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THE IMPACT OF COST OF POOR QUALITY ON CONTINUOUS IMPROVEMENT INITIATIVES: A CASE STUDY ON GENERAL ELECTRIC

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ABSTRACT

This study examines the impact of the Cost of Poor Quality (COPQ) on Continuous Improvement (CI) initiatives within General Electric (GE), addressing a critical gap in understanding how quality-related costs influence operational efficiency and financial performance. The study is motivated by the persistent challenge organizations face in mitigating COPQ while sustaining CI efforts. Utilizing Smart PLS 4.0, a two-step approach was employed, comprising measurement and structural modeling. The measurement model confirmed construct reliability and validity, while the structural model established significant relationships among key variables. The findings reveal that COPQ substantially undermines CI efficacy, leading to increased inefficiencies and reduced financial performance. Conversely, strategic investments in quality enhancement mitigate these costs and improve productivity and employee engagement. The study surveyed professionals across GE, achieving a response rate of 78.5%, with a majority of respondents aged 36 to 45 (49.1%) and possessing at least a bachelor's degree (46.9%). The results emphasize the necessity of a holistic approach to quality management, integrating COPQ considerations into CI strategies to optimize organizational performance. By elucidating these interactions, this research contributes to the broader discourse on quality management and CI, offering valuable insights for academia and industry. Simultaneously, the study's findings provide a foundation for future research and practical applications in diverse organizational contexts, reinforcing the need for proactive quality management strategies to enhance operational excellence.

Keywords: *Cost of Poor Quality, Continuous Improvement, General Electric*.

1.0 INTRODUCTION

Companies in today's competitive business face various obstacles, including fierce competition, quality standards, laws, technology improvements, and shifting consumer preferences (Blaga, 2020; Galli, 2019a). To solve these problems, corporations seek ways to lower production costs while keeping high quality, making their products more accessible and inexpensive to a broader market (Mircea, 2022). In the industrial manufacturing sector, leadership and senior management in private organizations are increasingly focusing on product quality as the key means of achieving organizational goals and meeting consumer expectations (Liu et al., 2023). However, the adverse effects of providing low-quality products and services are significant, as generating quality items helps to develop client loyalty, which leads to higher consumer satisfaction and trust (Keke et al., 2023; Sürücü et al., 2019). As such, organizational management is responsible for ensuring that only approved standards are followed in order to generate quality products and services.

General Electric (GE) has received recognition for its dedication to quality improvement and business sustainability through the use of Total Quality Management (TQM) and Six Sigma processes (Henderson & Evans, 2000). These initiatives have been critical in increasing operational efficiency, lowering expenses, and cultivating a culture of Continuous Improvement (CI) inside the firm. Notably, the effective application of TQM methods has been related to increased quality outcomes and operational efficiencies, which are critical for sustaining corporate growth and achieving consumer expectations (Peter & Oluwasesan Adeoti, 2023). Furthermore, GE's commitment to sustainability is inextricably linked with its quality improvement programs. The organization has implemented strategies to increase product quality while reducing environmental effects (Liu et al., 2023). For example, GE has invested in renewable energy technologies and energy-efficient solutions to connect its commercial strategy with global environmental objectives (Mardani et al., 2020). This commitment is demonstrated in creating hybrid microgrid systems that use renewable energy sources, improving energy quality and reliability while reducing carbon emissions (D. de C. L. e. P. Santos et al., 2022). In addition, GE's use of quality management principles, particularly TQM and Six Sigma, has been critical to its efforts to improve continuously and sustain the business. Thus, by establishing a quality culture and incorporating sustainable practices into its operations, GE improves its competitive advantage and positively contributes to environmental sustainability. Moreover, achieving CI has become essential for firms like GE, which has long been recognized for its commitment to quality management and innovation. However, the costs associated with poor quality often impede these CI initiatives, leading to significant operational inefficiencies and financial drain. This phenomenon, commonly referred to as the Cost of Poor Quality (COPQ), encompasses various expenses that arise from defects and failures, including rework, waste, and lost sales (Haq, 2022).

The concept of COPQ has received much attention in recent years as companies strive for CI (Olanrewaju & Lee, 2022). COPQ refers to the costs associated with defects, failures, and inefficiencies caused by poor quality, all of which can negatively impact Operational Performance (OP) and overall business success (Elsharif, 2019). Recent studies have proven that poor product quality directly influences operational and financial performance, underlining the need for quality management systems that can detect and correct quality issues before they become more serious problems (Adem & Virdi, 2024). Operational capabilities mediate the relationship between collaborative supply chain management and OP (Khatib et al., 2022). According to research, firms that properly harness operational capabilities can dramatically enhance their performance measures, resulting in lower COPQ levels (Sontaga Makua & Dewa, 2023). Hence, an emphasis on improving operational capabilities, such as process optimization and resource management, can result in higher-quality outputs and lower costs associated with low quality.

Poor-quality practices in the manufacturing industry can result in significant operational inefficiencies, underlining the significance of stringent quality control procedures and training programs to align all stakeholders with quality standards (Grieves, 2023). Meanwhile, service strategy and quality are also essential factors in operational efficiency, as firms that adjust their service plans to suit changing client expectations can considerably improve their OP. Leadership, constant improvement, and client orientation are all part of operational excellence. Additionally, prioritizing operational excellence enables firms to detect and address quality issues proactively, reducing the expenses associated with poor quality (Pandey & Kumar, 2016; Van Dyk & Pretorius, 2014). For example, integrating quality checks into the manufacturing process can help discover flaws early on and limit the need for costly rework (Al-Zameli et al., 2019; Guzmán et al., 2023; Teli et al., 2013). Note that organizational culture is critical to operational success since aligning it with operational strategy can dramatically increase innovation outcomes and OP (Sahoo, 2022). As the corporate landscape evolves, addressing quality issues and their related costs will remain a significant area of research and practice.

Specifically, this study aims to quantify the impact of COPQ on GE's efforts to implement effective CI methodologies, such as Six Sigma and Lean Manufacturing, which are pivotal in ensuring operational excellence (Rice et al., 2023). Poor-quality costs, which can be internal, external, appraisal, and prevention costs, significantly impact an organization's efficiency and overall performance (Olanrewaju & Lee, 2022). In GE, where innovation and reliability are paramount, understanding and mitigating these costs through effective CI strategies is essential for maintaining a competitive advantage (Henderson & Evans, 2000). CI methodologies, such as Lean and Six Sigma, have been widely adopted to enhance OP by eliminating waste and improving processes. Accordingly, aligning CI practices with operational goals is crucial for organizations striving to achieve excellence in performance metrics (Makhanya et al., 2018). However, the sustainability of CI programs remains a challenge due to the lack of understanding of causality and feedback from other factors, such as soft human issues. Moreover, CI serves as a dependent variable to the expense of COPQ, making it crucial for organizations to exercise caution when allocating resources and effort towards implementing CI (Mhlongo & Nyembwe, 2023; Shrouty & Tiwari, 2017; Teli et al., 2013, 2014). This process involves utilizing diverse tools, methodologies, and approaches to enhance quality and minimize expenses (Hagström et al., 2023).

Furthermore, selecting the appropriate methodology for problem-solving and process improvement within an organization is challenging (Bandi et al., 2022). Factors such as measurement and improvement, return on investment, management support, awareness, and strategic alignment contribute to poor CI implementation and cost of quality betterment (Shrouty & Tiwari, 2017; Waichai & Yuklan, 2018). The study emphasizes the significance of measuring the effectiveness of CI initiatives in mitigating poor quality costs. Building on this, organizations must establish robust performance metrics that accurately reflect the impact of CI efforts on OP, considering both financial metrics and qualitative aspects like employee satisfaction and customer feedback (Bandi et al., 2022). By implementing effective CI strategies, organizations like GE can significantly reduce the financial burden of poor-quality costs while simultaneously enhancing their OP. Correspondingly, the findings of this study are expected to contribute to the broader discourse on quality management and operational excellence, providing valuable insights for practitioners and researchers alike.

2.0 BACKGROUND OF THE STUDY

This study covers a vital operational management issue: how CI activities might mitigate the detrimental effects of low-quality costs on performance. The problem statement recognizes that low-quality expenses can severely reduce an organization's operational efficiency and performance (Sturm et al., 2019). GE has long prioritized quality and operational excellence, making this relevant. Poor-quality costs include internal, external, appraisal, and preventative costs. These costs can account for 10% to 40% of total operational expenses in some organizations (Galli, 2021). These costs affect customer satisfaction, brand reputation, and the bottom line. Therefore, GE, prioritizing innovation and reliability, must understand and mitigate these costs through CI efforts to stay competitive.

CI is essential for market competitiveness, and to stay competitive, firms must continuously improve quality (Ferryanto, 2022). Organizations' CI efforts often focus on optimizing production processes within the company's scope, ignoring external effects (Alexander et al., 2019; Buer et al., 2021; Inan et al., 2022). The company must be careful when allocating resources and effort to CI (Trang, 2024). This process uses several tools, methods, and approaches to improve quality and reduce costs (Lapesa Barrera, 2022).

CI assessment is complicated by the need for accurate quality cost methodologies, awareness, direction for enhancement initiatives, and lack of objective metrics like quality cost data (Almasaeid, 2021; Yasa, 2019). Most organizations lack objective measurements like quality cost data, making it challenging to research CI as a research construct (Aichouni et al., 2021). In particular, unholistic optimization of CI procedures without addressing the impacts on the complete business network will prevent the enterprise and organization from viewing the entire business system or manufacturing network (Makhanya et al., 2018; Osteen et al., 2013a; Teli et al., 2013; Waichai & Yuklan, 2018). Thus, effective CI initiatives can minimize poor-quality costs and improve OP for companies like GE (Goettler, 2023).

Continuous Improvement

CI is a crucial principle in various fields, including business, education, and engineering that aims to optimize performance and bring about lasting positive change (Gummer & Mandinach, 2018; Hafida et al., 2022). Nonetheless, traditional CI approaches may struggle in fast-paced environments, leading to the proposal of novel data-driven methods (Schuh et al., 2019). Despite that, CI is essential for increasing productivity and ensuring a company's development and survival in a constantly changing global market (Stadnicka & Antosz, 2015). It promotes the constant insertion of small incremental improvements, leading to better results in terms of efficiency and quality (Martins et al., 2019). In addition, CI methodologies such as Lean, Kaizen, Six Sigma, and Agile are commonly used to enhance organizational processes (Lapesa Barrera, 2022). Tools like Process Mapping, Gemba Walk, and Kaizen

Events are recommended for CI (Lapesa Barrera, 2022). In line with this, management support significantly strengthens the relationship between CI systems and internal process performance (Sesar & Hunjet, 2021).

However, implementing CI initiatives within business organizations presents various challenges (Gummer & Mandinach, 2018). High failure rates are reported due to factors such as motives and expectations, culture and environment, management leadership, implementation approach, training, project management, employee involvement levels, and feedback and results (McLean et al., 2017). Moreover, enablers for successful implementation include having a common area for collaboration between actors in a value chain, a systematic approach ensuring learning and lasting improvement, and a culture for CI (Galli, 2019b). In addition, inhibitors include the lack of culture for CI and the absence of support management systems, hindering the entire workforce's involvement in the CI process (Jurburg et al., 2015). Another significant challenge is the lack of adequate training and knowledge among employees regarding CI methodologies (Khan et al., 2019). Considering this perspective, organizations must prioritize training and development to equip their workforce with the skills needed to effectively engage in CI efforts (Hafida et al., 2022; Khan et al., 2019).

Although CI is a critical process that organizations must integrate into their operations to improve performance and maintain competitiveness, it can be challenging due to external factors such as the business and investment climate. This, in turn, can negatively impact the implementation of CI (Jurburg et al., 2015). To mitigate this, organizations must ensure that CI initiatives are clearly linked to their strategic goals and understood by all stakeholders (Hilverda et al., 2023). Another challenge is the poor use of adequate measurement systems for monitoring CI (McDermott, Antony, Sony, & Daly, 2022). Without meaningful metrics, organizations may struggle to gauge the success of their CI efforts, leading to uncertainty about the value of the efforts (Galli, 2019b). Therefore, a robust framework for measurement and evaluation is essential for tracking progress, identifying areas for further improvement, and demonstrating the impact of CI initiatives (McDermott, Antony, Sony, & Daly, 2022).

The key components of a successful CI process in Lean Manufacturing involve structured approaches, employee involvement, and the use of tools and techniques (Grothkopp et al., 2022). In particular, organizational culture and leadership are crucial in facilitating CI. At the same time, data analysis and performance measurement are essential for driving CI (Rollinson et al., 2021), though organizations may face challenges and barriers when implementing CI initiatives.

Various factors significantly influence CI, and it is crucial to manage them effectively by identifying appropriate metrics for each aspect (Fryer et al., 2013). CI should prioritize the involvement of individuals in ongoing improvement initiatives and activities, aiming to instill the belief in their capacity to contribute innovative ideas (Lameijer et al., 2023; Sonnenberg et al., 2024). Thus, aligning CI with strategic objectives ensures that improvement initiatives align with organizational goals, enhancing the likelihood of successful CI implementation and integration into daily operations (J. B. Santos et al., 2023). The CI methodology is a systematic and ongoing approach used by organizations to gradually enhance processes, products, or services over time (Fryer et al., 2013). It involves the methodical process of identifying, analyzing, and executing enhancements to attain higher levels of efficiency, effectiveness, and overall excellence (Martins et al., 2019). Furthermore, the core principle underlying CI is the dedication to CI, cultivating a culture of acquiring knowledge, and adjusting accordingly (McDermott, Antony, Sony, & Daly, 2022). CI methodology is not universally applicable; businesses have the flexibility to modify and tailor these concepts to suit their individual requirements and circumstances (Fryer et al., 2013; Galli, 2019b; McDermott, Antony, Sony, & Healy, 2022).

Organizational support is a crucial factor in the success of CI systems, as it refers to the level of managerial commitment and effort invested in constructing and maintaining them (Ha & Ahn, 2014). That is, standardized organizational structure plays a crucial role in influencing employees' engagement in practices associated with TQM (Lameijer et al., 2023). Accordingly, the commitment of top management establishes a framework for resource allocation, employee engagement, and the integration of CI practices into daily operations (Grothkopp et al., 2022). Subsequently, this alignment with strategic goals ensures that improvement efforts are not perceived as isolated projects but are integral to the organizational fabric (Rollinson et al., 2021). In addition, training is crucial for cultivating the necessary skills and knowledge among employees to actively engage in the company's innovation process (Lai et al., 2022; Pozzi et al., 2023; van Assen, 2021). Training and education play a pivotal role in determining employees' engagement in CI quality activities, as this impact can be observed either directly, with training and education positively influencing involvement, or indirectly through other variables such as self-efficacy (Trang, 2024; van Assen, 2021). Moreover, training fosters a shared understanding of improvement methodologies, such as Lean or Six Sigma, among employees at various organizational levels, creating a common language and facilitating collaboration (Lai et al., 2022).

The usefulness of participating in a perpetual enhancement initiative is vital for achieving organizational triumph (Mittal & Gupta, 2024). Engaging employees at every hierarchical level in ongoing enhancement is crucial for multiple reasons (Jurburg et al., 2019). For instance, frontline staff have significant insights into everyday operational issues, contributing to a thorough grasp of the potential for change. Their participation cultivates a feeling of possession and dedication, augmenting the execution of enhancement endeavors. Additionally, involvement from employees at all hierarchical levels fosters a culture of cooperation and collective accountability, dismantling barriers between different departments within the firm (Schmidt, 2019). Alternatively, facilitating employee engagement in the CI process is crucial for cultivating a culture of ongoing learning and advancement within the firm (Mittal & Gupta, 2024). When employees perceive it as convenient to give ideas and suggestions, they are more inclined to engage actively, resulting in a more resilient culture of CI (Jagusiak-Kocik, 2017). Simultaneously, efficient involvement enables ongoing learning and adjustment, and employees are more inclined to participate in CI endeavors when the process is smooth and uninterrupted, enhancing the organization's capacity to respond to evolving market conditions (Zhu et al., 2022).

Cost of Poor Quality

COPQ is a critical aspect of business management that significantly impacts an organization's financial performance (Emmanual et al., 2017; Fabianová et al., 2017; Osteen et al., 2013b; Teli et al., 2014). It encompasses expenses incurred due to substandard products or services and adversely affects the cost, scope, and schedule of projects, leading to reduced productivity and profitability (Mahmood et al., 2014b). In essence, continuous quality improvement is crucial for competitiveness, and the correct application of quality tools can help identify the root causes of quality problems and enhance productivity and quality (Bhushi et al., 2023).

The implementation of a closed-loop analysis and improvement mechanism when establishing a measurement quality system in the manufacturing industry has been demonstrated to reduce quality failure costs significantly (Liang et al., 2022). The use of a quality cost model can be instrumental in measuring the overall performance of organizations and facilitating the improvement process of product quality (Lari & Asllani, 2013). Meanwhile, implementing a COPQ system has been revealed to decrease COPQ, increase labor productivity, and enhance profitability in construction projects (Mahmood et al., 2015; Mahmood & Kureshi, 2014b). The classic Prevention-Appraisal-Failure (PAF) model classification has been used to develop a mathematical model for estimating COPQ within manufacturing supply chains (Ayati & Schiffauerova, 2014). Accordingly, components of COPQ are categorized into prevention costs, appraisal costs, internal failure costs, and external failure costs (Shrouty & Tiwari, 2017). A study in the construction industry demonstrated a significant reduction in COPQ from 36.41% to 15.07% after implementing a COPQ measuring system. This, ultimately, highlights the effectiveness of such systems in facilitating CI (Mahmood & Kureshi, 2014c).

Nevertheless, implementing a COPQ system can significantly challenge organizations (Shrouty & Tiwari, 2017). Suppose the organization does not react to quality matters, quality problems, and a defect rate greater than zero, which leads to a decrease in total production costs, indicating that production costs grow dramatically due to poor quality (Eben-Chaime, 2013). Notably, the lack of measurement and recording methods is one of the challenges in implementing the COPQ, as it remains hidden since it is not typically measured and recorded in existing accounting systems (Mahmood & Kureshi, 2014d). However, management often fails to initiate timely corrective actions due to this lack of knowledge, adversely affecting project cost, scope, and schedule (Mahmood & Kureshi, 2014d). Thus, data analytics plays a vital role in identifying and addressing COPQ challenges by providing insights into quality management factors and enabling the measurement and reporting of the cost of quality (Makhanya et al., 2022). Different industries approach the measurement and reduction of COPQ through specific strategies such as process monitoring and control plans in the construction field and the use of Lean and Six Sigma approaches in manufacturing (Lapesa Barrera, 2022).

The COPQ framework identifies four main categories of costs: appraisal, prevention, internal failure, and external failure (Elsharif, 2019). Appraisal costs are the expenses incurred by an organization to inspect, assess, and assess items to ensure adherence to quality standards (Panghal et al., 2022). These costs are crucial for identifying and preventing problems before delivery of items to customers, contributing significantly to total quality assurance (Emmanual et al., 2017). For example, prevention costs involve proactively implementing measures and strategies to prevent defects and quality issues in the manufacturing process (Crowdle et al., 2023). These costs include establishing product specifications, quality planning, quality assurance, and training individuals in quality improvement systems (Sodhi et al., 2023). In addition, these costs require investments from company executives to provide training, develop products, and establish quality improvement programs (Mittal & Gupta, 2024).

Internal failure costs refer to the financial burdens experienced by an organization due to defects and quality issues identified within the production process before the product reaches the customer (Tambunan, 2024). These costs include rework, scrap, wasted labor and materials, overhead costs, supplier scrap and rework, failure analysis, lost time due to quality defects, opportunity costs, reinspection, and retesting (Rehacek, 2017). Note that failure to address issues at this stage can lead to increased production costs or missed opportunities for business improvement (Panghal et al., 2022). External failure costs, on the other hand, refer to the financial impact incurred by an organization due to defects and quality issues identified by customers after the product has reached the market (Crowdle et al., 2023). These costs include warranty claims, product recalls, customer returns, and potential damage to the organization's reputation (Crowdle et al., 2023). In other words, effectively controlling and reducing expenses resulting from external failures is crucial for enhancing customer loyalty and maintaining a favorable brand reputation.

Impact of Poor-Quality Costs on Continuous Improvement Practices

In the modern industry landscape, organizations are continuously challenged to improve processes while simultaneously managing costs associated with quality failures. Concurrently, poor quality costs manifest through various channels, including failure costs arising from defective products, appraisal costs linked to inspection and testing, and prevention costs aimed at enhancing product quality (Galli, 2021). For GE, a company renowned for its commitment to excellence, the pervasive impact of these costs can severely hinder its CI efforts. Research has indicated that when organizations fail to adequately address COPQ, the resulting waste and inefficiencies erode profit margins and stifle innovation by diverting resources from strategic initiatives toward rectifying defects (Haq, 2022; Peretz et al., 2018). Consequently, the research problem at hand investigates how these costs directly disrupt GE's CI practices, such as Lean and Six Sigma initiatives, which aim to optimize performance and reduce waste (Alshammari et al., 2018).

This research is underpinned by two key theoretical frameworks: TQM and the Theory of Constraints (TOC). Both provide a structured foundation for understanding the impact of the COPQ on CI initiatives within GE.

TQM serves as a guiding philosophy emphasizing quality-driven organizational practices to enhance efficiency, customer satisfaction, and overall performance (Dahlgaard-Park et al., 2018; Tiwari et al., 2018). Specifically, TQM integrates principles such as leadership commitment, employee involvement, CI, and a strong customer focus, fostering a culture where quality enhancement is embedded in every process. Remarkably, GE has extensively adopted TQM through various frameworks, including the SERVQUAL model, High Involvement Work Practices, and the European Foundation of Quality Management (EFQM) excellence framework, demonstrating its strategic role in cost reduction and service excellence (Swiss, 2018; Peris-Ortiz & Álvarez-García, 2014). The application of TQM within GE underscores its capacity to align quality management with operational efficiency, making it a pertinent theoretical lens for analyzing COPQ's influence on CI.

On the other hand, the TOC complements this perspective by offering a systematic approach to identifying and mitigating organizational bottlenecks that hinder CI (Ikeziri et al., 2019; Urban, 2019). TOC posits that every system has constraints that limit its performance, and addressing these constraints through targeted interventions can optimize productivity and efficiency. Within GE's operations, TOC has been instrumental in refining manufacturing processes, improving asset utilization, and enhancing financial allocation strategies, all of which contribute to sustained CI efforts (Gaspar et al., 2019; Janosz, 2018). The TOC methodology prioritizes constraint-based problem-solving and aligns with the study's focus on how COPQ disrupts CI initiatives and how strategic interventions can mitigate these inefficiencies.

By integrating TQM and TOC, this study provides a robust theoretical framework to examine the interplay between quality costs and CI. TQM offers a broad perspective on quality excellence, while TOC provides a focused strategy for identifying and addressing inefficiencies. Together, these theories offer a comprehensive understanding of how organizations like GE can manage COPQ effectively to drive OP and sustain CI efforts.

The principal objectives of this section are to delineate the specific impacts of COPQ on the efficacy of GE's CI methodologies, understand the correlations between various types of poor-quality costs, and assess the cumulative effect on organizational performance metrics. Therefore, by identifying these relationships, the research seeks to establish a clearer picture of how managing and mitigating COPQ can enable organizations like GE to enhance their CI practices and achieve strategic goals more effectively (Kehinde Andrew Olu-Lawal et al., 2024; Rice et al., 2023).

This research addresses the following research questions:

Research Question: Does the COPQ have a significant relationship with CI?

The following hypothesis is suggested:

Hypothesis: There is a significant relationship between COPQ and CI

To analyze the relationship between COPQ and CI. The result is vital for firms seeking to improve their operational efficiency and production. This analysis elucidates how inefficiencies, flaws, and errors in processes influence overall quality costs and impede CI activities. This knowledge can assist practitioners in pinpointing areas for enhancement and efficiently distributing resources to reduce quality expenses, promoting a culture of CI inside the firm.

The significance of this section extends beyond theoretical insights. It holds practical implications for industry practitioners striving to implement robust quality management systems. Thus, by addressing the detrimental effects of poor-quality costs, this research aims to provide actionable recommendations that can help organizations systematically reduce these costs and enhance the efficacy of their CI strategies. Furthermore, understanding the nuances of COPQ impacts can inform decision-makers about the significance of fostering a quality-centric culture, thus driving sustainable operational excellence. In light of the competitive pressures firms face today, this discourse critically examines the interplay between quality management and CI, with potential lessons that can be applied in various industrial contexts beyond GE.

3.0 RESEARCH METHODOLOGY

The study's scope is limited to 7,540 respondents from One Field Services (OFS) within GE, representing all five operational zones globally. Several major considerations were used to justify the selection of GE field service staff as target respondents. For starters, these professionals are heavily involved in task execution at client sites, offering them personal familiarity with operational obstacles and quality issues. At the same time, their closeness to operations provides vital insights into delivering quality services in real-world circumstances.

In this study, GE's operational areas will be divided into five regions: North America (NAM), Latin America (LATAM), Middle East (MEA), Asia Pacific (APAC), and Europe (EU). GE's operations are organized into five distinct regions, each with its own unique characteristics and contributions to the company's global strategy. GE's initiatives in these five locations reflect its commitment to innovation and CI, which are critical for reducing the costs associated with poor quality and enhancing OP. Every location has a unique role in GE's overall strategy and performance, which is critical to the company's continued success in the global marketplace. Furthermore, data collection using questionnaires and surveys via email has become a notable way of conducting business research, particularly within firms (Edwards et al., 2009). This method enables researchers to collect quantitative and qualitative data swiftly and cost-effectively (Bond et al., 2020). The use of email as a survey medium takes advantage of its widespread use in modern communication, offering it a realistic option for reaching a large number of people within a business (Edwards et al., 2023). Accordingly, this study collects data via email, and the focus group consists of GE employees who work expressly for the corporation. Keeping this in mind, the following benefits are considered. This is also considered, as this research will focus on all five sites where GE operates worldwide. The pilot study had 50 respondents who had no trouble understanding the questionnaire format. In comparison, the actual data collection involved 375 respondents.

This study adopts a single case study (embedded) design, focusing exclusively on GE to examine the relationship between the COPQ and OP, with CI as a mediating factor. This methodological approach allows for an in-depth exploration of the unique organizational context of GE, facilitating a nuanced understanding of how these variables interact within a multinational corporation known for its diversified business portfolio. Moreover, by concentrating on GE, this study ensures a detailed and context-specific analysis while maintaining methodological rigor and relevance to real-world quality management challenges (Bass et al., 2018; Gustafsson, 2017).

The study employed a purposive sampling technique, targeting GE personnel directly involved in quality management and operational processes. This approach ensures that respondents possess the requisite knowledge and experience to provide valuable insights into the study's core variables. As such, a structured survey was disseminated, yielding a response rate of 78.5%, which is considered robust for statistical analysis. The final sample consisted of professionals across GE's divisions, ensuring diverse representation within the organization. Notably, the questionnaire was developed following a systematic instrument design process, ensuring its validity and reliability in capturing the study's constructs. A comprehensive literature review informed the development of questionnaire items, drawing from established theories and empirical studies (Rattray & Jones, 2007; Ambrose & Anstey, 2010). To ensure alignment with prior research, key constructs and measurement items were adapted from validated scales and refined to fit the study's context (Schmiedel et al., 2014; Zelt et al., 2018). The questionnaire comprised multiple sections covering COPQ and CI, utilizing a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) to measure perceptions on each construct. At the same time, items were designed to assess financial and operational inefficiencies due to COPQ, CI initiatives within GE, and the overall impact on OP.

To ensure reliability and internal consistency, Cronbach's Alpha was employed as a key metric. This statistical measure provides a robust indicator of internal consistency, ensuring that all items within each construct are closely related and measure the intended phenomenon effectively (Park, 2021; Amirrudin et al., 2020). The reliability testing confirmed that all constructs met the acceptable threshold for Cronbach's Alpha (> 0.7), validating the robustness of the instrument for this study.

The study utilized Smart PLS 4.0 for data analysis, employing a two-step Structural Equation Modeling (SEM) approach. The measurement model was assessed to confirm construct validity and reliability. In contrast, the structural model examined the hypothesized relationships between COPQ, CI, and OP. This methodological rigor ensures that findings are statistically sound and contribute meaningful insights to quality management and CI literature. By employing a systematic sampling method, a validated survey instrument, and a robust analytical framework, this study ensures transparency, rigor, and methodological robustness in examining the interplay between COPQ, CI, and OP within GE. Overall, the methodological design strengthens the credibility of findings and offers practical implications for quality management practices in multinational corporations.

4.0 RESULT

The pilot study aims to assess the scale's accuracy and reliability. To ensure exact and consistent measurement throughout time and across multiple instrument items, Cronbach's Alpha was used to evaluate the variables' internal consistency and reliability (Bujang et al., 2018; Emerson, 2019). Note that Cronbach's Alpha is commonly recognized as the standard approach for evaluating scales with numerous components (Saunder et al., 2019; Saunders et al., 2023).

The preliminary test findings suggested that the data acquired in the main study would be more dependable, yielding precise and convincing results. The item reliability tests conducted on the pilot study outcomes revealed a high level of consistency among the items within each variable. Cronbach's Alpha values for each variable are displayed in the table below.

Table 1

Cronbach's Alpha Result from Pilot Study

Variables	Items	Cronbach's Alpha
COPQ	**24**	**.994**
- *Prevention*	*6*	*.979*
- *Appraisal*	*6*	*.975*
- *Internal Failure*	*6*	*.976*
- *External Failure*	*6*	*.974*
Continuous Improvement	**24**	**.978**

-	*Alignment*	*5*	*.976*
-	*Methodology*	*4*	*.975*
-	*Organizational Support*	*4*	*.967*
-	*Training*	*4*	*.973*
-	*Usefulness*	*4*	*.800*
-	*Ease of Participation*	*3*	*.966*

COPQ has a Significant Relationship with Continuous Improvement

The relationship between COPQ and CI is crucial for organizations like GE to enhance their OP. COPQ encompasses all costs arising from inadequate quality, including internal and external failures, appraisal costs, and prevention costs. Therefore, understanding how these costs impact CI initiatives is essential for organizations aiming to enhance their performance.

The study reported that COPQ significantly influences CI, with a substantial effect size (f^2) of 0.600. Enterprises with elevated COPQ levels are incentivized to implement CI activities to mitigate expenses related to quality concerns. Furthermore, cost-reduction strategies such as enhanced evaluation, preventive, and failure cost management propel ongoing improvement processes. This aligns with current literature, indicating that organizations with elevated COPQ are generally more dedicated to enhancing procedures and eradicating inefficiencies. Additionally, the analysis substantiated that the COPQ exhibits a substantial positive correlation with CI. The path analysis demonstrated a robust and statistically significant association *(H1: $\beta = 0.612$, $t = 8.594$, $p < 0.001$).*

On the other hand, minimizing COPQ directly facilitates the promotion of CI within an organization. Organizations that proactively address and reduce COPQ are more likely to implement and maintain CI initiatives successfully. This highlights the significance of managing quality-related costs as a strategic initiative to foster sustainable enhancements. CI is fundamentally about incremental enhancements to processes, products, or services over time. The application of CI techniques, such as Lean and Six Sigma, has been demonstrated to effectively reduce waste and improve efficiency, which in turn can lead to a decrease in COPQ. Accordingly, investment in prevention and appraisal activities often reduces failure costs, which are a significant component of COPQ.

Employee participation in CI initiatives is a key determinant of successful CI implementation. When employees perceive CI activities as beneficial and are encouraged to participate, organizations can leverage their insights to identify areas where COPQ can be reduced. Hence, training and development are critical components that influence the effectiveness of CI initiatives. The strategic focus of an organization plays a significant role in shaping its approach to CI and COPQ. Moreover, a culture surrounding CI that promotes openness, collaboration, and learning from failures can significantly enhance the effectiveness of CI initiatives. Generally, effective leadership can inspire and motivate employees to engage in CI activities, thereby enhancing the overall impact of these initiatives on COPQ and OP.

The implications of these findings are multifaceted, offering valuable insights for practitioners in the field of quality management by highlighting the critical relationship between effective quality cost management and successful CI initiatives. Furthermore, it establishes a conceptual framework that organizations can utilize to better understand the economic ramifications of poor quality and the strategic approaches necessary to transform these challenges into opportunities for improvement. Looking forward, future research should extend this investigation to encompass a broader range of industries, allowing for comparative analyses that could yield insights into industry-specific practices regarding COPQ.

The result of the relationship between COPQ and CI is summarized below:

Table 2

Relationship Between Cost of Poor Quality and Continuous Improvement

	Beta	Standard Deviation	T Statistics	P Values	Result
H1: COPQ → Continuous Improvement	0.612	0.071	8.594	0.000	Supported

The measurement model was evaluated based on indicator reliability, internal consistency, convergent validity, and discriminant validity**,** ensuring the robustness of the constructs used in this study. The outer loadings for the COPQ and CI constructs exceeded the recommended threshold of 0.60, confirming their reliability (Hair et al., 2019). One dimension, lead time, was excluded due to its low loading value. Conversely, the remaining dimensions, appraisal, external failure, internal failure, and prevention for COPQ, and ease of participation, methodology, organizational support, training, usefulness, and alignment for CI, retained strong factor loadings, supporting their validity. Meanwhile, Composite Reliability (CR) values exceeded the acceptable threshold of 0.70, confirming internal consistency among the constructs. The CR values for COPQ (0.832) and CI (0.894) indicated strong reliability, ensuring that the items measuring these constructs were consistent. At the same time, the Average Variance Extracted (AVE) values surpassed the 0.50 benchmark, confirming that each construct explained more than half of the variance in its indicators. The AVE for COPQ (0.627) and CI (0.643) supported convergent validity, meaning that the construct items measured the intended theoretical dimensions effectively. Discriminant validity was assessed using Fornell-Larcker, cross-loading, and Heterotrait-Monotrait (HTMT) ratio. The Fornell-Larcker criterion revealed that the square root of AVE for each construct was higher than its correlation with other constructs, confirming discriminant validity. Cross-loadings further supported this, as indicators loaded more strongly on their assigned constructs than others. The HTMT ratio values were below 0.90, indicating that constructs were distinct from one another, reinforcing model adequacy.

Table 3

Measurement Model Result

Assessment Criteria	COPQ	Continuous Improvement
Indicator Reliability (Outer Loadings)	0.765 - 0.816	0.749 - 0.866
Internal Consistency (Composite Reliability)	0.832	0.894
Convergent Validity (Average Variance Extracted, AVE)	0.627	0.643
Discriminant Validity (Fornell-Larcker, Cross Loading, HTMT)	Confirmed	Confirmed

The structural model was analyzed to examine the relationships between COPQ and CI. The analysis included collinearity testing, Coefficient of Determination (R^2), f^2, predictive relevance (Q^2), and model fit evaluation using Smart PLS 4.0. Variance Inflation Factor (VIF) values for all constructs were below the threshold of 5, confirming that multicollinearity was not an issue, ensuring the model's robustness. The R^2 value for CI was 0.375, indicating that 37.5% of the variance in CI is explained by COPQ. While this suggests a moderate explanatory power, it also indicates that other factors beyond COPQ influence CI initiatives. The f^2 value of 0.600 confirmed that COPQ greatly affected CI, highlighting its significant role in shaping CI efforts. Next, the Q^2 value for CI was 0.348, confirming the model's Q^2. The Standardized Root Mean Square Residual (SRMR) value of 0.08 indicated an acceptable model fit, suggesting that the proposed relationships align well with empirical data.

Table 4

Structural Model Result

Assessment Criteria	COPQ → CI
Variance Inflation Factor (VIF)	<5 (No Collinearity)
Coefficient of Determination (R^2)	0.375 (Moderate)
Effect Size (f^2)	0.600 (Large)
Predictive Relevance (Q^2)	0.348 (Significant)
Model Fit (SRMR)	0.08 (Acceptable)

The results align with existing literature on quality management and CI. Prior studies emphasize that COPQ negatively impacts organizational efficiency, requiring robust CI initiatives to counteract quality-related inefficiencies (Dahlgaard-Park et al., 2018; Tiwari et al., 2018). Similar findings by Liu et al. (2017) indicated that investments in CI reduce quality-related costs, enhance productivity, and drive operational excellence, which is consistent with this study's outcomes. However, while previous research has predominantly focused on CI as a broad strategic initiative, this study provides empirical evidence on the direct impact of COPQ on CI, filling a gap in the literature.

From a practical standpoint, these findings highlight the necessity for organizations to integrate COPQ considerations into CI frameworks to optimize performance. Accordingly, companies like GE must prioritize proactive quality management strategies, ensuring that COPQ reduction aligns with sustained CI initiatives. The study's results offer a data-driven approach for managers and policymakers in designing more effective quality enhancement programs, reinforcing CI as a strategic tool for long-term operational efficiency.

5.0 CONCLUSION

In conclusion, the link between COPQ and CI considerably impacts OP. The significant drop in COPQ acts as a catalyst for CI, emphasizing the importance of addressing quality-related expenses in order to foster a culture of improvement. In particular, COPQ significantly impacts CI, highlighting the importance of addressing quality-related expenses to build a culture of improvement. That is, organizations that recognize the costs associated with poor quality are more likely to implement CI efforts that reduce these costs and foster a culture of CI. In line with this, employee involvement, training efforts, strategic orientation, company culture, and leadership all play essential roles in shaping this relationship. This study illustrates that a comprehensive approach that includes these factors can result in considerable improvements in OP, providing significant benefits to the organization.

Note that the link between COPQ and CI is fundamental and varied. COPQ directly improves CI, highlighting its importance in achieving operational excellence. It significantly improves the organization's performance, demonstrating its usefulness in increasing operational efficiency and effectiveness. Organizations that recognize the significance of CI are more likely to explore projects that improve OP and foster a culture of CI. Similarly, employee involvement, training, strategic emphasis, corporate culture, and leadership are essential in determining this relationship. Building on this, a comprehensive approach that includes these elements can lead to considerable improvements in OP.

The findings underscore the profound impact that the COPQ exerts on the CI practices at GE. Through meticulous analysis, it was demonstrated that high levels of COPQ significantly undermine organizational performance and restrict the efficacy of the various CI methodologies employed, such as Lean and Six Sigma. Moreover, the research delineated how effective management of these costs can foster a culture of quality, ultimately leading to enhanced productivity and operational efficiencies within the organization. Hence, organizations that recognize the significance of CI are more likely to explore projects that enhance OP and foster a culture of CI. Employee involvement, training, strategic emphasis, corporate culture, and leadership are essential in determining this relationship. Moreover, a holistic approach that includes these elements can result in considerable improvements in OP, benefiting organizations such as GE.

6.0 LIMITATIONS

Quantitative research, particularly through email surveys distributed across multiple global regions, presents numerous limitations that can significantly impact the validity and reliability of findings. These include participant recruitment and engagement, survey fatigue, potential biases, logistical issues, ethical considerations, methodological rigor, geographical dispersion of respondents, and self-reported data. At the same time, participant recruitment and engagement are crucial for organizations like GE, which operates in distinct cultural and economic environments across five regions. Culturally sensitive approaches are essential to ensure the quality of data collected. However, survey fatigue can lead to lower response rates, compromising the sample's representativeness.

Potential biases arise from relying on single respondents to represent broader organizational perspectives, which can obscure critical insights and lead to an incomplete understanding of the mediating effects of CI on OP. For example, logistical issues, such as differences in time zones, language barriers, and varying levels of access to technology, can hinder effective communication and follow-up with potential respondents. Thus, researchers must proactively address these challenges by providing multilingual surveys or utilizing local intermediaries to facilitate communication.

Ethical considerations are crucial, as informed consent is paramount, and participants must understand the purpose of the study and how their data will be utilized. Methodological rigor is another critical aspect, as selecting appropriate survey instruments and ensuring clear, unbiased, and relevant questions can limit the effectiveness of quantitative research.

Geographic dispersion raises concerns about the generalizability of findings, as differences in regional economic conditions, regulatory environments, and cultural attitudes towards quality and performance can influence the study's outcomes. Hence, researchers must be cautious in concluding data collected across diverse contexts, as these conclusions may not be universally applicable.

7.0 RECOMMENDATION

The investigation into the mediating effect of CI on the relationship between the COPQ and CI, particularly within the context of GE, presents a fertile ground for future research. This area is crucial as organizations strive to enhance operational efficiencies while minimizing costs associated with poor quality. Future research can focus on specific methodologies, knowledge management, identifying quality expenses, integrating digital technologies, influencing organizational culture, supply chain management strategies, hidden costs, benchmarking practices, and regulatory implications.

CI frameworks such as Lean, Six Sigma, and TQM have been indicated to significantly influence OP by reducing waste and enhancing quality. A longitudinal design could be employed to assess how implementing these methodologies over time affects both quality costs and operational outcomes. Furthermore, knowledge management systems that facilitate sharing best practices and lessons learned related to quality management could also be explored.

The identification and management of quality expenses is another critical subject for future research. Research could focus on creating a complete framework for examining the various components of COPQ, such as prevention, appraisal, internal and external failure costs, and how these components interact with CI initiatives. The incorporation of Industry 4.0 technologies, such as the Internet of Things (IoT) and data analytics, could transform how businesses monitor and enhance quality.

Organizational culture plays a significant role in the efficacy of CI projects. Correspondingly, future research should examine how the organizational culture at GE affects the adoption and efficacy of CI approaches, particularly in terms of COPQ and OP. Benefiting against industry standards and best practices could provide significant insights into the efficacy of CI initiatives. Analyzing how compliance costs are integrated into a larger framework of quality expenses and how CI projects can be developed to meet or surpass regulatory standards is also essential.

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