **4.98** | **4.34** | **3.80** | **3.28** | **2.67** | **3.25** |
| External Failure cost | 1.97 | 2.25 | 2.41 | 2.16 | 1.94 | 2.80 | 1.76 | 2.29 |
| Warranty Adjustment | | | | | | | | |
| Accessories to branch (70%of despatch) | 0.16 | 0.14 | 0.14 | 0.04 | 0.12 | 0.10 | 0.08 | 0.09 |
| Mechanics Salary at branches | 0.51 | 0.46 | 0.43 | 0.31 | 0.50 | 0.35 | 0.35 | 0.34 |
| Salary of customer service dept. | 0.08 | 0.11 | 0.10 | 0.09 | 0.09 | 0.08 | 0.08 | 0.06 |
| Penalties Levied (CSD) | 0.68 | 0.21 | | 0.06 | 0.20 | | 0.51 | 0.41 |
| **Total External Failure cost** | **3.40** | **3.17** | **3.08** | **2.66** | **2.85** | **3.33** | **2.78** | **3.19** |
| Prevention Cost | | | | | | | | |
| Training cost | 0.00 | 0.00 | 0.14 | 0.00 | 0.00 | 0.05 | 0.00 | 0.08 |
| Man hrs spent on preventive maint. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.06 |
| **Total Prevention Cost** | **0.00** | **0.00** | **0.14** | **0.00** | **0.00** | **0.07** | **0.00** | **0.14** |
| Appraisal Cost | 0.06 | 0.08 | 0.10 | 0.07 | 0.06 | 0.07 | 0.06 | 0.07 |
| Dismantling for quality testing | | | | | | | | |
| Wages and salaries for inspection | 0.64 | 0.64 | 0.64 | 0.64 | 0.81 | 0.81 | 0.81 | 0.81 |
| Calibration | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.02 | 0.01 |
| **Total Appraisal Cost** | **0.70** | **0.72** | **0.75** | **0.71** | **0.88** | **0.88** | **0.89** | **0.89** |
| **Total Quality Cost** | **7.21** | **8.04** | **8.95** | **7.71** | **7.53** | **7.56** | **6.34** | **7.47** |
| Quality cost Rs./Luggage | 17.58 | 20.45 | 29.09 | 70.11 | 47.41 | 51.92 | 51.47 | 68.91 |
| % of Prodn Value | 2.27% | 3.18% | 3.80% | 6.11% | 3.58% | 4.18% | 3.86% | 6.22% |
| Production in pieces | 41018 | 39318 | 30762 | 10997 | 15891 | 14560 | 12321 | 10841 |
| Prodn in Rs. Lacs | 317.17 | 252.87 | 235.34 | 126.18 | 210.58 | 180.93 | 164.51 | 120.10 |

## VII. ANALYSIS

The total quality cost and quality cost/luggage is plotted over eight months as shown in Fig. 1 & 2 and is used for giving valuable suggestions for improvements in order to reduce the overall quality cost [4].

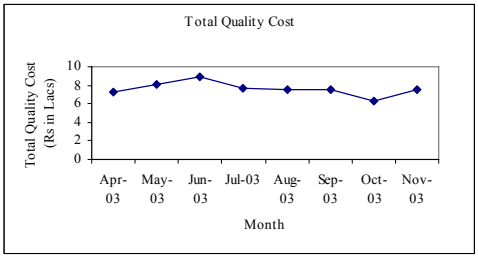


Fig. 1 Trend of Total Quality Cost

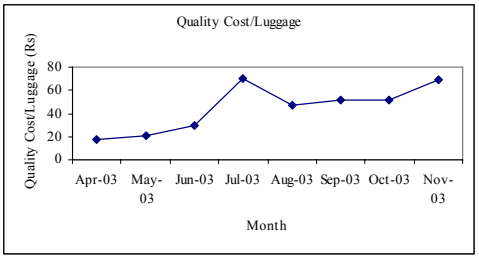


Fig. 2 Trend of Quality Cost/Luggage

## VIII. Conclusion

The main focus of the study was to review the literature and the research carried out by different authors in the area of quality cost. Standardise the cost elements in various quality cost categories as applicable to the industry under study. Quality cost system is developed for an industry. From the summary sheet it is noted that prevention cost is minimum. Main target areas are internal failure and external failure cost. Within internal failure cost, Breakdown maintenance and Spares and Consumables are the root points to be critically analysed. While in the External Failure Cost, Warranty adjustment is to be given main attention. Training and quality planning activities need to be encouraged which will definitely increase the prevention cost but will have reverse effect on appraisal and failure cost. This will definitely reduce the overall quality cost and the performance of the industry would improve.

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