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Cost of Quality for Automobile Industry: A Review

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Abstract: - *For any business to be globally competitive, there are two essential and integral criteria - cost and quality. Worldwide trade has uncontrollable growth rates due to highly significant working factors and strategies. The era of quality control is over, the new era is about New Product Development (NPD) considering overall quality, efficiency, features, after sales performance guarantee, morale building of customers and process development for first-time-right with zero faults and mistakes. This must be ensured right from raw material supplier, vehicle audit, supplier selection, monitoring of supplier quality and delivery, incoming inspection, development, design, perfect layout planning, right kind of machine tool procurement, systematic material movement planning, in-house process control. All of this has to be done at competitive cost planning and achieved, else you are liable to fail in the market. Defects are generated, are solved using the Six Sigma methodology. Six Sigma is the powerful methodology to drive improvement initiatives and reduce cost of quality. The cost of quality would help in analysing the operating costs for effective costs and profitable business management.*

Keywords: - *Automobile Industry, Cost of Quality, Dealer, Six Sigma, Supplier*

I. Introduction

The Automobile industry is a pillar of the global economy, one of the main drivers of macroeconomic growth and stability and technological advancement in both developed and developing countries, extending over many adjacent industries. Understanding the development of the automobile industry in different countries provides guidelines for developing countries like India. India's auto industry is the sixth largest producer of automobiles in the world in terms of quality and quantity. It has grown 14.4 % in the last decade, as revealed by the Society of India Automobile Manufacturers (SIAM). With more than 34 manufactures, the auto industry adds 7% to the GDP of the country and is also responsible for 7-8 % of the total employed population. The Indian Automobile industry covers around 2.6 million units having an output of approximate INR 2000 Crore per annum. For the past three decades, the total production of cars has been 40,000 per year. Earlier, the production had been limited to three main empires of automobile manufacturers, Hindustan Motors, Premier Automobiles and Standard Motors. There has been a huge increase in automobile production, with a catalyst effect by indirectly increasing the demand for several raw materials like steel, rubber, plastics, glass, paint, electronics and services.

The Automobile sector has been a large contributor to the GDP of India as compared to other sectors. Automobile sector being a large and fast growing, it is selected for further analysis. In the Automobile sector, competition in the market is increasing day by day. Such competition can be tackled with considerable amount of success if a customer needs addressed quickly. Customer needs must be met with least manufacturing cost, less lead time to bring the product to market and better execution than existing competitors in the market. Every company relies on innovation to compete globally. The task of delivering a new product or a novelty process as quickly as possible has become ever more essential to sustain in the market. Therefore, for Indian companies to compete with global companies, it is very much essential to be at a similar higher level of working, in all spheres of the business. Over the years, the automobile industry has become one of the most important sectors and one of the largest contributors to GDP.

II. Present Challenges In Indian Automobile Industry

The major challenges of Indian Automobile industry are mentioned below;

a) High customer expectation, b) Competition, c) Slowdown in the market, d) Provisions for Research and Development activities, e) Internal rejections, Rework, and Supplier quality problems, and, f) Recalls and Field failures.

a) High customer expectation: Customer's expectations are increasing day by day and are ever on the rise. This is the communication era and customer is aware of all aspects such as, product needs, requirements for performance, safety aspects, aesthetic appearance as regards colour, shape and interior decoration, operating performance viz., fuel economy, maintenance, serviceability, driving fatigue and comfort, the number of variants from low end to high end with enriched features, economical pricing.

b) Competition: It has become very vital and important to launch attractive models with innovative features and variants with quality, economical and affordable cost, before your competitor does it, with a lot of advertising, educating customers about the product, its enriched features and cost in comparison with the products offered by your competitors, to capture and retain market share. One should have an agreement and understanding with financial institutions, make easy and economical finance options available for customers, launch schemes sponsoring gifts, free insurance packages, loyalty bonus, extended warranty period, free roadside assistance if the vehicle breaks down and attractive buy back options for old vehicles.

c) Slowdown in the market: With the present slowdown in the market, many challenges are faced such as, space to keep already producing an inventory of vehicles, how to achieve break even and stop losses, how to cut down cost, reduce manpower, forecasting sales for following quarters, managing suppliers for slowdown of production, managing cash flow to keep the business alive etc.

d) Provisions for Research and Development activities: Budgetary provision for R and D activities essential to be innovative and remain in the business, to compete for future business, for market penetration and to maintain position and leadership in the market. Though the industry may be facing a crisis, you cannot afford to ignore or postpone this requirement.

e) Internal rejections, Rework and Supplier quality problems: To keep the product competitive with regard to economical pricing, it is important to consider factors that ultimately impact product costing and pricing such as, price criteria accounting for the costs of quality components, internal rejections, internal rework and supplier quality issues. All these need to be kept under total control. By limiting obvious costs like scrap and rework, companies completely overlook the most damaging hidden costs. Hence there is a need to analyze the tool necessary for implementation leading to performance enhancement.

f) Recalls and Field failures: This is another challenge faced by the automotive industry. Recall is mass call back of vehicles by the automobile company to rectify a problem after the sale and delivery of vehicles to customers. Recall means that some Automobile defect has escaped detection during all stages from design, manufacturing and testing, and reflects the poor quality of the entire quality management system and related business processes. Field failure is a breakdown of the Automobile after delivery, and within the service period for manufacturing defect. Correction of the problem is applied in the field and corrective action is taken inside the company or at the suppliers' end to overcome the problem.

A. Major recalls in the Automobile Industry

The Recalls in the Automobile industry are not a new trend as the giant automotive maker has been doing it from the 20th century. With developing technology, the occurrence of such a situation should have been blocked, but instead it has grown worse. One may attribute it to rising fuel costs, increase in competition, and higher expectations of customers and so on, but Automobile recalls are a reality, which can only be displaced by focusing on reducing quality cost. Measuring quality cost is an essential step in achieving competitiveness because these costs are strongly related to the company's annual revenue. One of the most important categories of quality costs is that of external failure costs. Assessment of COQ identifies areas where quality cost savings and reducing total poor quality costs and improving customer service activities that will increase customer satisfaction are possible. Some major recalls are mentioned in Table 1.

Table 1: Major Automobile Recalls (Source http: www.motortrend.com/new/recall and www.siam.in/siam-voluntary -recalls)

Company	Models Recalled	Recall Reasons	Date of Recall	Quantity
Mercedes Benz India	A, B, C class, CLA, GLA, GLC	The steering column may not be sufficiently grounded	06 Mar, 2018 12 Jun, 2018 14 Jun, 2018 02 May, 2018	2673 5520 4962 599
Maruti Suzuki India	Swift and Dzire	Airbag problem	25 Jul, 2018	1279
Honda Cars	City, Civic, Jazz,	Airbag problem	31 Jan, 2017	41580

India	Accord			
Maruti Suzuki India	Baleno, Swift Dzire	Fuel filter and air bag problem	27 May, 2016	93375
Nissan	Giant Nissan	Faulty braking system	25 May, 2013	22188
Toyota Motors	Corolla	Airbag problem	11 Apr, 2013	17.6 lakhs
Honda	Fit Sport	Electronic stability control system	27 Apr, 2013	46000
Hyundai Motor	Kia	A potentially faulty switch and a loose head liner	03 Apr, 2013	1.8 million
BMW	BMW	Potential electrical problems	19 Feb, 2013	7.5 lakhs
Toyota Motor	Prius	Steering mechanism and hybrid system water pump	14 Nov, 2012	7.8 million
Ford	Newly build vehicles	Defective child lock	12 Mar, 2013	7150
Ford	Minivans	Corrosion issue	12 Mar, 2013	2.30 lakhs
Suzuki	Swift	Operations are not impacted	07 May, 2012	1 lakh
Toyota Kirloskar Motor (TKM)	Innova	To rectify a faulty cable on the steering wheel	09 Apr, 2014	44989
Honda	Amaze, Brio	Faulty brake	06 May, 2014	31226
Maruti Suzuki India	Ertiga, Swift and DeZire	To replace a faulty fuel filler neck	05 Apr, 2014	1.03 lakhs

B. **The impact of Recalls**

Impacts of the recalls are mentioned below.

- 17.6% shares of Toyota were reduced due to recalls.
- Industry analysts and executives calculated approximately that it would cost around $250-million in warranty costs alone for Toyota.
- A new study indicates that the view of Toyota being a dependable car has reduced 30% from a year ago; moreover, Toyota has paid more than $48 million thus far in fines related to recalls.
- The sheer size of Honda recall, almost 4,00,000 cars, creates a difficult situation, as the number seems surprising and unbelievable to potential customers when they view the headlines.
- As quality cost increases, customer dissatisfaction increases, shifting the customer to a competitor, leading to decrease in profit and the share market of the company.

III. Qualaity Cost or Cost of Quality

"Quality Costs" is not the price of manufacturing products of higher level goods or service. It rather represents the dissimilarity between the real cost of a product and the amenities, and what the deduced prices would be if there were no chances of substandard service, failure of products, or faults and shortcomings in their manufacture.

3.1 Types of Cost of Quality (COQ):

Poor-quality cost is defined as all the cost incurred to help the employee do the job right every time, and the cost of determining, if the output is acceptable, plus any cost incurred by the company and the because the output did not meet all the required specifications and/or customer expectations. Table 2 lists the elements of Poor-quality costs.

Table 2: Elements of Poor Quality Costs

I. Direct poor- Quality Costs
A. Controllable poor - Quality Cost
1. Prevention cost
2. Appraisal cost
B. Resultant poor-Quality Cost
3.Internal error cost
4. External error cost
II. Indirect poor-Quality Costs
1. Customer-incurred cost
2. Customer-dissatisfaction cost
3. Loss of reputation cost

Prevention Costs: The costs of all activities specially designed to prevent poor quality of products or services. Examples are the costs of new product review, quality planning, supplier capability surveys, process capability evaluations, quality improvement team meetings, quality improvement projects, quality education and training.

Appraisal Costs: The costs associated with measuring, evaluating or auditing products or services to assure conformance with quality standards and performance requirements. These include the cost of incoming and source insection/test of purchased material; in process and final inspection or test; product, process, or service audits; calibration of measuring and test equipment; and the costs of associated supplies and materials.

Internal Failure Costs: Failure costs occurring prior to delivery of the products or furnishing of a service, to the customer. Examples are the costs of rework, reinspection, retesting, rework, trail review, and down grading.

External Failure Costs: Failure costs occurring after delivery of the product or after furnishing of a service to the customer. Examples are the cost of processing customer complaints, customer returns, warranty claims, recalls.

Customer-incurred PQC: Customer incurred COQ come into view when a product fails to meet the requirements of the customers. Some typical customer-incurred PQC are,

Loss of productivity while equipment is down; Travel costs and time spent to return defective merchandise; and, Repair cost after warranty period is over.

Customer Dissatisfaction PQC: Customers now require a much better product to satisfy their expectations and demands. Companies may very well be making parts to specifications, but the specifications may not be good enough to retain old customers, let alone attract new ones. Products that perform at an acceptable level today may not do so tomorrow and probably not the next day. The stress of market share holding is felt by competitors as well and there is no doubt about it as the market today is very competitive.

Loss of Reputation COQ: Loss of reputation and working strategies of COQ are very difficult to quantify. Similar is the case in predicting the reasons for customer dissatisfaction and customer incurred COQ. Expenditure incurred due to loss of reputation may change or develop from customer dissatisfaction costs in that they depend on the customers.

Cost of Conformance (COC) and cost of nonconformance (CONC) Quality Cost: BS 6143-1(1992) is a better method for applying quality to the company. The cost of quality has been separated into the cost of conformance (COC) and cost of nonconformance (CONC). COQ = COC + CONC. The cost of conformance (COC) is the process cost of providing products required for quality standards. The cost of nonconformance (CONC) is the failure cost associated with the process not being operated to the requirements. The process cost model can be applied for any process in the organization.

3.2 Quality Cost Elements:

Improving the bottom line is the goal, as many changes in further expenditure may increase the overall operational cost will decrease through the reduction of failure. Fig. 1 shows the size of diverse costs of quality constituents.

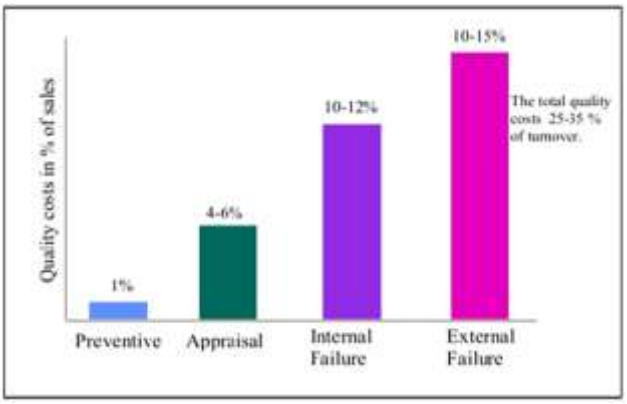

Fig. 1: Quality Cost Elements

3.3 Goal of Quality Cost:

As illustrated in Fig. 2, most costly condition occurs when a customer finds defects. The costliest position in the industry may occur when a customer finds defects or faults in the same. Had the manufacturer organization found the defects, through much inspection, testing and checking, a less increased expenditure condition would have resulted. If the manufacturing or service organization's quality program had been geared toward defect prevention and continuous quality improvement, defects and their resulting costs would have been minimized, thus leading the most desirable condition. The goal of any quality cost system thus can help in aiding quality improvement work done that will lead to functioning and management, that can lead to a much more cost reduction opportunities. The strategy for using Quality Cost is simple and is as follows.

- Take direct attack on failure costs in an attempt to drive them to zero;
- Invest in the right prevention activities to bring about improvement;
- Reduce the appraisal costs, according to the results achieved;
- Continuously evaluate and redirect prevention efforts to gain further improvement.

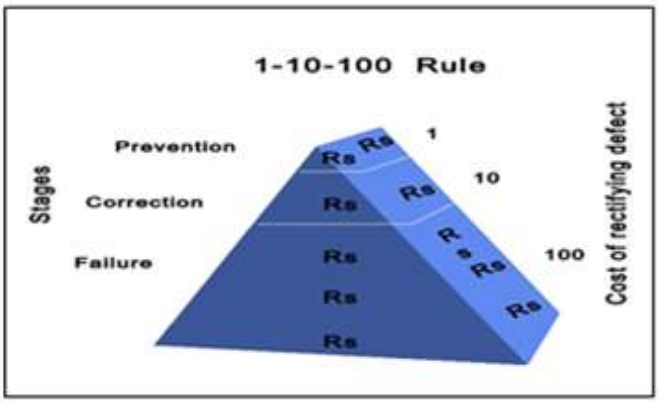

Fig. 2: Comparative Cost of Quality

3.4 Use of Quality Cost:

- A COQ system provides a means for monitoring operational performance and identifying an area for improvement with respect to costs.
- It can facilitate the identification and elimination of the organizational activities that do not provide or enhance quality from the customer's perspective, and help locate the source of hidden costs, which may be as much as 20 to 30 % of revenues.
- The 20 to 30% of annual sales of a company are dissipated in bad Quality Costs, i.e. internal and external failures. The information generated from a COQ system may also be used to demonstrate to employees the quality and financial impact of product, service, and process failure, to help generate support and provide financial justification for future quality initiatives.
- Helping managers and employees understand and control processes.

IV. Supplier Quality

With companies outsourcing their manufacturing to strategic partners across the globe and sell industrial products, they need to preserve their preferred supplier status to continue to be considered for future business. Thus, they are under pressure to ensure that their products continue to meet or exceed acceptable PPM and corrective action thresholds set by their customers. Hence, managing their own supplier's quality is very high on the agenda for these companies.

Most organizations do not track and measure the cost of poor supplier quality (COPQ) attributed to their suppliers. Such COPQ may add up to over 10% of the organization's revenue. Some companies only track supplier COPQ by measuring scrap and increase in material review board (MRB) inventory. Results have shown that materials account for less than 50% of the total COPQ. The following should be taken into account to calculate the actual COPQ.

- Scrap, rework, sorting and processing costs due to poor quality;
- MRB inventory and processing costs due to inspection failure;
- Using equipment that is capacity constrained for rework due to poor quality, reducing the overall utilization of the production line;
- Freight costs due to expedited shipping to customers/downstream plants;
- Warranty expenses due to poor quality; and,
- Recall expenses due to poor quality of products shipped to customers.

Quality Management Systems (QMS) or manufacturing systems can track whenever any of the above costs are incurred due to supplier quality issues. World-class manufacturers are using all the above factors to track the actual supplier-related COPQ.

V. Dealer Quality

Dealership service quality is essential for automaker reputation and profit. A more common customer service issue is failed repair. A company that allows dealerships to botch repairs not only faces high repeat warranty costs, but also a "below average" rating in consumer reports, which might not accurately reflect how well the vehicle was designed and produced. Many dealers' service processes, particularly for low- to mid-range car lines like Chrysler's, clearly disrespects customers' time and intelligence. Many people blame the company for dealer problems; either they don't realize that the dealership is individually owned, or they feel the company should not be tolerating bad dealers. The problem goes beyond lost customers. The amount of improper, incorrect or unnecessary repairs, often caused by not listening to customers or by ignoring factory service bulletins, can dramatically inflate warranty costs. Because dealer-caused problems are often blamed on the company by customers and their acquaintances, the company's reputation ultimately takes the blow.

VI. Six Sigma And Quality Cost

Six Sigma was a way for Motorola (1987) to express its quality goal of 3.4 DPMO where a defect opportunity is a process failure that is critical to the customer. A Six Sigma initiative focuses on reducing the costs of poor quality due to low sigma levels of performance. Designing new features (increasing the sigma levels) will enable management to reap increased customer satisfaction and bottom-line results.

Six Sigma is primarily a methodology for improving the capability of business processes by using statistical methods. Its goal is defect reduction (COQ) and it eliminates process variation poor quality costs by 20 to 30% of a company's revenues. Six Sigma improvement activities should be carried out in project form. In organizations it is built around customer's needs. The relation between Sigma level and defects per million opportunities (DPMO) is given in Table 3.

Table 3: Conversion of DPMO into Sigma

Defects per Million Opportunities	Sigma Level
690000	1
308537	2
66807	3
6210	4
233	5
3.4	6

Six Sigma is classed among initiatives for quality improvement and total quality management. The benefits of quality improvement initiatives argue their potential to increase customer satisfaction by improving product quality and reduce production costs by lowering costs associated with poor quality.

VII. Conclusion

- The Indian auto industry operating on the higher side of the range of COQ. Hence, the need for assessment and reduction of the OEMs COQ is very essential.
- Assessments of Supplier Quality Cost are also equally important.
- The Dealer Quality directly impacts on overall customer satisfaction/dissatisfaction and hence loyalty towards buying a product from a particular OEM. This has an impact on overall loss of customers. Likely loss of sale, which, when converted into cost, is a big impact on OEM Quality Cost. Hence, assessment of Dealer Quality Cost is very essential as it directly impacts OEM Quality Cost and also OEM
- DMAIC is a powerful methodology of Six Sigma to reduce COQ and improve Quality. Therefore, to improve the Quality level at a Six Sigma level, implantation of Six Sigma is indispensable for OEMs.
- DFSS is a systematic methodology of Six Sigma to enable the organization to design products and processes that meet customer expectations and can produce at six sigma quality level leading to reduction in COQ.

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