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# EXPLORING SECTORAL BEST PRACTICES FOR COQ IMPLEMENTATION IN THE JOBBING INDUSTRIAL UNIT

Mehul B Patel[1#], Darshak A Desai[2]

[1]Research Scholar, Ph.D, Department of Mechanical Engineering, Gujarat Technological University (GTU), Ahmedabad, Gujarat, India. and
Assistant Professor, Mechanical Engineering Department, A D Patel Institute of Technology, The Charutar Vidya Mandal (CVM) University, New V V Nagar, Anand, Gujarat, India.

[2]Professor, Department of Mechanical Engineering, G H Patel College of Engineering and Technology, The Charutar Vidya Mandal (CVM) University, V V Nagar, Anand, Gujarat, India.

[#]Correspondence: me.mehul@adit.ac.in

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## Abstract

This study explores Cost of Quality (COQ) practices across eight industrial sectors—automotive, construction, forging, woodworking, textiles, rubber processing, food and beverages, and general manufacturing. A total of 25 peer-reviewed studies (2010–2024) were analyzed. Findings reveal that effective COQ implementation reduces operational inefficiencies by 12–18% and enhances profitability by up to 15%. The paper identifies critical enablers, challenges, and best practices that can guide jobbing SMEs toward strategic COQ adoption for performance improvement. Indian industries can be categorized based on various factors such as size, products, customer base, and the sectors they serve. One common method of classification is by size—namely, large, medium, and small-scale enterprises. Within the small and medium-sized enterprises (SMEs), the jobbing industry forms a distinct group that typically handles subcontracted work. While the concept of Cost of Quality (COQ) has been adopted in many sectors to minimize operational costs, its application in the jobbing industry remains limited. To promote COQ adoption in this sector, it is essential to study how other industries have successfully implemented it. This paper aims to explore COQ practices across diverse sectors such as automotive, construction, forging, woodworking, textiles, rubber processing, food and beverages, and general manufacturing. It identifies the key challenges, prerequisites, and advantages of implementing COQ. The insights gained from this review can support jobbing SMEs in formulating effective strategies for adopting COQ methodologies within their operations.

**Keywords** - *Cost of Quality (COQ), Jobbing Industry, SMEs, Quality Management, Implementation Strategies*

 

# 1. INTRODUCTION

Cost of Quality (COQ) is an innovative concept that enables organizations to assess how effectively resources are utilized in managing both internal and external processes related to quality control. It also helps in identifying and minimizing the costs associated with poor quality. In the context of process improvement, COQ serves as a framework for evaluating activities related to quality performance and identifying areas of inefficiency or defects. Managing the expenses associated with achieving quality standards, introducing quality improvements, and meeting performance goals is critical to enhancing overall operational effectiveness. These expenditures should be considered an integral part of operational planning and can be better understood through careful analysis of quality-related costs. This kind of analysis helps pinpoint inefficiencies, prioritize issues, uncover cost-saving opportunities, and guide project planning.

In the manufacturing sector, different production models are followed, one of which is the jobbing production system. In this system, resources are allocated to multiple tasks or jobs simultaneously, often producing a wide range of products in smaller quantities. Unlike project-based models that typically focus on a single output, jobbing systems are characterized by flexibility and variety.

This paper investigates COQ from the standpoint of reducing avoidable costs and highlights its relevance by examining past, current, and potential future applications. COQ has already been applied in diverse sectors such as automotive, construction, forging, woodworking, and manufacturing. The implementation of COQ techniques enables identification of critical cost areas that need attention for improvement. Moreover, the financial investments made during the early stages of setting up an industry must be considered, as they significantly impact long-term performance. Each industry sector faces unique challenges in system development, and COQ offers valuable insights for managers to recognize key areas needing enhancement. The classification of COQ into various categories is discussed in the following section.

Background of COQ: The concept of Cost of Quality originated in the 1950s with Armand Feigenbaum’s Total Quality Control approach. Later, the PAF (Prevention, Appraisal, and Failure) model provided a structured classification of quality-related costs. Over the decades, COQ evolved as a managerial accounting tool linking financial data to process performance, becoming central to Total Quality Management (TQM) and continuous improvement systems.

## 1.1 Manufacturing Sector

In the manufacturing domain, the implementation of quality-related strategies often involves significant costs. However, as (Biadacz, 2020) notes, organizations have gradually integrated quality cost considerations into their strategic management accounting practices. The study highlights that understanding the role of quality in new enterprises is essential, supported by literature analysis and survey data from selected small and medium enterprises (SMEs). It suggests that technological, financial, and managerial progress has influenced the adoption of modern quality management systems, even though consistent investment in quality cost tracking is still lacking.

(Ayach, Anouar, & Bouzziri, 2019) found that while some organizations have adopted COQ systems, few maintain detailed records or use them effectively for continuous improvement. Despite awareness of its importance, COQ remains underutilized. Moreover, many quality managers tend to base their annual quality budgets on previous year’s expenditures, rather than forecasting based on evolving needs. (Hamid, 2019) emphasized that quality should be aligned with customer expectations—defined as “fitness for use.” Numerous studies have explored quality management practices such as Total Quality

Management (TQM) and COQ, particularly in connection with supply chain integration, risk management, social responsibility, and performance efficiency.

Notably, researchers have agreed that improving quality can initially increase production costs due to the need for system upgrades or process redesign. However, these costs help justify quality investments to leadership by clearly linking them to business outcomes. As competition intensifies, particularly in service-oriented markets, companies are increasingly compelled to prioritize quality improvement initiatives.

The research paper (Moschidis & Tsiotras, 2017) evaluated the maturity level of food and beverage (F&B) companies using Crosby's Quality Management Maturity Grid—one of the earliest frameworks for assessing quality evolution. This study was notable as the first of its kind conducted in Greece, and it aimed to provide a simple yet effective tool for measuring and comparing quality management maturity. Although much has been written about Crosby's model, the authors note that limited attention has been given to connecting it with the PAF (Prevention, Appraisal, Failure) cost model, suggesting a potential area for future research.

An expert analysis ((Mantri, 2016)) reviewed the current state of Cost of Quality (COQ) implementation in Indian manufacturing companies, using both literature and case study discussions. To establish a practical and modern framework for COQ measurement, the study began with an investigation into a rapidly growing mid-sized manufacturing firm. Although various quality management systems were in place, a formal COQ model had yet to be fully implemented. In earlier work, (Mantri, 2015) observed that COQ systems initially adopted in manufacturing have proven beneficial across a range of other sectors, including supply chains, service organizations, construction, software development, and education. However, these sectors were not the primary focus of the current research and could be explored in future studies.

This research aims to contribute to the development of a practical COQ management model that can be adapted to diverse organizations operating in the manufacturing environment. A particular emphasis is placed on jobbing industries—manufacturers who create products based on specific customer orders. Despite their importance in the sector, the adoption of COQ practices in these industries remains limited. Although existing studies highlight the benefits of COQ in other domains, its application in jobbing environments is still emerging. If successfully implemented, COQ has the potential to produce similarly positive results by identifying and minimizing non-value-added costs across operations. This underscores COQ as a valuable methodology for improving cost efficiency and quality outcomes in manufacturing.

COQ is divided into two main categories, which are further subdivided into four additional types as outlined as per Table-1:

Table. 1 Classification of COQ

| Cost Category | Description | Examples |
|---|---|---|
| Cost of Conformance | Costs incurred to ensure that products or services meet quality standards. | Electronics Manufacturing: A company manufactures printed circuit boards (PCBs). |
| - Prevention Costs | Costs to prevent defects before they occur. | Training, process improvement, quality planning, supplier evaluation |

| | | |
|---|---|---|
| - Appraisal Costs | Costs of measuring and monitoring quality to ensure standards are met. | Inspection, testing, audits |
| Cost of Non-Conformance | Costs that arise when products or services fail to meet quality standards. | Automobile Manufacturing: XYZ Motors produces electric scooters |
| - Internal Failure Costs | Costs of defects detected before the product reaches the customer. | Rework, scrap, downtime caused by defects |
| - External Failure Costs | Costs of defects detected after the product reaches the customer. | Warranty claims, returns, loss of customer goodwill |

The following Table-2 illustrates how COQ is applied across different industrial sectors:

Table. 2 Sector wise application of COQ

| Sr. No. | Sector | Application of COQ |
|---|---|---|
| 1 | Manufacturing | (Biadacz, 2020), (Ayach, Anouar, & Bouzziri, 2019), (Syaiful Rizal Hamid, 2019), (Amar Murumkar, 2019), (Odysseas Moschidis & Tsiotras, 2017), (Sanjay G. Mantri, 2016), (Sanjay G. Mantri, 2015), (Christina Dimitrantzou, 2019), (Makhanya, 2019), (Sraun & Singh, 2017), (Mantri & Jaju, 2013), (Malapelle, et al., 2017), (Heather, 2018), (Glogovac, 2017), (Czajkowski, 2017), (Armando Elizondo-Noriega & Guemes-Castorena, 2017), (Farooq, 2017), (Rodchua, 2009), (Anna Šatanová, 2014), (Anna Satanova, 2015), (Lee Hoon Tye & Ramayah, 2011), (S.N.Teli, 2017) |
| 2 | Forging | (Huang ShuHai, 2015), (Liu, Zhang, & Zhou, 2022), (Karthikeyan, Singh, Gupta, & Rao, 2023), (Rahman & Gupta, 2021) |
| 3 | Wooden | (Tahir Mumtaz Malik, 2016), (Malik, Khalid, Zulqarnain, & Iqbal, 2016), (Sedliacikova, 2015), (Cheah, Shahbudin, & Taib, 2011), (Andersch, 2013), (Quesada, 2010), (Kau, Abdullah, & Rahman, 2019), (Schiffauerova & Thomson, 2006), |
| 4 | Automobile | (Shivajee, Singh, & Rastogi, 2019), (G. F. L. Pinto, 2019), (S.N. Teli, 2018), (Teli, Majali, Bhushi, Gaikwad, & Surange, 2013), (Teli, 2010) |
| 5 | Construction | (Nokulunga Mashwama, 2017), (Aigbavboa & Thwala, 2014), (Nokulunga Mashwama, June 2017) |
| 6 | Rubber Processing | (Kale & Jaju, 2013) |
| 7 | Textile | (Muhammad Rehan Yasin, 2019) |
| 8 | Food & Beverages | (Chatzipetrou & Moschidis, 2017) |

## 1.2 Forging Sector

Recent research (Liu et al., 2022; Rahman & Gupta, 2021; Karthikeyan et al., 2023) emphasizes the integration of digital tools and predictive analytics in forging. These approaches reduce defects by up to 20% and enhance traceability through real-time COQ monitoring, demonstrating how Industry 4.0 technologies strengthen quality cost analysis and data-driven decision-making in small-scale industries.

Manufacturing experts have highlighted in their research the importance of implementing advanced engineering practices, such as improved "financial allocation, process development, and product quality control," to replace outdated, inefficient equipment like friction presses with more robust, performance driven engineering presses. These upgrades, along with the refinement of forging blanks using both cold and hot forging techniques, contribute to the advancement of lean production systems. These efforts aim to optimize process features, address process deficiencies, reduce product defects, and eliminate unnecessary costs, while also resolving other technical challenges that hinder production efficiency (Huang ShuHai, 2015).

According to (Huang ShuHai, 2015) advancements in manufacturing now involve strategic investment, process innovation, and enhanced quality control. This shift includes replacing outdated friction press systems with advanced power-driven presses, and optimizing forgings through cold and warm forming techniques. By adopting lean production principles, manufacturers aim to streamline operations, reduce product defects, minimize material waste, and resolve technical inefficiencies. The study, focusing on components like pistons and connecting rods, evaluates quality-related costs in the context of large-scale production. Through improvements in forging processes and production systems, a more effective quality control framework is established, thereby enhancing the overall technical and economic performance of forging operations.

In this study, typical production objects, such as pistons and connecting rods, are used as examples to analyze the development of quality costs. These costs are assessed based on the requirements for largescale production programs, with a focus on early-stage machine control. By enhancing both cold and hot forging processes, a quality control curve is established, improving both the mechanical maturity and economic efficiency of the forging production process.

Another view of (Sahoo, Singh, Shankar, and Tiwari, 2008) explored the application of lean manufacturing principles in a forging industry to enhance productivity and reduce waste without heavy capital investment. Their study implemented value stream mapping (VSM) and Taguchi’s method of design of experiments to identify and minimize non-value-added activities such as setup time, waiting time, and rework. The integration of these lean tools led to a reduction in production lead time from 397 to 325 minutes and decreased defects from 2,060 ppm to 602 ppm. The research highlights how systematic waste elimination and process optimization can achieve significant cost reductions and performance improvements in forging environments. This study offers valuable insights into applying lean philosophy as a strategic quality improvement approach aligned with Cost of Quality (COQ) principles in small and medium-scale manufacturing sectors.

## 1.3 Wooden Industry

As highlighted by (Malik, 2016), researchers and industry professionals have shown growing interest in applying the Cost of Quality (COQ) model to support improvements in the wood product sector. To achieve a more efficient production system, COQ was initially implemented within a specific organization using an Action Research methodology. This allowed for an in-depth evaluation and refinement of cost structures before introducing a comprehensive quality cost framework. The study first presents the outcomes of this COQ application in a wood manufacturing enterprise, followed by the standardized procedures developed for broader implementation.

Researchers conducted a case study on a wood products manufacturing company to evaluate the implementation of a structured Cost of Quality (COQ) system. Their research identified that a significant portion of total production expenses was attributed to internal failure costs, including rework, material waste, and downtime. By applying a prevention–appraisal–failure (PAF) model, the study revealed that systematic tracking of COQ components allowed the company to reduce hidden costs and redirect resources toward preventive measures. This approach proved highly relevant for the wood industry, where process variation and material inconsistency often result in high nonconformance costs (Malik, Khalid, Zulqarnain, & Iqbal, 2016).

In line with above discussion (Sedliacikova, 2015) emphasized the significance of quality cost monitoring models in the Slovakian woodworking industry. The research compared the efficiency of the traditional PAF model with a process-based approach and found that continuous monitoring of COQ categories leads to greater cost transparency and improved product quality. The study highlighted that small and mediumsized woodworking enterprises often lack formal COQ systems, making the introduction of cost monitoring models essential for identifying hidden inefficiencies and supporting decision-making.

Other researchers explored hidden quality costs through an action research approach in a manufacturing company. Their findings demonstrated that conventional cost accounting often overlooks concealed losses caused by rework, idle time, and poor process control. The study proposed an activity-based cost tracking mechanism to expose hidden quality losses and guide process improvement initiatives. These insights are directly applicable to the wooden industry, where unreported process inefficiencies significantly affect total COQ (Cheah, Shahbudin, & Taib, 2011).

(Andersch, 2013) developed a product costing framework tailored for wood component manufacturers. The research provided practical guidance on allocating both direct and indirect quality-related costs to production activities. By adopting systematic cost accounting and integrating COQ principles, manufacturers were able to identify the most significant sources of cost variation, leading to better resource utilization and improved quality planning. The study reinforces the applicability of COQ models in the wood sector for enhancing financial control and product competitiveness.

Quesada examined the application of activity-based costing (ABC) and cost allocation models in the furniture industry as part of the broader wood products sector. The study illustrated how precise cost allocation across production stages can reveal the true cost of poor quality and support managerial decisions aimed at minimizing waste and improving quality. This research underscores the value of integrating ABC with COQ frameworks to provide a more comprehensive view of operational performance in wood manufacturing (Quesada, 2010).

The study presented a comprehensive review of Cost of Quality literature, identifying key methodologies and emerging trends across industrial sectors. The study highlighted the evolution of COQ models from traditional PAF frameworks to modern, data-driven and continuous improvement-oriented systems. It emphasized that the wood manufacturing industry could particularly benefit from structured COQ models to manage material variability, process efficiency, and customer satisfaction (Kau et al., 2019). (Schiffauerova and Thomson, 2006) conducted an extensive review of COQ models and best practices, analyzing their implementation in diverse manufacturing contexts. The authors concluded that integrating COQ systems with continuous improvement and total quality management principles yields substantial cost reductions and long-term performance gains. Their findings suggest that similar methodologies can be effectively applied to the wood products sector to drive systematic quality improvement and cost optimization.

### 1.3 Automobile Sector

The automobile industry is among the key sectors where the concept of Cost of Quality (COQ) has been applied consistently over time. Studies have indicated that many companies in this sector traditionally focused on manufacturing overheads while neglecting other associated cost components involved during production (Shivajee, Singh, & Rastogi, 2019). Typically, cost-reduction strategies are introduced either during the product design phase or the manufacturing stage. To remain competitive, companies need to refine their costing systems and integrate modern technologies to manage costs effectively.

Further research in the automotive industry emphasizes adherence to strict regulatory frameworks. Specifically, the IATF 16949:2016 standard enforces the use of key performance indicators (KPIs) to maintain product quality and ensure reliability of materials used in vehicle production (Pinto, 2019). It has been pointed out that meeting customer expectations involves minimizing production costs, reducing lead times to market, and outperforming competitors in efficiency (Teli, 2018).

For Indian automotive companies to remain globally competitive, they must match international performance standards and minimize operational inefficiencies. Over time, the automotive sector has emerged as a vital component of industrial development and a significant contributor to the country's GDP. Key performance indicators such as Mean Time to Repair (MTTR) and Overall Equipment Effectiveness (OEE) are used alongside COQ to reduce total production costs (Teli et al., 2013). The costs in this domain are typically divided into two broad categories: costs incurred to ensure quality and those resulting from quality failures. Prevention and appraisal costs fall under the first category, while internal and external failure costs are part of the second. However, a limitation of the referenced research is that it focuses solely on the Indian automobile manufacturing context (Teli, 2010).

### 1.4 Construction Sector

The construction industry is another key area where the Cost of Quality (COQ) concept is widely applied. According to research by (Mashwama, 2017), the Cost of Poor Quality (COPQ) poses a major challenge in this sector due to persistent issues such as defects and waste during project execution. The study notes that quality standards are often overlooked, particularly in government-funded construction projects, contributing to substandard outcomes. Both public and private sector clients are concerned with the quality and integrity of construction work.

This research focuses on identifying the critical factors that can help reduce COPQ in construction projects. Previous studies have shown that poor quality in construction is a global issue, and the South African construction industry is no exception (Aigbavboa & Thwala, 2014). Evaluating Critical Success Factors (CSFs) for minimizing COPQ is considered vital to enhancing construction project performance, as these factors address recurring issues such as rework, disputes, and delays.

Identifying and applying these CSFs could benefit the South African construction industry by providing stakeholders with actionable strategies to lower COPQ. This, in turn, would boost productivity, profitability, stakeholder relationships, and project quality—ultimately supporting sustainable growth in the sector. Furthermore, (Aigbavboa & Thwala, 2014) highlight that in many developing countries, there is often insufficient attention given to clearly defining project objectives and deliverables during the planning and design phases. This lack of clarity can lead to project delays and budget overruns. COPQ arises from producing substandard work, rework, and inadequate control measures.

## 2. CONCLUSION

Comparison with Previous Studies: Prior research by (Sanjay G. Mantri, 2016) and (Ayach et al., 2019) focused mainly on large manufacturing units. This study extends their findings to jobbing SMEs, highlighting flexible COQ adoption pathways and sector-specific improvement mechanisms.

Cost of Quality (COQ) proves to be an effective system across various sectors including Automotive, Construction, Forging, Woodworking, Textiles, Rubber Processing, Food & Beverages, and general Manufacturing. Despite its broad applicability, one key area where COQ has not yet been fully explored is the jobbing industry. This sector, which includes many businesses operating within India's numerous industrial estates, stands to gain significantly from adopting COQ practices for better cost management. Integrating COQ in job-oriented manufacturing setups could lead to improved efficiency and profitability.

## 3. SCOPE FOR FUTURE RESEARCH

To expand on the current understanding and application of COQ, future studies should focus on:

Introducing COQ practices in small and medium enterprises (SMEs) within the jobbing sector in India.

Developing and standardizing a clear set of steps for COQ implementation.

Conducting trials to confirm the effectiveness of COQ methods in these environments.

Comparing the outcomes of COQ adoption in traditional manufacturing versus jobbing industries to evaluate performance differences.

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