Addis Ababa University

College of Technology and Built Environment

School of Mechanical and Industrial Engineering

Modeling organizational performance through the integration of sustainable quality management practices: the case of Bishoftu motor vehicle engineering industry (BMVEI)

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Declaration

I hereby declare that the work which is being presented in this thesis entitled "Modeling organizational performance through the integration of sustainable quality management practices: the case of Bishoftu motor vehicle engineering industry" is original work of my own, has not been presented for a degree of any other university and all the resource of materials used for this thesis have been dually acknowledged.

Mesesret Bogale ----------- Sep 18/2025

Signature Date

This is to certify that the above declaration made by the candidate is correct to the best of my knowledge.

Dr.Gezahagn Tesfaye(PhD)(Advisor) ------------- Sep 18/2025

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Table of Contents

List of figures

List of tables

List of Acronyms

- *BMVEI (Bishoftu Motor Vehicle Engineering Industry)*
- *SQMS (Sustainable Quality Management System)*
- *TMS (Top Management Support)*
- *CF (Customer Focus)*
- *EI (Employee Involvement)*
- *TD (Training and Development)*
- *CI (Continuous Improvement)*
- *OP(Organizational Performance)*
- *OEE (Overall Equipment Effectiveness)*
- *COQ(Cost of Quality)*
- *IS0(International Organization for Standardization)*
- *TQM(Total Quality Management)*
- *JIT(Just-In-Time)*
- *SEM (Structural Equation Modeling)*
- *PLS-SEM (Partial Least Squares Structural Equation Modeling)*
- *HTMT(Heterotrait-Monotrait Ratio)*
- *VIF (Variance Inflation Factor)*
- *NFI (Normed Fit Index)*
- *AVE (Average Variance Extracted)*

Abstract

This study rigorously investigates the modeling of organizational performance through the integration of Sustainable Quality Management Systems (SQMS) within the tank overhaul sector at Bishoftu Motor Vehicle Engineering Industry (BMVEI), Ethiopia. Amidst operational inefficiencies, including extended overhaul times, elevated defect rates, and suboptimal capacity utilization, BMVEI typifies challenges in resource-limited manufacturing environments. Employing an explanatory quantitative research design and structural equation modeling (SEM), the study examines key SQMS dimensions—top management support, customer focus, employee involvement, training and development, and continuous improvement—and their direct influence on organizational performance. Empirical findings reveal statistically significant positive relationships, with customer focus and training showing the highest impact, collectively explaining 62.9% of performance variance. This research contributes a robust, context-specific framework linking sustainability principles with quality management to advance operational efficiency and product quality. The results provide critical theoretical and managerial implications, advocating the adoption of integrative sustainable practices to promote resilience and competitiveness in manufacturing industries within developing economies.

Key words: Sustainable Quality Management System, Organizational Performance, Operational Efficiency, product quality, Structural Equation Modeling

Chapter one

1.1 Introduction

The integration of sustainable quality management practices (SQMP)is a vital strategy for manufacturing industries worldwide to address increasing pressures related to environmental sustainability, regulatory compliance, and comparative advantage.specifically,the automotive manufacturing sector, including specialized industries like tank and armored vehicle overhaul, faces intense challenges to enhance operational efficiency and product quality while embracing sustainability. Global research suggests that the SQMP implementation can significantly reduce waste, improve process efficiency and promote customer satisfaction and brand loyality,leading to superior organizational performance and long term competitiveness (Sarkis,2020; Singh, D., Singh, H., Singh, J., & Kumar, R. ,2019)

In manufacturing industries, Sustainable Quality Management integrates traditional quality management objectives with sustainability principles, including environmental responsibility, social accountability, and economic growth. This integration supports compliance with international standards, operational excellence, and environmental stewardship, thereby fostering innovation and continuous improvement (Sarkis, 2020). In the automotive sector, in particular, benefits from SQMS through improved equipment effectiveness, defect reduction, shorter cycle times, and waste minimization, all of which contribute to stronger organizational outcomes in resource-constrained contexts (Thunyachairat et al., 2024)

Within Ethiopia, the automotive industry holds significant importance for economic development, technology advancement, and employment generation. The Bishoftu Motor Vehicle Engineering Industry (BMVEI), established in 1984 near Addis Ababa, is a key player offering maintenance and overhaul services for military vehicles, including tanks such as the T-72, T-55, T-89, BRDM-2, and TAPC 6X6. This factory's tank overhaul process consists of multiple stages, yet it currently suffers from operational inefficiencies — with overhaul times extending from the standard one month to two or three months, while operating at about 50% of its capacity and experiencing a defect rate of 15% (Quality inspection report,2025).

BMVEI’s challenges stem from organizational and operational weaknesses including inconsistent leadership commitment, substandard raw materials, limited employee involvement, insufficient training, poor communication, and weak documentation and testing practices. These issues directly affect the facility’s ability to meet the Ethiopian Ministry of Defense’s demands and underscore an urgent need for a more integrated and sustainable quality management approach.

This study addresses these challenges by exploring Sustainable Quality Management practices within BMVEI’s tank overhaul sector, developing a conceptual framework to demonstrate how integrative practices influence organizational performance. The research contributes theoretically by extending existing models, such as integrating the Triple Bottom Line (TBL) with Total Quality Management (TQM), to resource-constrained Ethiopian contexts, offering practical solutions to enhance operational efficiency and product quality.

The specific objectives include assessing the current state of SQMP at the tank overhaul factory, identifying root causes of quality and operational inefficiencies, developing a framework for integrating sustainable quality practices, and evaluating the effect of these integrated practices on organizational performance. Methodologically, the study employs an explanatory quantitative research design, using structured questionnaires and document reviews, analyzed through structural equation modeling (SEM) to explore causal relationships between SQMS dimensions and organizational outcomes in BMVEI’s tank overhaul sector

1.2 Back ground and justification

This study focuses on modeling organizational performance through the integration of sustainable quality management Practices within the Bishoftu motor vehicle engineering Industry (BMVEI) specifically in tank over haul sector. As an essential sector in Ethiopia's manufacturing landscape, the automotive industry plays a critical role in enhancing economic growth, employment, and technological advancement. This includes exploring how environmentally friendly and socially responsible quality management practices can lead to improved efficiency and product quality in the automotive sector.

The integration of sustainable quality management practices is essential for maintaining competitive advantage in global markets. These practices improve operational efficiency, enhance product quality, and increase customer satisfaction. For BMVEI’s tank overhaul sector, adopting sustainable methods can reduce waste and improve product reliability, contributing to Ethiopia’s economic and environmental sustainability objectives .By embracing these practices, the tank and armored vehicles overhaul factory can strengthen its operational performance and position itself effectively in Ethiopia's evolving automotive landscape, contributing to both economic growth and environmental sustainability.

Bishoftu motor vehicle engineering Industry (BMVEI), established in 1984 located in Debrezait, some 45 km to the south east of Addis Ababa, the capital city of the federal democratic republic of Ethiopia. Initially founded to provide maintenance and overhaul services for military vehicles and equipment, it has expanded its operations significantly over the years. With a workforce of over 1000 employees, the company operates in various sectors within the automotive industry. These sectors include powertrain production, vehicle production, construction machinery production, body and frame production, and tank and armored vehicle overhaul. This study specifically done on tank and armored vehicles overhaul factory and this factory overhauls different types of tanks which are T-72,T-55,T-89,BRDM-2 and TAPC 6X6 tanks .this all tanks have the same overhauling process. Tank maintenance and overhauling process have10 stages which are (Stage 1: Tank Inspection Team, Stage 2: Disassembling Line, Stage 3: Sandblasting, Stage 4: Body Repair, Stage 5: Painting, Stage 6: System Workshop, Stage 7: Power Train Workshop, Stage 8: Tank Assembling Line, Stage 9: System Test and Final Test 10: Delivery.) Research indicates that the Ethiopian automotive industry has not shown substantial growth primarily due to quality issues, which delay competitiveness.

Figure 1.1 Tank over haul process

The company’s vision emphasizes self-reliance in military hardware maintenance, making it a pivotal player in the country’s defense and infrastructure sectors. The key customer of tank and armored vehicles overhaul factory includes the Ethiopian Ministry of Defense. The organization's core activities are structured around the maintenance and production of various automotive components, serving both military and civilian needs.

The automotive industry is vital for economic growth in emerging markets like Ethiopia, particularly through the Bishoftu motor vehicle engineering Industry (BMVEI). Integrating sustainable quality management practices is crucial for optimizing organizational performance, enhancing product quality, and promoting environmental sustainability and operational efficiency within this key sector (Pacana&Czerwińska, 2020).

Quality management practices in the automotive sector have evolved to emphasize sustainability, driven by increasing consumer demand for environmentally friendly products and the need for compliance with international standards (Czerwińska et al., 2019). Studies indicate that organizations that integrate sustainability into their quality management frameworks not only enhance their competitive advantage but also contribute to broader economic and social goals (Dubey et al., 2015)

Therefore, the tank and armored vehicle over haul sector was selected due to its significance in Ethiopia's automotive sector and its potential for growth through sustainable quality management practices. This case offers a unique opportunity to explore how integrating sustainability can enhance operational performance, improve product quality, and increase customer satisfaction. Furthermore, it contributes to broader national development goals, making it an ideal subject for examining the impact of sustainable practices in an emerging market context.

1.3 Problem statement

Improving operational efficiency and product quality in the automotive sector increasingly requires adopting sustainable quality management techniques. As global manufacturing industries navigate environmental sustainability, regulatory compliance, and customer expectations, the need for efficient and integrated quality management systems has become urgent (Chiarini, 2017; Kumar et al., 2018). However, many organizations struggle with effective implementation, leading to persistent inefficiencies and product quality challenges that undermine competitiveness (Koufteros et al., 2015)

The tank overhaul sector is currently struggling with a range of quality-related challenges in its tank production and overhauling processes, which significantly impact operational efficiency and product quality. Symptoms of these challenges are evident throughout tank and armored vehicle overhaul operations.

In its service according to its plan and standard one tank fully overhaul process takes only 1-month but in current situation takes 2-3 months due to rework process and component rejection. The operational efficiency of the tank overhaul sector is inadequate because of it is operating at only 50% of its maximum capacity. Also the defect rate in the The Bishoftu Motor Vehicle engineering Industry (BMEVI), specifically in the tank overhaul sector, is a significant quality issue, standing at 15% (quality inspection doc, 2025). This indicates a critical need for improved quality management practices to minimize defects, reduce rework costs, and optimize the overall overhaul process. This is directly impacts the organization’s ability to meet the demands of its primary customer, the Ethiopian ministry of defense.

Root causes include inconsistent leadership commitment, substandard raw materials, limited employee involvement, insufficient training, poor communication, and weak documentation and testing practices (Oakland, 2014; Kumar et al., 2018; Kafetzopoulos & Psomas, 2015; Singh et al., 2019; Luthra et al., 2017; Talib et al., 2013). Addressing these requires integrating sustainable quality management practices to enhance accountability, improve material quality, empower employees, strengthen training, poor communication, and robustify documentation and testing, thereby reducing defects and improving efficiency.

Therefore, addressing these challenges requires the integration of sustainable quality management practices that strengthen accountability, ensure the use of quality inputs, enhance employee participation, improve workforce training, establish effective communication, and build robust documentation and testing systems. Embedding these practices into the Bishoftu motor vehicle engineering Industry (BMVEI) specifically done on tank and armored vehicles overhaul factory is essential to reducing defects, minimizing rework, and improving service delivery. In doing so, the organization can enhance both operational efficiency and product quality, while fulfilling its strategic role in meeting the defense needs of the country and ensuring long-term organizational performance

1.4 Research questions

- What is the current state of sustainable quality management practices in tank overhaul factory?
- How can a framework for integrating sustainable quality management practices be developed to address challenges in tank overhaul factory?
- To what extent does the integration of sustainable quality management practices influence organizational performance in tank overhaul factory?

1.5 Objective of the study

1.5.1 General objective of the study

To model organizational performance through the integration of sustainable quality management practices in the tank overhaul sector of Bishoftu motor vehicle engineering industry (BMVEI).

1.5.2 Specific objective of the study

- To assess the current state of sustainable quality management practices in BMVEI's tank overhaul sector.

- To develop a model for integrating sustainable quality management practices across tank over haul sector operations to enhance over haul performance.
- To evaluate the influence of integrated sustainable quality management practices on organizational performance in BMVEI's tank overhaul sector.

1.6 Scope of the study

This study focuses on modeling organizational performance through integration of sustainable quality management practices specifically within tank over haul sector in BMVEI.it includes stakeholder interviews, structured questionnaires, and direct observations of production processes, as well as analysis of internal documents. However, the research excludes border automotive sectors and unrelated manufacturing practices to maintain clarity and depth. This focused boundary allows for a detailed examination of unique challenges faced by tank over haul sector in BMVEI ,ensuring that the finding are relevant and actionable for improving operational efficiency and product quality in this specialized context.

1.7Limitation of the study

Limitations of the study include a shortage of documented data and, due to time constraints; some respondents may not have completed the questionnaires on time. The success of the study also depended on the honesty of respondents; some participants may have provided inaccurate answers, which could affect the accuracy of conclusions. Additionally, the study was conducted only in BMVEI’s tank overhaul sector, so the findings and recommendations may not fully generalize to other sectors or organizations.

1.8 Significance of the study

This research aims to provide valuable theoretical insights in to tank over haul sector regarding the integration of sustainable quality management practices.it will identify the critical factors influencing the adoption of these practices and offer recommendations for their effective implementation. These findings have the potential to enhance the growth and competitiveness of BMVEI tank over haul sector and contribute to the country’s overall development.addtionally; this research will be relevant to other developing countries seeking to implement sustainable quality management practices in their industries.

1.8 Organization of the study

The thesis was structured into five chapters as indicated below.

- **Chapter One: Introduction**

  The first chapter introduces the background of the study, statement of the problem, basic research questions, and objectives of the study, limitation and the significance of the study and further scope of the study is also presented.

- **Chapter Two: Review of Related Literature**

  This chapter deals with the review of existing literature to throw more light on the concepts of the subject matter which includes the theoretical, empirical, and conceptual literatures with regards to the topic of the study.

- **Chapter Three: Research Methodology**

  This chapter illustrated the research approach, research design, the source of data, data collection method, data collection instrument, data analysis method, validity &reliability, and research ethics.

- **Chapter Four: Results and Discussions**

  This chapter provided information on data presentation, analysis, Interpretation, and discussion of the findings of the study.

- **Chapter Five: Summary, Conclusions, and Recommendations**

  This chapter dealt with the summary, conclusions, and recommendations that will be drawn from the findings of the study.

Chapter two

2. Literature review

2.1 Introduction

This chapter presents a comprehensive review of existing literature related to sustainable quality management practices and their impact on organizational performance within the automotive manufacturing sector. It aims to establish a theoretical foundation for the study by examining key quality management theories, sustainability frameworks, and integrated quality and sustainability models that are crucial for enhancing operational efficiency and product quality. This chapter presents a comprehensive review of existing literature related to sustainable quality management practices and their impact on organizational performance within the automotive manufacturing sector. It aims to establish a theoretical foundation for the study by examining key quality management theories, sustainability frameworks, and integrated quality and sustainability models that are crucial for enhancing operational efficiency and environmental stewardship.

The relevance of sustainable quality management practices (SQMP) has grown significantly as industries strive to balance economic goals with environmental and social responsibilities. The literature highlights the evolution of quality management from traditional approaches to modern, sustainability-oriented frameworks that address complex challenges such as resource efficiency, waste reduction, and stakeholder engagement. Special attention is given to quality management theories including Total Quality Management (TQM), Six Sigma, Lean Management, and ISO standards, alongside sustainability theories like the Triple Bottom Line (TBL), Stakeholder Theory, and Circular Economy principles.

Additionally, the literature review explores the integration of sustainability into quality systems, demonstrating how this synergy leads to improved organizational performance measured through various operational, environmental, customer-focused, and financial metrics. Empirical studies from global and developing country contexts underscore the benefits, challenges, and best practices of adopting sustainable quality management in automotive manufacturing. These insights provide a critical backdrop for understanding the specific issues faced by BMVEI's tank overhaul sector and inform the development of a tailored organizational performance model.

The chapter concludes by identifying gaps in the existing research and justifying the need for this study, particularly in the Ethiopian automotive industry context, to contribute both theoretical advancements and practical solutions for sustainable quality improvements.

2.2 Theoretical review

2.2.1 Quality Management Theories

Quality management (QM) theories provide structured approaches to enhance organizational performance by ensuring products meet customer expectations. This section critically evaluates key theories Deming's PDCA cycle, Juan's Quality Trilogy, Crosby's Zero Defects, TQM, Six Sigma, and Lean Management and their relevance to BMVEI's tank overhaul sector. While these theories offer universal principles, their application in Ethiopia requires adaptation to address resource constraints, such as limited technology and supply chain vulnerabilities, as seen in similar developing markets (Iqbal et al., 2021).

2.2.1.1 Quality Management Theories

1. Deming's Theory: W. Edwards Deming's Plan-Do-Check-Act (PDCA) cycle emphasizes statistical process control and systemic thinking for continuous improvement (Oakland, 2014). At BMVEI, applying PDCA could reduce defects (15% per 2025 Quality Inspection Report) by using local data to monitor rework rates, though limited digital tools may require manual adaptations (Iqbal et al., 2021).
2. Juran's Quality Trilogy: Joseph Juran's trilogy—quality planning, control, and improvement—stresses management's role in setting clear goals (Singh et al., 2019). Masoudi and Shahin (2025) found that Juran's approach improves coordination in multi-stage processes, directly applicable to BMVEI's 10-stage tank overhaul process to address prolonged overhaul times.
3. Crosby's Zero Defects: Philip Crosby's "Zero Defects" concept focuses on prevention over inspection, using the Cost of Quality (CoQ) framework (Kazzaz, 2023). Mathura et al. (2024) showed that preventive practices reduced rework in automotive sectors, relevant for BMVEI's high defect rates due to substandard materials.

4. Total Quality Management (TQM):TQM emphasizes continuous improvement, employee involvement, and customer focus. Hananta and Susyanti (2024) demonstrated TQM's success in automotive manufacturing, improving quality and satisfaction. Masoudi and Shahin (2025) found TQM enhances sustainability in SMEs, relevant for BMVEI's need for cross-departmental collaboration to reduce overhaul times. In Ethiopia, TQM's participatory approach must navigate hierarchical structures (Iqbal et al., 2021). Six Sigma Theory: Six Sigma uses the DMAIC framework (Define, Measure, Analyze, Improve, Control) to reduce defects (Goetsch & Davis, 2010). Masoudi and Shahin (2025) reported reduced rejection rates in Taiwanese automotive firms using DMAIC. At BMVEI, Six Sigma could address defect rates but faces challenges from limited digital infrastructure, requiring manual data tracking (Iqbal et al., 2021).
5. Lean Management Theory: Lean focuses on waste elimination and process optimization. Karuppiah et al. (2024) showed Lean with Value Stream Mapping reduced waste in automotive firms. For BMVEI, Lean can address capacity underutilization (50%) in resource-constrained settings, as supported by Dubey et al. (2015).

In Summary QM theories (Deming, Juran, Crosby, TQM, Six Sigma, Lean) emphasize continuous improvement, process standardization, and customer focus. Their adaptation to Ethiopia's automotive sector, particularly BMVEI, requires addressing resource and technological constraints. Limited research explores these adaptations in developing-country contexts, highlighting a gap this study addresses by integrating sustainability into QM for enhanced performance.

2.2.1.2 Quality Management Models

1. ISO 9001 Quality Management System

ISO 9001 provides a standardized framework for quality management systems, emphasizing customer focus, leadership, process approach, and continual improvement. Certification to ISO 9001 has been associated with improved organizational performance and market competitiveness. The 2015 revision of ISO 9001 introduced a greater emphasis on risk-based thinking and aligning quality management with strategic direction (International Organization for Standardization, 2015).

2. Integrated Sustainable Quality Management Framework (iSQMF)

The convergence of QM and sustainability has led to the development of models that incorporate environmental and social considerations into quality frameworks. Sustainable Quality Management (SQM) emphasizes the integration of sustainability principles into QM practices, promoting long-term organizational success and stakeholder satisfaction. Studies have highlighted the importance of aligning quality strategies with sustainable growth objectives in the automotive industry (Karuppiah et al., 2024).

3. SERVQUAL Model

The SERVQUAL model assesses service quality by measuring the gap between customer expectations and perceptions across five dimensions: tangibles, reliability, responsiveness, assurance, and empathy. It helps organizations identify areas for service improvement (Goetsch & Davis, 2010).In Summary Models like ISO 9001, iSQMF, and SERVQUAL provide structured QM approaches with sustainability integration. Their application in Ethiopia's resource-constrained automotive sector is underexplored, justifying this study's focus on adapting these models for BMVEI's tank overhaul sector.

2.2.2 Sustainability theory

Sustainability theories serve as essential foundations for embedding environmental, social, and economic considerations into organizational strategies. In the last decade, theoretical advancements have emphasized a multidimensional understanding of sustainability, particularly in the context of quality management systems. The most dominant frameworks in recent literature include the Triple Bottom Line (TBL), Stakeholder Theory, Natural Resource-Based View (NRBV), emergent theories like Dynamic Capabilities Theory and Institutional Theory and Circular Economy Framework which extend classical models to better address sustainability challenges in dynamic and resource-constrained environments.

1. Triple Bottom Line (TBL) Theory

The Triple Bottom Line remains the most widely adopted framework in sustainability discourse. The theory proposes that organizations should prioritize three dimensions of performance: economic, social, and environmental. More recent literature revalidates this theory in practical contexts. (Opoku & Li, 2025) emphasized that TBL-guided organizations are more resilient, especially when sustainable principles are integrated into their quality management systems (QMS). They argue that focusing only on cost and efficiency undermines long-term organizational viability.

Furthermore, Thunyachairat et al. (2024, applied the TBL framework to the Thai automotive sector and found that TBL principles enhance organizational performance by aligning lean and quality strategies with sustainability goals. The study provides empirical support for TBL's relevance, particularly when integrated with operational excellence frameworks like Total Quality Management (TQM).

2. Stakeholder Theory

Freeman's Stakeholder Theory (1984) has been revisited and extended in recent literature to encompass sustainability challenges. According to (Opoku & Li, 2025), organizations that align their QMS with stakeholder expectations—ranging from regulatory bodies to local communities—report improved innovation, compliance, and reputation.

More specifically, Singh et al. (2019), showed that involving internal stakeholders (such as employees) in decision-making and quality improvement efforts led to better non-financial performance outcomes in the Ethiopian automotive sector. Their findings suggest that sustainable QMS must be inclusive and adaptive, recognizing the diverse interests of both internal and external stakeholders.

3. Natural Resource-Based View (NRBV)

Hart's NRBV (1995) has gained new traction as industries face heightened ecological constraints. According to recent extensions of this theory, firms gain sustainable competitive advantage by developing capabilities that promote pollution prevention, product stewardship, and clean technologies (Opoku & Li, 2025). Iqbal et al. (2021) applied this theoretical lens to the Ethiopian automotive industry, suggesting that firms that integrate Lean, TQM, and green initiatives can not only reduce waste and inefficiencies but also enhance their adaptive capacity in resource-scarce environments. The NRBV complements the TBL by focusing on how firms internalize environmental sustainability into core operational strategies.

4. Dynamic Capabilities Theory

This theory has emerged as a complementary approach to sustainability, especially in volatile business environments. It suggests that firms must continuously reconfigure their resources and competencies to maintain long-term competitive advantage. (Opoku & Li, 2025) argued that integrating sustainability into QMS requires dynamic capabilities such as organizational learning, innovation, and adaptive leadership. These capabilities help firms to not only react to sustainability pressures but also to proactively shape new markets and regulations.

5. Institutional Theory

Institutional Theory posits that organizational behavior is shaped by regulatory, normative, and cognitive pressures from the environment. Recent research like Dubey, et, al.(2022) shows how compliance with international standards like ISO 9001:2015 acts as a driver for sustainability by institutionalizing practices related to quality, ethics, and environmental stewardship. Particularly in developing countries, this theory helps explain the role of external mandates in shaping internal sustainability efforts.

6. Circular Economy Framework

A more recent theoretical development, the circular economy (CE), proposes a closed-loop system where waste is minimized and materials are reused. CE principles are increasingly embedded in quality management strategies to improve environmental performance and resource efficiency (Geissdoerfer et al., 2018).In automotive manufacturing; circularity can be introduced through design-for-reuse, remanufacturing, and end-of-life vehicle recovery systems.

In summary, Sustainability theories guide organizations in incorporating environmental, social, and economic considerations into operations. Frameworks such as the Triple Bottom Line (TBL), Stakeholder Theory, Natural Resource-Based View (NRBV), Dynamic Capabilities Theory, Institutional Theory, and Circular Economy (CE) provide mechanisms for firms to enhance competitiveness, improve environmental compliance, and align with stakeholder expectations These theories offer significant advantages by integrating sustainability into operations, supporting strategic decision-making, and fostering long-term performance. However, few studies investigate the combined effect of these theories on automotive performance in developing countries, leaving a research gap in understanding their holistic and synergistic impact under local constraints.

2.2.3 Integration of Sustainability into Quality Management (SQMS)

Traditional Quality Management (QM) principles, including Total Quality Management (TQM), Six Sigma, and Lean Manufacturing, have historically emphasized operational efficiency, defect reduction, and customer satisfaction. Core principles are Continuous Improvement (CI), Customer Focus (CF), Employee Involvement (EI), Training and Development (TD), Top Management Support (TMS), and Social Responsibility (SR) provide a robust foundation for achieving high-quality outcomes (Talib et al., 2013)

However, traditional QM primarily addresses operational and process efficiency, often overlooking the broader environmental, social, and economic impacts of organizational activities. With increasing global pressures for sustainability, there is a clear need to expand traditional QM principles to incorporate sustainability dimensions. This integration forms the foundation of Sustainable Quality Management (SQM), which balances quality, efficiency, and societal responsibility.

The integration of sustainability into QM involves explicitly integrating traditional principles with environmental, social, and economic sustainability, creating a more holistic framework that strengthens organizational performance. The following elaborates how each sustainability dimension enhances traditional QM practices and highlights the contributions of this research:

1. Environmental Sustainability

Environmental sustainability emphasizes reducing ecological impact, conserving resources, and optimizing production processes. This research extends traditional QM by demonstrating how principles such as CI and TMS can be leveraged to achieve measurable environmental outcomes:

- Continuous Improvement (CI): Traditionally aimed at defect reduction, CI is expanded to include environmental performance metrics such as energy efficiency, material waste reduction, and emissions control. CI ensures that environmental performance improves alongside quality (Talib et al., 2013)
- Top Management Support (TMS): Leaders play a crucial role in prioritizing environmental initiatives, allocating resources for eco-friendly technologies, and embedding sustainability into organizational strategy. The study illustrates that without TMS, environmental goals are unlikely to be fully realized (Nazir et al., 2024).
- Training and Development (TD): Employees trained in environmental best practices contribute to operational sustainability, ensuring that green initiatives are implemented effectively across all levels (Masudin, I.et.al.2025).

In summary Embedding environmental objectives into traditional QM processes improves overall equipment effectiveness (OEE) while reducing defects and waste in defense-sector manufacturing.

2. Social Sustainability

Social sustainability focuses on enhancing employee well-being, stakeholder engagement, and ethical organizational practices. The research extends traditional QM principles to explicitly address social dimensions:

- Customer Focus (CF): Beyond quality satisfaction, CF now includes stakeholder expectations for ethical, safe, and socially responsible products. In defense manufacturing, aligning with government and community expectations is critical for trust and credibility (Mathura et al., 2024)
- Employee Involvement (EI): Traditionally aimed at improving operational outcomes, EI now contributes to social responsibility, fostering employee engagement in ethical practices, innovation, and community-oriented initiatives (Restuputri, D.et, al.2025).

- Top Management Support (TMS): Leadership ensures that social sustainability initiatives are integrated into strategic decision-making, promoting policies that protect employee welfare and community interests (Nazir et al., 2024).

In summary, incorporating social sustainability into traditional QM strengthens organizational culture, improves stakeholder satisfaction, and enhances employee engagement, which is critical for operational resilience in the defense sector.

3. Economic Sustainability

Economic sustainability emphasizes long-term viability, cost-efficiency, and market competitiveness. This research elaborates on how traditional QM principles support financial sustainability when aligned with sustainable practices:

- Continuous Improvement (CI): Optimizes processes to reduce costs and improve productivity, contributing to financial sustainability (Talib, F et al., 2013).).
- Training and Development (TD): Traditionally focused on skills for quality improvement, TD now equips employees with sustainability competencies, enabling them to implement environmentally and socially responsible practices efficiently (Restuputri, D.et,al.(2025).

- Top Management Support (TMS): Leaders allocate budgets and resources strategically to balance sustainability investments with operational goals, ensuring alignment with organizational performance objectives Nazir et al., 2024).

In summary: Integrating sustainability into economic planning ensures defense-sector organizations can reduce operational costs, maintain regulatory compliance, and improve Return on Quality Investment (RoQI) while achieving broader social and environmental goals.

✓ By adding sustainability dimensions to traditional QM principles, this study transforms conventional quality management into Sustainable Quality Management practices that balances efficiency, environmental responsibility, social accountability, and economic performance. The research provides both a conceptual and practical contribution, demonstrating that integrating sustainability into traditional QM enhances organizational performance, stakeholder trust, and long-term viability especially in complex sectors such as defense manufacturing.

2.2.4 Performance Metrics Affected by Sustainable Quality Management practices

The integration of sustainable quality management practices (SQMP) into manufacturing and operational systems has been shown to significantly impact a wide range of key performance indicators (KPIs). These KPIs serve as measurable outcomes that help organizations assess improvements in operational efficiency, environmental performance, customer satisfaction, and strategic competitiveness.

1. Operational Performance Metrics

Several studies highlight improvements in operational efficiency following the adoption of SQMP:

- Overall Equipment Effectiveness (OEE): A critical metric in manufacturing, OEE is frequently improved through Lean and Six Sigma practices integrated with sustainability goals. For example, (Opoku & Li, 2025).reported significant increases in OEE after implementing a sustainability-focused quality improvement program in a South African automotive plant.

- Defect Rates & Rework: Studies by Kumar et al., (2018)and Singh, D et al. (2019) Show that defect rates and rework costs decline significantly when eco-conscious TQM and Six Sigma practices are implemented. In Taiwan, defect rates dropped as Six Sigma levels improved from 5.11 to 5.44.
- Cycle Time and Lead Time: The implementation of sustainable Lean practices, as discussed by Thunyachairat et al. (2024) in the Thai automotive sector, shortened production cycles and improved process flow while reducing environmental waste.

2. Environmental Performance Metrics

The emphasis on sustainability directly influences how firms track and reduce environmental impact:

- Waste Reduction: (Opoku & Li, 2025).noted that the integration of Just-in-Time and Lean Six Sigma in Ethiopian automotive firms led to measurable reductions in both production and packaging waste.
- Energy Consumption and Emissions: (Thunyachairat et al., 2024).reported that firms integrating ISO 9001:2015 with sustainability protocols saw improved energy efficiency and lower carbon emissions.
- Resource Utilization Efficiency: (Iqbal et al., 2021).highlighted that SQMS encourages more efficient use of raw materials, contributing to lower input costs and sustainable manufacturing.

3. Customer-Focused Metrics

Customer satisfaction is a central measure of quality success and is positively influenced by sustainability-oriented quality improvements:

- Customer Satisfaction Scores (Singh et al., 2019). found significant increases in customer satisfaction when TQM practices were aligned with sustainable service design and product innovation.

- Complaint and Return Rates: As per Rathilall & Singh (2018), customer complaints and product returns decreased in South African automotive firms following Lean Six Sigma enhancements that also met environmental compliance.

4. Financial and Strategic Performance Metrics

Although not always directly measurable through sustainability lenses, financial KPIs are positively impacted by sustainable quality integration:

- Cost of Quality (COQ): Studies such as (Opoku & Li, 2025). show that sustainable improvements led to reduced internal and external failure costs, effectively lowering COQ.
- Return on Quality Investment (RoQI): Firms adopting SQMP often observe improved ROI from quality programs due to better market performance and reduced penalties or compliance costs.

5. Human Resource and Organizational Culture Metrics

SQMP also affects soft metrics related to employee engagement and organizational learning:

- Employee Morale and Participation: (Iqbal et al., 2021emphasized increased employee involvement and morale where continuous improvement was aligned with sustainability training and recognition programs.
- Training Effectiveness(Opoku & Li, 2025).found that sustainability-focused quality training increased long-term employee retention and knowledge transfer.

In summary, SQMS positively influences operational, environmental, customer-focused, financial, and human resource performance. Operational gains include improved equipment effectiveness, reduced defects, and shorter cycle times, while environmental benefits involve waste reduction, energy efficiency, and better resource utilization .Customer-focused improvements include higher satisfaction and fewer complaints while financial performance benefits from lower Cost of Quality (COQ) and higher returns on quality investment .. Human resources benefit through improved employee morale, engagement, and training effectiveness Nevertheless, research gaps exist in examining the interactions among these performance dimensions and the long-term impact of SQMS in developing-country automotive industries, indicating a need for comprehensive, longitudinal studies.

2.2.5 Options of Modeling Softwares for the Thesis

The thesis titled "Modeling Organizational Performance Through the Integration of Sustainable Quality Management Practices: The Case of Bishoftu Motor Vehicle Engineering Industry (BMVEI)" primarily employs Partial Least Squares Structural Equation Modeling (PLS-SEM) to examine relationships among latent constructs, such as top management support and customer focus, and organizational performance (Hair et al., 2019). PLS-SEM is favored in quality management and manufacturing research for its predictive capabilities and robustness with smaller samples, as evidenced in studies on TQM and sustainability (Hair et al., 2013; Rasoolimanesh & Ali, 2023). The thesis utilized SmartPLS 4 for core PLS-SEM analysis and SPSS version 25 for descriptive statistics and reliability checks (Ringle et al., 2022; Khan et al., 2023). This review outlines step-by-step options for modeling softwares suitable for such theses, categorized by type (e.g., PLS-SEM-specific, general SEM, statistical analysis). Selections emphasize suitability for quantitative explanatory research with survey data (N=95), latent variable handling, path analysis, and validity tests (e.g., Cronbach’s alpha, AVE, HTMT), drawing from methodological literature (Hair et al., 2019; Sarstedt et al., 2022).

Step 1: PLS-SEM Specific Softwares (Primary Options for Latent Variable Modeling)

These tools are optimized for PLS-SEM's predictive focus, small samples, and non-normal data, as recommended in quality management applications (Hair et al., 2013; Sarstedt et al., 2022).

- **SmartPLS 4 (Used in the Thesis)**: A graphical tool supporting path coefficients, R^2, bootstrapping, HTMT, VIF, and model fit (e.g., SRMR) (Ringle et al., 2022). Strengths: User-friendly interface for iterative modeling; handles modest samples (like N=95); academic license ~$100 (SmartPLS, n.d.). Limitations: Less emphasis on covariance-based fit compared to alternatives (Khan et al., 2023). Why used/fit: Chosen for its predictive focus on explaining 62.9% variance in organizational performance; aligns with manufacturing studies (Thunyachairat et al., 2024).

- **ADANCO**: Dedicated PLS-SEM software with consistent PLS (PLSc) for reflective models and strong validity tools (e.g., HTMT) (Henseler & Dijkstra, 2015). Strengths: Cost-effective (~$100 academic); robust for discriminant validity (Sarstedt et al., 2022). Limitations: No advanced nonlinear features; limited GUI (Khan et al., 2023). Why an option: Could replace SmartPLS for simpler validity-focused analysis in quality management frameworks (Hair et al., 2019).
- **WarpPLS**: PLS-SEM tool specializing in nonlinear relationships and formative constructs (Kock, 2019). Strengths: Handles common method bias; step-by-step interface (Khan et al., 2023). Limitations: Niche (~$200 license); less community support (Sarstedt et al., 2022). Why an option: Useful if the thesis explored nonlinear effects in sustainable practices on performance (Hair et al., 2013).

Step 2: General SEM Softwares (Hybrid or CB-SEM Alternatives)

These support PLS-SEM extensions or CB-SEM for confirmatory testing, applicable if emphasizing theory confirmation (Khan et al., 2023; Sarstedt et al., 2022).

- **Mplus**: Hybrid for PLS-SEM/CB-SEM, with multilevel and Bayesian capabilities (Muthén & Muthén, 2017). Strengths: Robust for non-normal data; handles mediation/indirect effects (Khan et al., 2023). Limitations: Expensive (~$600); syntax-heavy (Sarstedt et al., 2022). Why an option: Could extend the thesis to longitudinal quality performance analysis, though less ideal for small samples (Hair et al., 2019).
- **AMOS (IBM SPSS Add-on)**: Graphical CB-SEM tool with PLS extensions; integrates with SPSS for descriptives (Arbuckle, 2019). Strengths: Easy path diagramming; bootstrapping for small samples (Khan et al., 2023). Limitations: Costly (~$500/year); assumes normality (Sarstedt et al., 2022). Why an option: Complements SPSS (used in thesis for descriptives); good for visualizing SQMP-OP paths (Hair et al., 2019).
- **LISREL**: Classic CB-SEM for linear models and multilevel analysis (Jöreskog & Sörbom, 2019). Strengths: Precise estimation for complex latent structures (Khan et al., 2023). Limitations: Steep learning curve; outdated interface (~$500) (Sarstedt et al., 2022). Why an option: If the thesis needed advanced confirmatory testing of sustainability theories (Hair et al., 2013).

Step 3: Statistical Analysis Softwares (For Descriptive and Supplementary Modeling)

These handle regression, factor analysis, or reliability checks, as used in the thesis alongside SEM (Hair et al., 2019; Khan et al., 2023).

- **SPSS Version 25 (Used in the Thesis)**: GUI for descriptives (means, frequencies), reliability (Cronbach's alpha), and basic regression (IBM Corp., 2017). Strengths: Intuitive for preliminary analysis; handles survey data well (Hair et al., 2019). Limitations: Limited to non-SEM modeling; expensive (~$1,000/year) (Khan et al., 2023). Why used/fit: Employed for demographic summaries and initial reliability (alpha >0.70); pairs well with SmartPLS (Sarstedt et al., 2022).
- **Stata**: Syntax/GUI for regression, clustering, and path analysis (StataCorp, 2023). Strengths: Strong diagnostics; good for econometrics in performance modeling (Khan et al., 2023). Limitations: Costly (~$800/year) (Sarstedt et al., 2022). Why an option: Could analyze direct effects of quality practices without full SEM (Hair et al., 2013).
- **SAS**: Enterprise tool for regression, ANOVA, and data mining (SAS Institute, 2023). Strengths: Scalable for manufacturing metrics (Khan et al., 2023). Limitations: Programming-intensive; high cost (Sarstedt et al., 2022). Why an option: For advanced statistical tests on overhaul efficiency data (Hair et al., 2019).

Step 4: Open-Source/Free Alternatives (Cost-Effective Options for Academic Theses)

These provide flexibility without licensing fees, suitable for resource-constrained research like in developing economies (Hair et al., 2019; Sarstedt et al., 2022).

- **R (with Packages like plspm, semPLS, lavaan)**: Code-based for PLS-SEM, regression, and EFA (R Core Team, 2023; Rosseel, 2012). Strengths: Free; customizable (e.g., bootstrapping scripts); integrates visualization (Khan et al., 2023). Limitations: Requires programming (Sarstedt et al., 2022). Why an option: Reproducible alternative to SmartPLS for path modeling and validity checks (Hair et al., 2013).
- **Jamovi**: Free GUI wrapper for R; supports regression, factor analysis, and basic SEM (The jamovi project, 2023). Strengths: SPSS-like interface; no coding needed (Khan et

al., 2023). Limitations: Fewer advanced PLS features (Sarstedt et al., 2022). Why an option: Easy substitute for SPSS descriptives and simple modeling (Hair et al., 2019).

- **JASP**: Free, graphical for PLS-SEM, regression, and reliability (JASP Team, 2023). Strengths: Intuitive; includes HTMT/VIF (Khan et al., 2023). Limitations: Less mature for complex models (Sarstedt et al., 2022). Why an option: Budget-friendly for theses validating quality-performance links (Hair et al., 2013).

Step 5: Machine Learning/Predictive Alternatives (If Shifting from SEM)

If the thesis emphasized prediction over causal modeling, these could forecast performance based on quality variables (Sarstedt et al., 2022; Khan et al., 2023).

- **Python (with scikit-learn, statsmodels)**: Scripting for regression, ML trees, and clustering (Pedregosa et al., 2011). Strengths: Free; handles predictive modeling (e.g., random forests for variable importance) (Khan et al., 2023). Limitations: Coding required (Sarstedt et al., 2022). Why an option: For non-latent alternatives to SEM in performance optimization (Hair et al., 2019).
- **RapidMiner**: GUI for ML workflows like regression and prediction (Hofmann & Klinkenberg, 2013). Strengths: Visual; free community version (Khan et al., 2023). Limitations: Pro features cost ~$2,500/year (Sarstedt et al., 2022). Why an option: Exploratory prediction of defect rates or efficiency (Hair et al., 2013).

Recommendations for Selection in This Thesis Context

For a thesis like yours (explanatory, small sample, latent constructs), PLS-SEM softwares (e.g., SmartPLS, ADANCO) are optimal for core modeling, with statistical tools (e.g., SPSS, R) for support (Hair et al., 2019; Sarstedt et al., 2022). Choose based on budget (free like R/JASP for academics), ease (GUI like SmartPLS/AMOS), or complexity (Mplus for extensions) (Khan et al., 2023). If avoiding SEM entirely, focus on regression in SPSS/R for simpler direct effects analysis (Hair et al., 2013)

2.3 Empirical review

2.3.1 Empirical Insights into Sustainable Quality Management Practices: A Global Perspective

Recent global studies affirm that sustainable quality management practices yield tangible benefits across industries. Sustainable quality management (SQM) has increasingly become a strategic imperative for industries worldwide, as organizations strive to align operational efficiency with long-term environmental and social sustainability. Empirical studies across various global contexts offer valuable insights into the design, implementation, and performance implications of SQM frameworks.

Thunyachairat et al. (2024) conducted a comprehensive study in the Thai automotive industry to evaluate the relationship between Total Quality Management (TQM), Lean practices, and firm performance. Using structural equation modeling (SEM), they found that the integration of sustainability principles into TQM and Lean frameworks significantly enhanced operational and environmental performance. Key success factors included leadership commitment, continuous improvement, and waste minimization.

Rathilall and Singh (2018) proposed a Lean Six Sigma framework tailored to the South African automotive sector. Their findings revealed that combining these quality management practices with environmental sustainability objectives led to reduced process variation, improved energy efficiency, and better compliance with international environmental regulations.The study emphasized that integrating quality with sustainability fosters a culture of proactive problem-solving and long-term thinking.

In a case study of a Taiwanese auto-parts manufacturer, Kumar, P et.al. 2018).demonstrated how Six Sigma tools improved both product quality and environmental outcomes. Through the DMAIC (Define, Measure, Analyze, Improve, Control) methodology, the firm reduced defect rates and material waste while achieving a measurable increase in sigma levels from 5.11 to 5.44. The case highlights how quality tools can be adapted to support sustainability goals without compromising efficiency.

Thirupathi et al. (2024) applied system dynamics modeling in the Indian manufacturing industry to explore the interdependencies among quality, sustainability, and performance. The model showed that investments in workforce training, green technologies, and process innovations yielded long-term environmental, economic, and social benefits. Their work highlighted the importance of feedback loops and strategic foresight in sustainable manufacturing.

Karuppiah, K.et.al 2024). analyzed ISO 9001:2015 implementation in Kenyan manufacturing firms. The results showed that the revised ISO standard—with its focus on risk-based thinking, stakeholder management, and continual improvement—helped firms achieve higher customer satisfaction, reduce non-conformities, and align their operations with sustainability objectives. Their study confirmed the effectiveness of international standards in embedding sustainability into routine quality processes.

(Opoku & Li, 2025). examined how sustainable quality management systems were being implemented in the Portuguese high-tech sector. They emphasized the role of leadership and organizational culture in successfully integrating environmental and social values into quality frameworks. Their research showed that SQM systems that embraced eco-innovation, employee participation, and lifecycle thinking contributed significantly to resilience and market competitiveness.

2.3.2 Empirical Insights into Sustainable Quality Management Practices: in local context and developing countries

In developing economies, sustainable quality management (SQM) practices are increasingly being recognized as key drivers of performance and competitiveness, especially in strategic industries like automotive manufacturing. However, due to infrastructural, financial, and institutional limitations, the adoption and integration of SQM frameworks in these contexts often differ significantly from their implementation in developed economies.

Singh et al. (2019) Conducted an empirical study in the Ethiopian automotive engineering sector to examine how Total Quality Management (TQM) practices influenced non-financial performance indicators. Their findings showed that specific practices such as employee involvement, customer focus, and continuous improvement had a positive impact on product quality, internal efficiency, and customer satisfaction. The study highlighted that sustainable quality efforts, even in the absence of heavy capital investment, could yield significant operational gains.

In one of the most comprehensive studies within Ethiopia’s automotive industry, Iqbal et al. (2021) developed an integrated continuous improvement model combining Lean, Six Sigma, and Just-in-Time (JIT) tailored for the Bishoftu automotive manufacturing cluster. The research revealed that this integration Reduced process variability, Improved production flow, Enhanced environmental compliance, and Strengthened the workforce's role in sustainable practices. Higher flexibility in production, Greater responsiveness to market changes, and Better quality assurance across the value chain. Their study suggested that environmental and social considerations when embedded into procurement, logistics, and inventory management could lead to significant improvements in both cost and quality metrics.

Beyond Ethiopia, other developing countries show similar progress. Njuguna and Ngugi (2020) analyzed Kenyan manufacturing firms implementing ISO 9001:2015. They found that adapting the standard’s quality and risk-based elements to local conditions helped firms improve stakeholder relationships, reduce customer complaints, and enhance overall process efficiency. This adaptation is particularly relevant to Bishoftu, where ISO-based models are being gradually adopted.

(Opoku & Li, 2025). assessed a quality improvement initiative in a South African automotive paint shop. Their results showed a substantial drop in production defects and better resource utilization—achieved through simple, context-appropriate quality tools aligned with sustainability targets.

summary: Empirical studies confirm SQMP’s benefits but lack context-specific applications for Ethiopia’s automotive sector. This study contributes by developing a tailored SQMS framework for BMVEI’s tank overhaul sector, addressing resource-constrained challenges.

2.3.3 Empirical Studies: Impact on Organizational Performance

A growing body of literature indicates that sustainable quality management practices are closely linked to improved organizational performance. The integration of sustainable quality management practices (SQMP) has been empirically linked to various aspects of organizational performance, especially in manufacturing industries. These practices when rooted in principles such as Total Quality Management (TQM), Lean, Six Sigma, and sustainability affect both financial and non-financial performance indicators. The empirical evidence supports the notion that sustainability and quality are not mutually exclusive but are synergistic drivers of performance improvement.

1. Empirical Evidence from Developing Contexts

Singh et al., (2019) analyzed TQM practices in Ethiopia’s automotive industry and found a strong relationship between sustainable practices particularly employee involvement, continuous improvement, and eco-conscious leadership and improvements in non-financial performance metrics. These included:

- Customer satisfaction
- Internal process efficiency
- Employee morale
- Waste reduction

They noted that performance gains were more pronounced when sustainability principles were embedded in everyday quality routines.

Similarly(Iqbal et al., 2021).proposed and validated an integrated continuous improvement framework in the Ethiopian automotive sector. Their empirical model, which incorporated sustainability into Lean, Six Sigma, and Just-in-Time systems, demonstrated significant improvements in:

- Product quality
- Resource utilization
- Energy efficiency
- Process reliability

The study concluded that sustainable integration helped manufacturers in Bishoftu reduce variability and operational costs while increasing market responsiveness.

In Kenya, Dubey et al., (2022) assessed ISO 9001:2015 implementation in manufacturing firms and found that integrating sustainability elements into quality management led to:

- Enhanced production reliability
- Greater stakeholder trust
- Improved environmental compliance

In South Africa, Opoku & Li, 2025examined the impact of quality improvement on production defectiveness in the automotive industry. Their findings indicated that Six Sigma deployment, when aligned with sustainability goals, significantly reduced:

- Rework rates
- Material waste
- Energy consumption

These improvements translated into enhanced Overall Equipment Effectiveness (OEE) and Cost of Quality (COQ) savings.

Kumar et al., 2023 studied the application of Six Sigma in an automotive manufacturing firm in Taiwan. The integration of quality tools with environmental impact assessments led to a sigma level improvement from 5.11 to 5.44. This demonstrated a direct correlation between process quality and sustainability-driven decision-making. Key metrics included:

- Sigma level improvements
- Cycle time reductions
- Carbon footprint per product unit

Thunyachairat et al., 2024explored the Thai automotive industry and found that the combination of TQM and Lean, supported by leadership and sustainability culture, enhanced:

- Innovation rate

- Delivery accuracy
- Operational agility

In summary, Empirical evidence demonstrates that integrating sustainability into quality management enhances operational efficiency, product quality and overall organizational outcomes. Global studies show that TQM, Lean, and Six Sigma frameworks improve process control, reduce waste, and increase customer satisfaction. In developing countries such as Ethiopia, Kenya, and South Africa, SQMP adoption has led to better resource utilization, defect reduction, and stakeholder trust. Despite these advantages, research gaps remain in understanding the long-term effects of SQMS adoption, the interactions among its dimensions, and the challenges of implementing these systems in resource-constrained environments, particularly in developing-country automotive industries.

2.4 Conceptual Framework

The integration of Sustainable Quality Management practices (SQMP) has become a strategic mechanism for improving organizational performance in manufacturing industries. SQMP emphasizes aligning leadership, customer focus, employee involvement, trainingand development, and continuous improvement with organizational operations. When systematically implemented, these elements enhance operational efficiency and product quality, thereby contributing to long-term organizational performance.

This study models organizational performance (OP) as the dependent variable and treats the main SQMP elements Leadership (top management support), Customer Focus, Employee Involvement, Training and Development, and Continuous Improvement as first-order antecedent constructs that influence OP. The conceptual model therefore tests the direct effects of each SQMP element on OP and will be estimated using PLS-SEM in Chapter Four (measurement model first, then structural model). Empirical studies in the automotive sector show that these dimensions, when applied systematically, improve operational efficiency, product quality, environmental compliance, and stakeholder trust (Abdi & Singh, 2021; Olalere & Ramdass, 2024; Sisay et al., 2021).

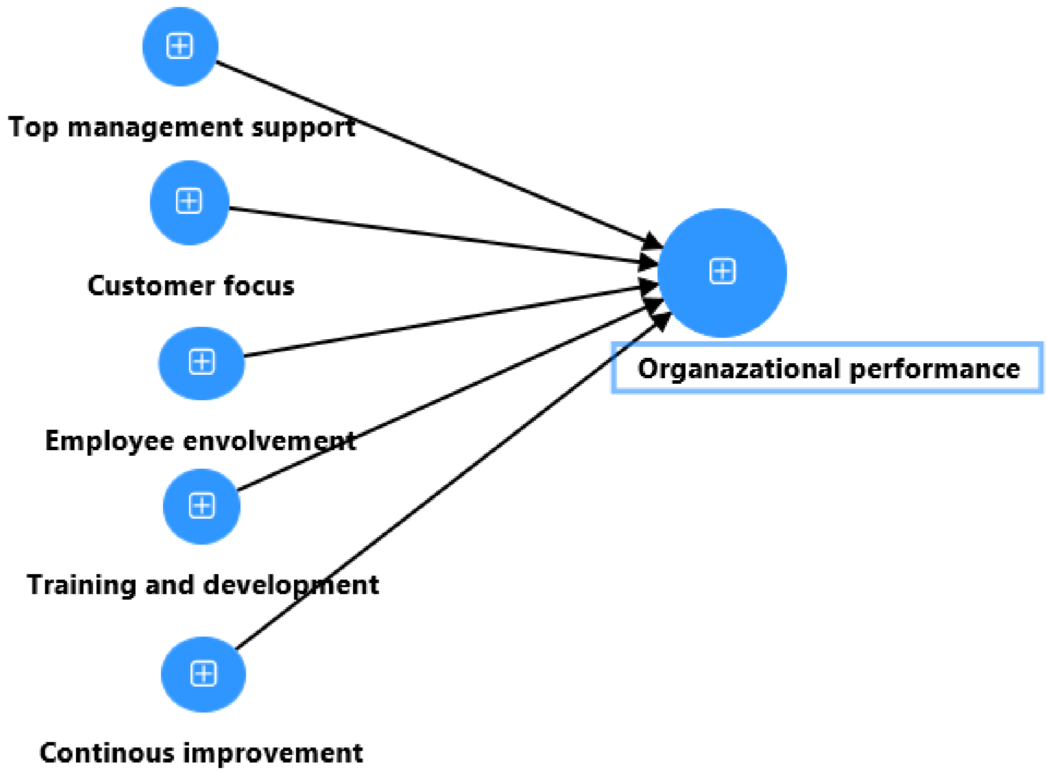

Figure 2.1 Conceptual Path Model

Chapter three

Research design and methodology

3.1 Introduction

This chapter focused on a detailed discussion about the research design and methodology of the study on modeling the relationship between sustainable quality management practices(SQMP) and organizational performance (OP) in the context of tank over haul sector.it explains the types of research strategy that the researcher adopted in the approach of data collection and methodology used in conducting this research out ling a good research strategy helps the researcher to reach an evidence based conculusion.it includes the research design, sources of data ,target population, sample size and sampling techniques. Additionally , it presents the data collection instruments, procedures followed for data gathering and the methods used for data analysis and presentation. the chapter also discusses the use of SPSS version 25 and SMARTPLS.04 software for statistically modeling and concludes with the processes used to access the validity and reliability of the questionnaire employed in the study.

3.2 Area of study

The Bishoftu motor vehicle engineering industry is the subject of the investigation. there are more than 50 automotive companies in Ethiopia ,according to data from metal industry development. Bishoftu stands out among the players in the automotive industry compared to other industries in Ethiopia. This study is conducted with specific focus on tank and armored vehicle over haul sector, which plays a vital role in maintain and refurbishing tanks and armored vehicles for the Ethiopian ministry of defence.the sector faces critical challenges, including prolonged overhaul times, high defect rates, and frequent rework, which hinder operational efficiency and product quality. This research investigates these challenges and examines the integration of sustainable management practices to address them. The study aims to identify root causes, propose practical causes solutions and enhance overhaul performance and quality within the tank over haul operations.

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3.3 Research framework

The research process ensures a methodical approach to obtaining valid and dependable results by identifying the research topic, choosing suitable methodologies, gathering data, assessing findings and making conclusions.

The framework that we used to do research is;

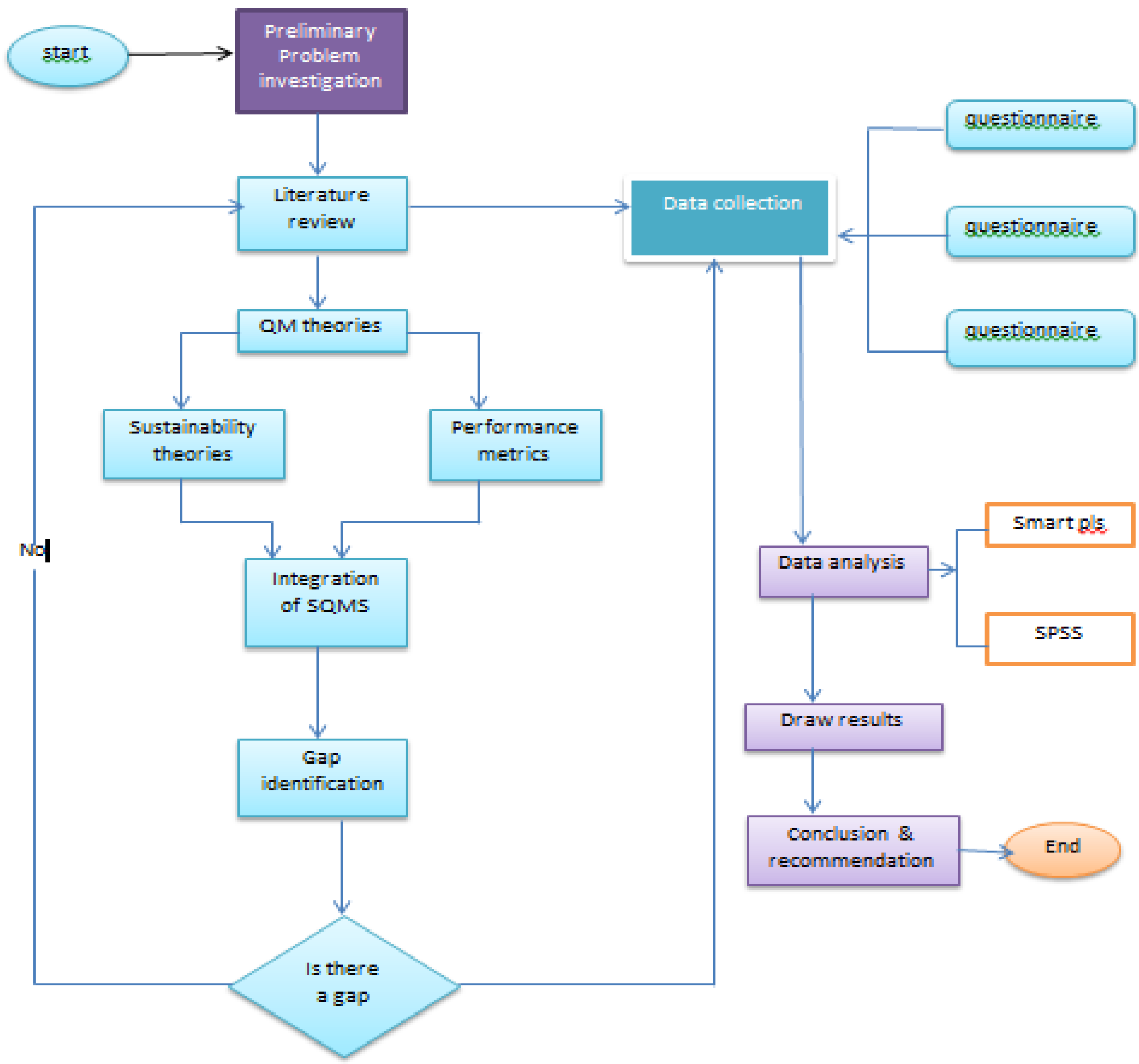

Figure 3.1: Research framework

3.4 Research design

Research design provides the framework for data collection, measurement, and analysis, and can generally be categorized as exploratory, descriptive (Creswell, J. W., & Creswell, J. D., 2017). Given the objectives of this study, an explanatory research design was adopted, as it is most appropriate for examining causal relationships between independent and dependent variables (Creswell, J. W., & Creswell, J. D., 2017). Specifically, this study focuses on modeling organizational performance by investigating how Sustainable Quality Management practices (SQMP) practices namely leadership, customer focus, employee involvement, training and development and continuous improvement affect organizational performance in terms of operational efficiency and product quality. Therefore, the researcher was used SPSS version 23 for descriptive statistics and preliminary reliability checks, and Smart PLS 04 for advanced structural equation modeling (SEM).

3.5. Research approach

To address quality-related problems in the tank overhaul sector of BMVEI, This study employs a quantitative research approach to model organizational performance through the integration of Sustainable Quality Management practices (SQMP) and to ensure a comprehensive understanding of the research problem. The quantitative component involves the collection and analysis of numerical data through structured questionnaires. The quantitative approach allows for statistical testing of the hypothesized relationships using SPSS version 25 for data preparation, descriptive statistics, and reliability assessment, followed by SmartPLS 4.0 for structural equation modeling (SEM). Overall, this research approach aims to provide a comprehensive framework for understanding the relationship between sustainable quality management and organizational performance in BAMI, facilitating actionable insights for improvement.

3.6 Target population and sample size determination

3.6.1 Target population

The target population, also known as the research population, refers to the entire group of individuals, elements, or objects that are of interest to the researcher and to which the research findings are intended to be generalized (Creswell, J. W., & Creswell, J. D., 2017). It represents the larger population from which a sample is drawn and is defined based on specific characteristics relevant to the research objectives (Pallant, J, 2020)). The target population for the study concentrating on modeling organizational performance through sustainable quality management practices in tank over hauling process at BMVEI encompasses approximately 125 individuals involved in the tank overhauling process at BMVEI. This includes tank assembly line workers, quality inspectors specialized in tank production, engineers focusing on tank over hauling process, production supervisors in the tank manufacturing process, plant managers supervising tank production activities, suppliers offering components for tanks, industry experts specializing in tank manufacturing. This population was identified based on tank overhaul sector employee records and is highly relevant to the study's objectives due to their critical roles in implementing sustainable quality management practices. Their specialized knowledge and experience offer valuable insights into how these practices influence organizational performance in areas such as operational efficiency and product quality.

3.6.2 Sampling techniques and sample size determination

3.6.2.1 Sampling techniques

This study employed a combination of stratified and purposive sampling techniques to ensure both representativeness and depth of insight. Stratified sampling was used to proportionally select participants from different departments within BMVEI, such as production, quality control, and administration, ensuring that diverse roles were fairly represented. Purposive sampling targeted individuals with specialized knowledge in sustainable quality management, including factory managers and quality supervisors. This approach was chosen to capture both general employee perspectives and expert insights. The sampling frame consisted of all full-time employees at BMVEI, with the list provided by the human resources department and categorized by job function.

3.6.2.2 Sample Size Determination

For the study titled "Modeling Organizational Performance through the Integration of Sustainable Quality Management Practices: In the Case of Bishoftu motor vehicle engineering industry," determining an appropriate sample size is essential to ensure reliable and valid research findings. The target population consists of 125 employees directly involved in the tank overhaul process.

A purposive sampling technique was used to select respondents with relevant expertise in tank overhaul operations, ensuring data relevance to the study's objectives. The sample size was determined using Yamane's (1967) formula:

A commonly used formula for the sample size calculation in quantitative research is:

$$\boxed{\text{Sample Size (n)} = n = \frac{\mathbf{N}}{\mathbf{1+N(e)^2}}}$$

Where:

- n= required sample size,
- ✓ N= population
- e= margin of error (the desired level of precision, e.g., 0.05).

i. Through questionnaires from 125 workers take sample size of 95 from total sample size workers

$n = \frac{N}{1+N(e)^2}$, n=125/1+125$(0.05)^2$=95. 24

n= N/1+N (e^2) n=125/1+385$(0.05)^2$

n= sample size n= 125/1+385(0.0025)

N= population n= 125/1+0.9625

e= level of error n= 95.24

N= 125, e=0.05

Thus, the total sample size is approximately 95 respondents.

To ensure proportional representation across departments, the Sekaran, U., & Bougie, R. (2016 stratified sampling formula was applied:

$n_i=(N_i/N)*n_t$

Where:

- n_i = sample size for stratum iii
- N_i = population size of stratum iii
- N = total population size (125)
- n_t = total sample size (95)

Based on departmental proportions, the stratified allocation is as follows:

Category	Target Population	Sample Size
TAVF staff	23	17
Power train shop	32	24
System work shop	38	29
Tank shop	32	25
Total	125	95

Table 3.1 Target population and sample size determination

Within each stratum, purposive sampling was employed to select respondents who possess the most relevant expertise for the questionnaire items, which focus on sustainable quality management practices such as leadership, customer focus, employee involvement, training and development and continuous improvement,. Eligible participants included quality managers, production supervisors, engineers, inspectors, and sustainability officers, as these roles provide informed and valid responses to the Likert-scale constructs used in the instrument.

This combined stratified–purposive approach was chosen because:

1. Stratification ensures all four departments are proportionally represented, avoiding over- or under-representation.
2. Purposive selection guarantees that only knowledgeable employees participate, which enhances the validity of responses.
3. The structure of the questionnaire — built around SQMP constructs (leadership, training and development, customer focus, employee involvement and continuous improvement etc.) requires respondents who directly engage in quality-related activities and decision-making.

A total of 95 questionnaires were distributed, with stratification ensuring proportionality and purposive selection ensuring construct validity. This approach aligns the sampling procedure with the study's objectives and strengthens the robustness of the findings for subsequent analysis in SPSS and smart pls.

3.6 Data Sources and Types

The study were used both primary and secondary source of data. The primary source of data was the response collected from the employees found at tank overhaul sector of Bishoftu motor vehicle engineering industry (BAMI). On the other hand, the secondary source of the data was gathered from different books, articles, journals, and different reports of company to support the primary data.

3.7 Data Collection Instruments

To effectively address the research objectives, both primary and secondary data sources were utilized.

✓ Questionnaire

- The questionnaire was designed to collect quantitative data and consisted of close-ended questions. This format allowed for both measurable responses
- Items in the questionnaire were measured using a five-point Likert scale, where Strongly Agree (SA) = 5, Agree (A) = 4, Neutral (N) = 3, Disagree (D) = 2, and Strongly Disagree (SD) = 1. The Likert scale was used to simplify the response process for participants and to facilitate efficient statistical analysis for data interpretation. The questionnaire was initially prepared in English and later translated into Amharic to ensure that respondents from different educational backgrounds in the tank overhaul sector of BMVEI could provide accurate and reliable information. Practices (SQMP) and their effect on organizational performance.

✓ Document review

Secondary data was obtained from internal organizational documents and publicly available materials such as:

- Quality audit reports and performance metrics from Tank over haul sector.
- Academic literature, past research, journals, and relevant books.
- Standards and guidelines including ISO 9001 and sustainability manuals

3.8 Data Analysis Method

The data analysis for this study was conducted using quantitative techniques. Quantitative data collected via structured questionnaires were analyzed using Statistical Package for Social Sciences (SPSS Version 25) for descriptive statistics, including means, standard deviations, and frequencies. Additionally, Structural Equation Modeling (SEM) was performed using SMARTPLS 4.0 to assess the relationships among the constructs. The measurement model was evaluated for reliability and validity through Cronbach's alpha and Average Variance Extracted (AVE) tests, ensuring the constructs were properly measured. Following this, the structural model was analyzed to test the relationship between the variables, with path coefficients and their significance assessed using bootstrapping techniques. The combination of these methods provided a comprehensive understanding of how sustainable quality management practices influence organizational performance in the Bishoftu motor vechile engineering industry.

3.9. Validity and Reliability

Ensuring the validity and reliability of the research instrument is crucial to guarantee the accuracy, consistency, and quality of the data collected (Hair Jr, J., Hair Jr, J. F., Sarstedt, M., Ringle, C. M., & Gudergan, S. P. ,2023). These criteria are essential for evaluating whether the constructs of interest such as leadership, customer focus, employee involvement, training and development, continuous improvement are measured correctly and consistently. In this study, both validity and reliability were carefully tested as described below.

3.9.1. Validity

Validity refers to the extent to which a research instrument accurately measures the intended concepts. To ensure the validity of the questionnaire, relevant literature and previously validated research instruments were reviewed to guide item formulation. The questionnaire was then pilot tested with at least 10 respondents from the tank overhaul sector of BMVEI to assess clarity, relevance, and comprehensibility of the items. Respondents were asked to provide feedback on any ambiguities or difficulties in understanding the questions, and necessary revisions were made accordingly.

Additionally, convergent validity was evaluated using the Average Variance Extracted (AVE), with values above 0.5 considered acceptable (Hair Jr, J., Hair Jr, J. F., Sarstedt, M., Ringle, C. M., & Gudergan, S. P., 2023). Discriminant validity was assessed by verifying that the square root of the AVE for each latent variable exceeded the correlations between the latent variables, as per the Fornell–Larcker criterion (Alarcón & Sánchez, 2015). These procedures ensured that each construct measured a distinct concept and contributed meaningfully to the overall model of organizational performance.

3.9.2. Reliability

Reliability refers to the stability and consistency of the measurement instrument. In this study, internal consistency reliability was measured using Cronbach's alpha, which is commonly applied for Likert-scale items. A Cronbach's alpha value of 0.7 or above is generally considered acceptable (Hair Jr, J., Hair Jr, J. F., Sarstedt, M., Ringle, C. M., & Gudergan, S. P. ,2023). Items with alpha values above 0.8 were considered to have good reliability, while values between 0.7 and 0.8 were deemed acceptable. Establishing reliability ensures that the respondents interpreted the questionnaire items consistently, enabling robust modeling of the relationship between SQMP practices and organizational performance.

3.10. Ethical Issues

The considerations of the ethical issues were necessary for the purpose of ensuring the privacy of participants as well as the confidentiality of respondent's data. In order to secure the consent of the selected participants, the researcher was clarified the purpose of the study and the role of participants in completion of the study. The researcher had also informed participants that their participation in the study was based on their willingness, and the idea and comments they raised highly honored and kept confidential. In the final result of the research paper personal information was not included, only the summary of relevant data that helped in answering the research questions were incorporated.

Chapter four

Result and Discussion

4.1 Introduction

This chapter deals with the presentation, analysis, and interpretation of the data in relation to modeling the effect of sustainable quality management practices on organizational performance, and how such practices can be integrated within of tank and armored vehicle over haul sector. To achieve the objectives of the study, primary data were gathered through structured questionnaires distributed to employees working in different departments of tank and armored vehicle over haul sector. The collected data were systematically analyzed, presented, and interpreted in this chapter with the support of SPSS version 25 for descriptive statistics and preliminary reliability checks, and Smart PLS 04 for advanced structural equation modeling (SEM).

4.2 Data editing and coding

After gathering the primary data, we carefully reviewed the responses to ensure they were complete and accurate. Any incomplete questionnaires were excluded from the analysis. We organized and coded the valid responses, which totaled 95, using Microsoft Excel. This helped us arrange and label the data effectively. Next, we imported the cleaned dataset into SPSS version 25 for further screening. This included checking for missing values, correcting errors, and identifying any outliers. Following this, descriptive statistics such as frequencies, percentages, means, and standard deviations were employed to summarize the demographic and main study variables. Finally, we analyzed the refined data in Smart PLS 04, the measurement model was assessed through reliability and validity checks, including indicator reliability, internal consistency, convergent validity, and discriminant validity. After establishing the measurement model, the structural model was evaluated to test the relationships among constructs. This stage included examining path coefficients, bootstrapping results, effect sizes, coefficient of determination (R^2), and overall model fit indices.

4.3. Demographic Characteristics of the Respondents

A total of 95 responses were received. About 75.8% of the respondents were male while 24.2 % of were female.

Table 4.1 Gender respondent rate

gender of respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	72	75.8	75.8	75.8
	female	23	24.2	24.2	100.0
	Total	95	100.0	100.0	

Source: Own Survey Result of SPSS data output, 2025

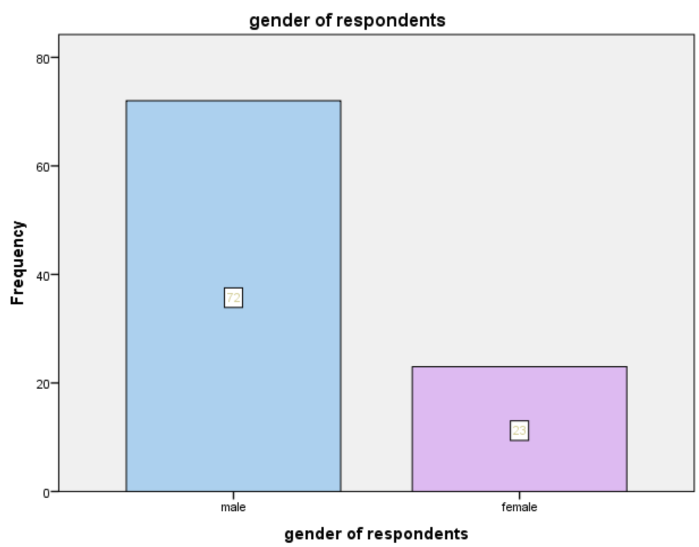

Figure 4.1 Graph of gender respondent rate

From figure 4.2, it is evident that 4.2 % are in the age group 21 to24 years,12.6% of respondent are in the age of 25 to 30 years, 61.1% respondent are in the age of 31 to 40 years ,13 % of the respondents are in the age group 41 to 49years and 8.4% of the respondents were over 50 year.

Table 4.2 Group of age Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	21–24	4	4.2	4.2	4.2
	25-30	12	12.6	12.6	16.8
	31–40	58	61.1	61.1	77.9
	41-49	13	13.7	13.7	91.6
	Over 50 years	8	8.4	8.4	100.0
	Total	95	100.0	100.0	

Source: Own Survey Result of SPSS data output, 2025

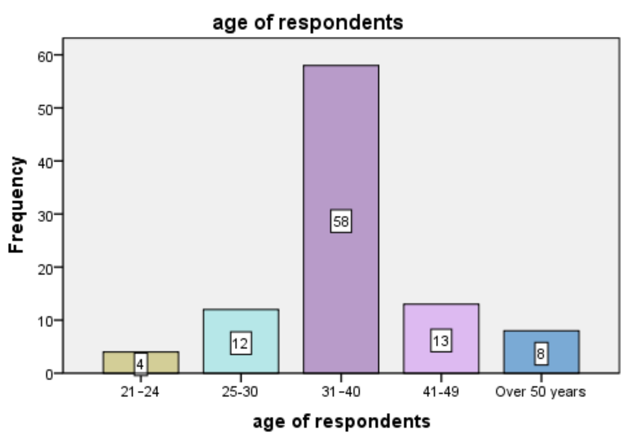

Figure 4.2 Graph of Age respondent rate

From figure 4.3, below it is clear that the majority of respondents in the engineering and technical support (45.3%), followed by the overhaul operation department (28.4%), and (14.7%) Administrative/ Support Services department. The rest (11.6%) are Quality Assurance department.

Table 4.3 Departments/section

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	overhaul operations	27	28.4	28.4	28.4
	Quality Assurance	11	11.6	11.6	40.0
	Engineering & technical support	43	45.3	45.3	85.3
	Administrative/Support Services	14	14.7	14.7	100.0
	Total	95	100.0	100.0	

Source: Own Survey Result of SPSS data output, 2025

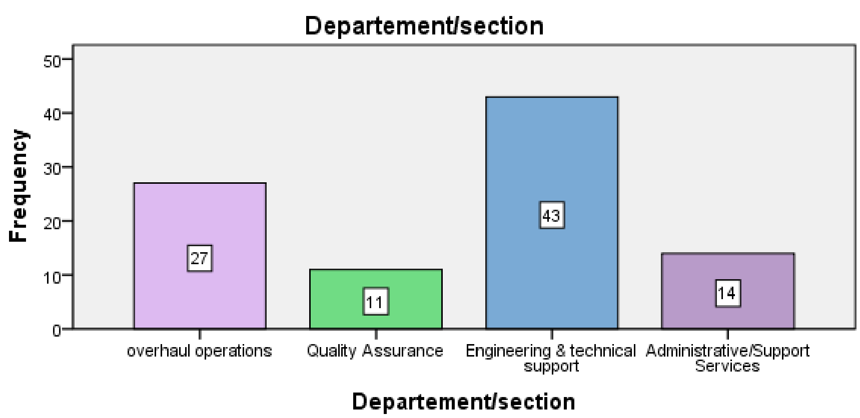

Figure 4.3 Graph of department respondent rate

From Figure 4.4, below indicates that the majority of respondents are (56.8%) have bachelor's degree, (25.3 %) have master's degree, (15.8%) have diploma and the rest 2.1% have doctoral degree.

Table 4.4 Educational qualification

Educational Qualification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Diploma	15	15.8	15.8	15.8
	Bachelor's Degree	54	56.8	56.8	72.6
	Master's degree	24	25.3	25.3	97.9
	Doctoral degree	2	2.1	2.1	100.0
	Total	95	100.0	100.0	

Source: Own Survey Result of SPSS data output, 2025

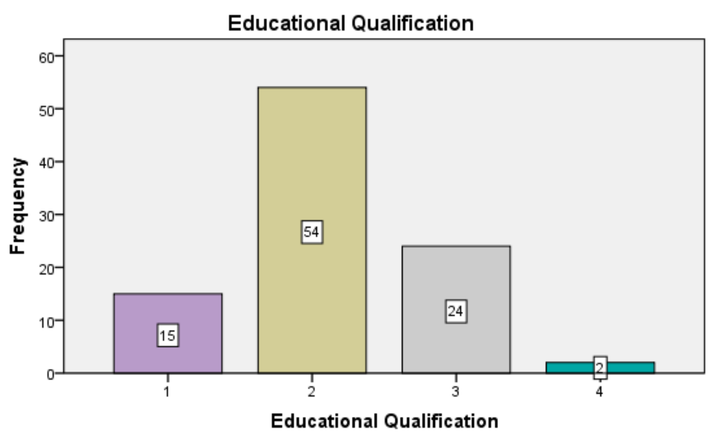

Figure 4.4 Graph of educational qualification of respondents

From Figure-4.5, below shows that the members of respondents who have been working for the BMVEI for more than 10 years are 40%, while 25.3 % from 5-10 years,16.8 % from 1-3 years , 11.6% from 3-5 years and 6.3% for less than 1 year .

Table 4.5 Duration of employees

Years of Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 1 year	6	6.3	6.3	6.3
	1- 3 years	16	16.8	16.8	23.2
	3-5 years	11	11.6	11.6	34.7
	5-10 years	24	25.3	25.3	60.0
	More than 10 years	38	40.0	40.0	100.0
	Total	95	100.0	100.0	

Source: Own Survey Result of SPSS data output, 2025

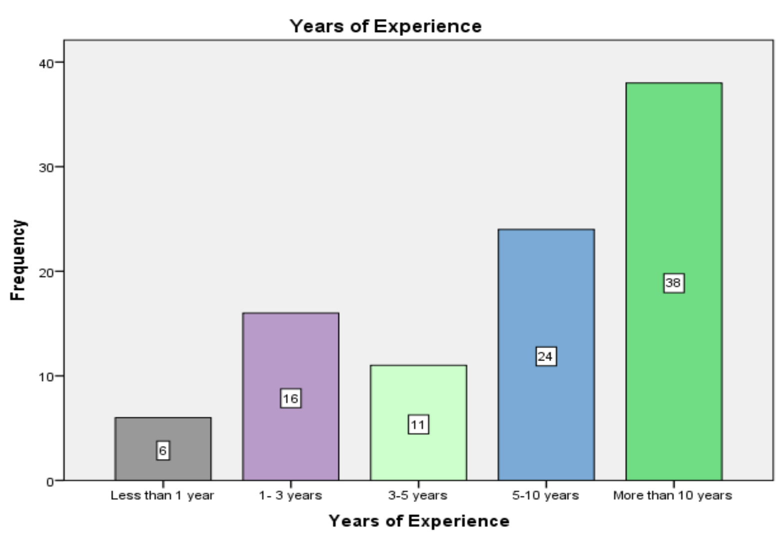

Figure 4.5 Graph of duration of employer's respondent rat

4.4. Descriptive Analysis of the independent variables

Conducting descriptive analysis on the independent variables (top management support, customer focus, employee involvement, training and development and continuous improvement and) provides a clear understanding of employees' perceptions and the current status of sustainable quality management practices. This step highlights the central tendency, variability, and distribution of responses, allowing identification of strengths, weaknesses, and areas requiring improvement. By summarizing the data before inferential or structural modeling, descriptive analysis ensures that the assumptions for further statistical tests are met and justifies the relevance of these variables in predicting organizational performance, enhancing the rigor and validity of the study.

4.4.1 .Top management support

The descriptive analysis of Top Management Support (TMS) (N=95) shows moderately positive perceptions, with a composite mean of 3.53 (SD≈1.04) across three items (3.51–3.55). About 46.3% strongly agree (4.00–5.00), while 17.9% disagree (<3.00). Negative skew (-0.244 to -0.767) indicates more optimistic responses, and kurtosis values (-0.210 to 0.121) indicate a slight lean toward higher scores with normal distribution, suggesting TMS supports sustainable quality practices and can be further strengthened

Table 4.6: Frequency of TMS

TMS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	1	1.1	1.1	1.1
	1.33	2	2.1	2.1	3.2
	1.67	1	1.1	1.1	4.2
	2.00	5	5.3	5.3	9.5
	2.33	4	4.2	4.2	13.7
	2.67	4	4.2	4.2	17.9
	3.00	13	13.7	13.7	31.6
	3.33	12	12.6	12.6	44.2
	3.67	9	9.5	9.5	53.7
	4.00	22	23.2	23.2	76.8
	4.33	10	10.5	10.5	87.4
	4.67	10	10.5	10.5	97.9
	5.00	2	2.1	2.1	100.0
	Total	95	100.0	100.0	

Source: Own Survey Result of SPSS data output, 2025

Table 4 7: Descriptive Analysis of TMS

Descriptive Statistics

	N	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
TM1	95	3.55	1.089	1.187	-.628	.247	-.210	.490
TM2	95	3.54	1.040	1.081	-.767	.247	.121	.490
TM3	95	3.51	.999	.997	-.244	.247	-.483	.490
Valid N (list wise)	95							

Source: Own Survey Result of SPSS data output, 2025

4.4.2 .Customer focus

The descriptive analysis of Customer Focus (CF) in the BMVEI tank overhaul study (N=95) shows moderately positive perceptions, with a composite mean of 3.46 (SD≈1.05) across three Likert items (means: 3.42–3.51). Frequency distributions indicate that 42.1% of respondents agreed or strongly agreed (4.00–5.00), while 21.1% disagreed (<3.00). Skewness values ranged from -0.295 to -0.602, reflecting a slight leftward lean toward higher agreement, and kurtosis values were near zero, suggesting distributions close to normal with no extreme outliers. These results imply that employees view BMVEI as proactive in sustainable, customer-focused quality practice.

Table 4.8: Frequency of CF

CF

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	1	1.1	1.1	1.1
	1.33	1	1.1	1.1	2.1
	1.67	3	3.2	3.2	5.3
	2.00	5	5.3	5.3	10.5
	2.33	9	9.5	9.5	20.0
	2.67	3	3.2	3.2	23.2
	3.00	10	10.5	10.5	33.7
	3.33	8	8.4	8.4	42.1
	3.67	14	14.7	14.7	56.8
	4.00	20	21.1	21.1	77.9
	4.33	11	11.6	11.6	89.5
	4.67	9	9.5	9.5	98.9
	5.00	1	1.1	1.1	100.0
	Total	95	100.0	100.0	

Source: Own Survey Result of SPSS data output, 2025

Table 4.9: Descriptive Analysis of CF

Descriptive Statistics

	N	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
CF1	95	3.51	1.051	1.104	-.295	.247	-.728	.490
CF2.	95	3.46	1.080	1.166	-.602	.247	-.349	.490
CF3	95	3.42	1.017	1.034	-.370	.247	-.466	.490
Valid N (list wise)	95							

Source: Own Survey Result of SPSS data output, 2025

4.4.3 .Employee involvement

The descriptive analysis of Employee Involvement (EI) in the BMVEI tank overhaul study (N=95) shows moderately positive perceptions, with a composite mean of 3.45 (SD≈1.09) across three Likert items (means: 3.37–3.58). Frequency distributions indicate that 56.8% of respondents agreed or strongly agreed (4.00–5.00), while 14.7% disagreed (<3.00). Skewness values (-0.491 to -0.692) suggest a slight lean toward higher agreement, and kurtosis values near zero indicate no extreme outliers. These results suggest that employees are generally engaged in decision-making, collaboration, and problem-solving, supporting sustainable quality management practices and overall performance.

Table 4.10: Frequency of EI

EI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	1	1.1	1.1	1.1
	1.33	2	2.1	2.1	3.2
	1.67	5	5.3	5.3	8.4
	2.00	5	5.3	5.3	13.7
	2.33	1	1.1	1.1	14.7
	2.67	12	12.6	12.6	27.4
	3.00	4	4.2	4.2	31.6
	3.33	9	9.5	9.5	41.1
	3.67	10	10.5	10.5	51.6
	4.00	28	29.5	29.5	81.1
	4.33	12	12.6	12.6	93.7
	4.67	4	4.2	4.2	97.9
	5.00	2	2.1	2.1	100.0
	Total	95	100.0	100.0	

Source: Own Survey Result of SPSS data output, 2025

Table 4.11: Descriptive Analysis of EI

Descriptive Statistics

	N	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
EI1.	95	3.58	1.068	1.140	-.692	.247	-.198	.490
EI2	95	3.40	1.189	1.413	-.631	.247	-.542	.490
EI3	95	3.37	1.022	1.044	-.491	.247	-.429	.490
Valid N (listwise)	95							

4.4.4. Training and Development

The descriptive analysis of Training and Development (TD) (N=95) shows moderately positive perceptions, with a composite mean of 3.59 (SD≈1.05) across three items (means: 3.45–3.71). Frequencies indicate that 61.1% of respondents agreed or strongly agreed (4.00–5.00), while 13.7% disagreed (<3.00). Skewness values (-0.296 to -0.597) and near-zero kurtosis suggest a slight lean toward higher ratings with normal distributions. These findings indicate that employees perceive the organization as providing skill-building, learning opportunities, and techniques that enhance sustainable quality practices.

Table 4.12 frequency of T&D

TD

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	1	1.1	1.1	1.1
	2.00	6	6.3	6.3	7.4
	2.33	6	6.3	6.3	13.7
	2.67	5	5.3	5.3	18.9
	3.00	10	10.5	10.5	29.5
	3.33	12	12.6	12.6	42.1
	3.67	12	12.6	12.6	54.7
	4.00	16	16.8	16.8	71.6
	4.33	12	12.6	12.6	84.2
	4.67	14	14.7	14.7	98.9
	5.00	1	1.1	1.1	100.0
	Total	95	100.0	100.0	

Source: Own Survey Result of SPSS data output, 2025

Table: 4.13 descriptive analysis of TD

	N	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
TD1	95	3.71	.944	.891	-.381	.247	-.343	.490
TD2	95	3.60	1.036	1.072	-.597	.247	-.463	.490
TD3	95	3.45	1.165	1.357	-.296	.247	-1.077	.490
Valid N (listwise)	95							

Source: Own Survey Result of SPSS data output, 2025

4.4.3 .continuous improvement

The descriptive analysis of Continuous Improvement (CI) (N=95) shows moderately positive perceptions, with a composite mean of 3.38 (SD≈1.08) across three items (means: 3.33–3.47). Frequency distributions reveal that 55.8% of respondents agreed or strongly agreed (4.00–5.00), while 11.6% disagreed (<3.00). Skewness values (-0.141 to -0.371) indicate a slight lean toward higher agreement, and near-zero kurtosis values indicate normal distribution. These results suggest that employees generally recognize efforts to analyze defects, invite suggestions, and implement sustainable quality improvements.

Table 4.14: Frequency of CI

CI

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.33	3	3.2	3.2	3.2
	1.67	1	1.1	1.1	4.2
	2.00	6	6.3	6.3	10.5
	2.33	6	6.3	6.3	16.8
	2.67	7	7.4	7.4	24.2
	3.00	10	10.5	10.5	34.7
	3.33	16	16.8	16.8	51.6
	3.67	13	13.7	13.7	65.3
	4.00	21	22.1	22.1	87.4
	4.33	4	4.2	4.2	91.6
	4.67	5	5.3	5.3	96.8
	5.00	3	3.2	3.2	100.0
	Total	95	100.0	100.0	

Source: Own Survey Result of SPSS data output, 2025

Table 4.15: Descriptive Analysis of CI

Descriptive Statistics

	N	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
CI1	95	3.47	1.009	1.018	-.371	.247	-.320	.490
CI2.	95	3.34	1.117	1.247	-.141	.247	-1.003	.490
CI3	95	3.33	1.005	1.009	-.248	.247	-.543	.490
Valid N (list wise)	95							

Source: Own Survey Result of SPSS data output, 2025

4.5 Descriptive analysis of dependent variable

The descriptive analysis of Organizational Performance (OP) in the BMVEI tank overhaul study (N=95) indicates moderately positive perceptions, with a composite mean of 3.51 (SD≈1.06) across three Likert items (means: 3.48–3.53). Frequency distributions show that 53.7% of respondents agreed or strongly agreed (4.00–5.00), while 18.4% disagreed (<3.00). Skewness values (-0.727 to -0.402) reflect a slight lean toward higher agreement, and kurtosis values near zero indicate approximately normal distributions without extreme outliers. These findings suggest that employees generally perceive BAMI's organizational performance as effective, reflecting both product quality and operational efficiency, supported by sustainable quality management practices.

Table 4.16: Frequency of OP

OP

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	2	2.1	2.1	2.1
	1.67	4	4.2	4.2	6.3
	2.00	1	1.1	1.1	7.4
	2.33	7	7.4	7.4	14.7
	2.67	3	3.2	3.2	17.9
	3.00	5	5.3	5.3	23.2
	3.33	20	21.1	21.1	44.2
	3.67	18	18.9	18.9	63.2
	4.00	17	17.9	17.9	81.1
	4.33	8	8.4	8.4	89.5
	4.67	7	7.4	7.4	96.8
	5.00	3	3.2	3.2	100.0
	Total	95	100.0	100.0	

Source: Own Survey Result of SPSS data output, 2025

__Table 4.17: Descriptive Analysis of OP__

Descriptive Statistics

	N	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
OP1.	95	3.53	.966	.933	-.727	.247	.393	.490
OP2	95	3.51	1.110	1.231	-.443	.247	-.607	.490
OP3	95	3.48	1.119	1.252	-.402	.247	-.687	.490
Valid N (list wise)	95							

Source: Own Survey Result of SPSS data output, 2025

4.6 Reliability Test of the Instruments

Reliability was assessed using Cronbach's alpha scale, which ranges from 0.00 (indicating no consistency) to 1.00 (indicating perfect consistency). Sekaran and Bougie (2016) classified the alpha values as follows: a score below 0.60 is deemed weak, a score between 0.60 and 0.70 is considered acceptable, a score from 0.70 to 0.80 is regarded as good, and a score above 0.80 is viewed as excellent.

__Table 4.18 Reliability Statistics__

Variables	No. of Items	Cronbach's Alpha
Top management support (TMS)	3	.797
Customer Focus (CUF)	3	.826
Employees Involvement (EMI)	3	.795
Training and Development (TD)	3	.729
Continuous Improvement (CI)	3	.740
Organizational performance (OP)	3	.715

Source: Own Survey Result of SPSS data output, 2025

As shown in Table 4.19 ,the Cronbach's Alpha coefficient values for the independent variables ranged from 0.729 to 0.826, while the dependent variable (OP) recorded a value of 0.715, all of which are above the recommended threshold of 0.70. The overall Cronbach's Alpha for all constructs was 0.826, indicating strong internal consistency among the variables. Hence, in the current study, sustainable quality management practices are measured using the variables TMS, CF, EI, TD, CI, and the dependent variable OP. This confirms that the measurement scale used in this study is accepted and highly reliable.

4.7. PLS-SEM Analysis

The model was evaluated using SmartPLS software (Ringle, Wende, & Becker, 2015). The estimation of the model employed the PLS-SEM technique, which involves assessing key parameters such as factor loadings, reliability, and validity of the constructs. Following the widely adopted two-step procedure (Hair, Hult, Ringle, & Sarstedt, 2019), the analysis first examined the measurement model to ensure indicator reliability, internal consistency, convergent validity, and discriminant validity. Subsequently, the structural model was assessed, focusing on the estimation and significance testing of path coefficients, coefficient of determination (R^2), and Finally, model validation was supported through statistical power analysis, ensuring that the sample size was adequate to detect the hypothesized relationships with sufficient statistical power (Hair, Howard, & Nitzl, 2020).

4.7.1 Measurement Model

The measurement model was assessed to ensure the consistency and validity of the observed indicators. Reliability was first examined through indicator loadings, where standardized outer loadings greater than 0.70 are considered satisfactory (Hair, Hult, Ringle, & Sarstedt, 2019). Loadings between 0.40 and 0.70 were carefully evaluated and retained only if their removal did not improve composite reliability (Sarstedt, Ringle, & Hair, 2020). Consistency was further evaluated using Cronbach's alpha and composite reliability (CR). Although Cronbach's alpha is a traditional measure, composite reliability is regarded as a more accurate indicator of internal consistency because it incorporates the standardized loadings of the observed variables. Following Hair et al. (2019), values above 0.70 were considered acceptable for both Cronbach's alpha and CR, ensuring that the constructs were measured consistently.

In addition to reliability, validity tests were applied to verify the quality of the constructs. Convergent validity was assessed using the Average Variance Extracted (AVE), which reflects the proportion of variance explained by a construct relative to measurement error. Consistent with Fornell and Larcker's (1981) guideline, an AVE value of at least 0.50 was required, meaning that each construct captured more than half of the variance of its indicators. Discriminant validity was then evaluated to confirm that constructs were distinct from one another. The heterotrait-monotrait ratio (HTMT) was used as the main criterion, with a threshold of less than 0.85, as recommended by Henseler, Ringle, and Sarstedt (2015). Using these iterative procedures, weak indicators with low factor loadings were removed, and the final measurement model demonstrated satisfactory reliability and validity.

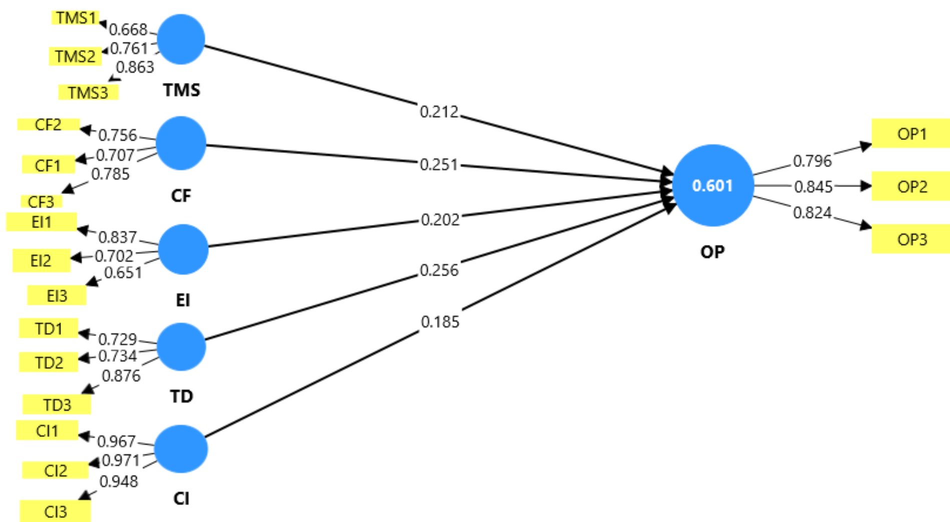

Figure 4.1: Measurement Model Path Model Output

4.7.1.1 Assessment of Reliability and Convergent Validity

This section presents the assessment of reliability and convergent validity, demonstrating that all constructs and their measurement items are consistent and adequately capture their intended latent variables. As shown in the table, the reliability and convergent validity of the study constructs were assessed. Cronbach's Alpha values for all constructs ranged from 0.719 to 0.826, indicating good internal consistency. Composite reliability values (rho_a and rho_c) varied between 0.729 and 0.899, exceeding the recommended threshold of 0.7, which confirms strong construct reliability. The Average Variance Extracted (AVE) values ranged from 0.639 to 0.733, demonstrating adequate convergent validity for all constructs. These results indicate that the measurement items used for CF, TMS, EI, SR, CI, TD, and OP are both reliable and valid, supporting their suitability for further structural analysis in the study.

Table 4.19 Reliability and Validity Results of Constructs"

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
CF	0.826	0.899	0.891	0.733
TMS	0.799	0.838	0.878	0.705
EI	0.794	0.866	0.878	0.707
CI	0.743	0.778	0.848	0.651
TD	0.742	0.743	0.852	0.657
OP	0.719	0.729	0.841	0.639

Source: Own Survey Result of SmartPLS data output, 2025

4.7.1.2 Discriminant validity

The Heterotrait-monotrait (HTMT) ratios were computed to assess discriminant validity among all constructs. The HTMT values ranged from 0.170 to 0.858 which are substantially below the conservative threshold of 0.85 and the liberal threshold of 0.90 (Henseler, Ringle, & Sarstedt, 2015). These results indicate that the constructs are empirically distinct, confirming the absence of discriminant validity issues. Accordingly, the measurement model demonstrates adequate discriminant validity, ensuring that each construct uniquely contributes to the assessment of sustainable quality management practices and organizational performance.

Table 4.20 Heterotrait-Monotrait (HTMT) ratio of Discriminant Validity

	Heterotrait-monotrait ratio (HTMT)
CI <-> CF	0.305
EI <-> CF	0.628
EI <-> CI	0.455
OP <-> CF	0.858
OP <-> CI	0.506
OP <-> EI	0.774
TD <-> CF	0.729
TD <-> CI	0.432
TD <-> EI	0.626
TD <-> OP	0.840
TMS <-> CF	0.717
TMS <-> CI	0.170
TMS <-> EI	0.445
TMS <-> OP	0.684

Source: Own Survey Result of SmartPLS data output, 2025

4.7.1.3 Analysis of Measurement Item Loadings

This section presents the analysis of factor loadings for all measurement items, showing how strongly each item represents its respective construct in the path model. The table presents the standardized factor loadings of the observed items on their respective constructs within the path model. All items show strong loadings ranging from 0.768 to 0.923, which are above the recommended threshold of 0.7. This indicates that each item reliably measures its intended construct. The results confirm that the measurement model is valid and consistent, providing a solid foundation for subsequent structural analysis of the relationships among the study constructs.

Table 4.21 Factor Loadings of Constructs in the Path Model

	CF	CI	EI	OP	TD	TMS
CF1	0.823					
CF2	0.847					
CF3	0.896					
CI1		0.815				
CI2		0.768				
CI3		0.836				
EI1			0.923			
EI2			0.820			
EI3			0.772			
OP1				0.852		
OP2				0.781		
OP3				0.763		

Source: Own Survey Result of SmartPLS data output, 2025

4.7.1.4 Multicollinearity Test of Independent Variables

Multicollinearity arises when independent variables in a regression model are highly correlated, which can inflate standard errors and produce misleading coefficient estimates (Kim, 2019; Marcoulides, 2018). This issue is commonly assessed using the Variance Inflation Factor (VIF), which measures the extent to which the variance of a regression coefficient is increased due to collinearity with other predictors (Choueiry, 2020). A VIF value greater than 5 is generally considered indicative of problematic multicollinearity, suggesting that the corresponding predictor is highly correlated with other variables in the model (Kim, 2019). High VIF values can obscure the true effect of each predictor on the dependent variable, reducing the reliability and interpretability of regression results. Therefore, monitoring VIF values is crucial for ensuring stable, reliable, and interpretable regression estimates (Marcoulides, 2018; Choueiry, 2020).

In the table below, The Variance Inflation Factor (VIF) values for all variables in this study ranged from 1.260 to 2.166, which is well below the commonly accepted threshold of 5. This indicates that multicollinearity is not a concern, meaning the independent variables—customer focus (CF), continuous improvement (CI), employee involvement (EI), and service reliability

(SR)—are not overly correlated and each provides unique information. As a result, the regression estimates are stable and reliable. These findings suggest that all variables contribute meaningfully to explaining organizational performance (OP) without redundancy, supporting the robustness of the proposed model.

Table 4.22 Measurement of VIF

	VIF
CF1	2.022
CF2	1.873
CF3	1.769
CI1	1.591
CI2	1.643
CI3	1.339
EI1	2.166
EI2	1.800
EI3	1.518
OP1	1.628
OP2	1.550
OP3	1.260
TD1	1.655
TD2	1.370
TD3	2.035
TMS2	1.520
TMS3	1.866
TMS1	1.896

Table 4.7: Collinearity Statistics VIF

Source: Own Survey Result of SmartPLS data output, 2025

4.7.2 Assessment of Structural Equation Model

Structural Equation Modeling (SEM), particularly using Partial Least Squares (PLS-SEM), examines the relationships among exogenous and endogenous latent variables by evaluating the coefficient of determination (R^2) and path coefficients (β) (Hair et al., 2019; Sarstedt et al., 2022). The R^2 value represents the proportion of variance in an endogenous latent variable explained by its predictors, while β values indicate the strength and direction of the relationships between latent constructs. Guidelines suggest that an R^2 above 0.26 reflects substantial explanatory power, and higher R^2 values indicate stronger model robustness (Zeng et al., 2021). In this study, the estimated model has an R^2 of 0.64, demonstrating a strong ability to explain variance in organizational performance based on the included latent constructs. The β estimates were used to identify the strongest predictors, with the construct having the largest β representing the most influential factor on the endogenous variable. Statistical significance of the path coefficients was assessed using a nonparametric bootstrapping technique with 5,000 resamples.

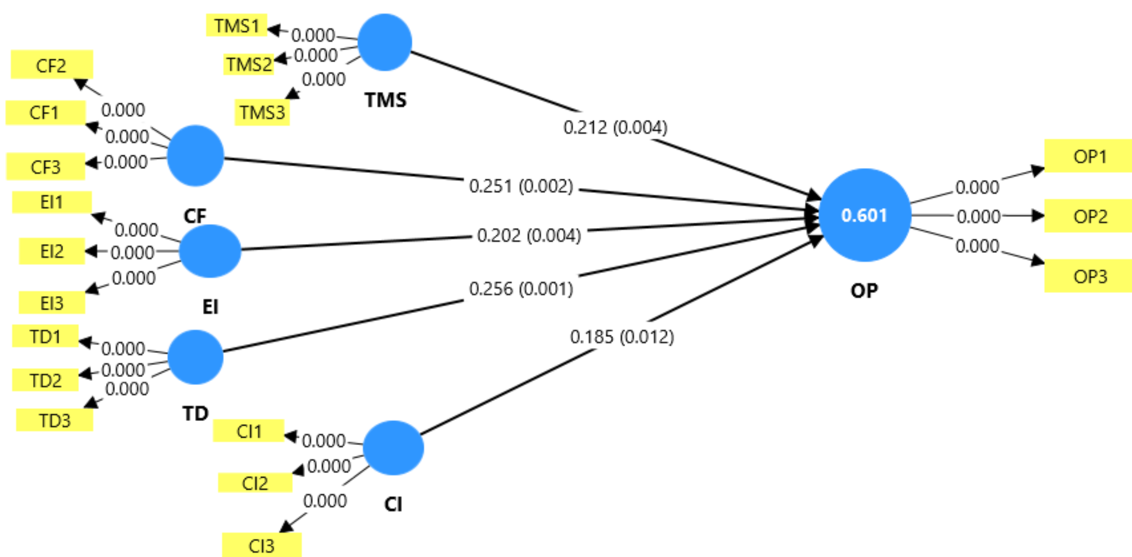

Figure 4.7 structural path modeling

For below table the structural model results indicate that all the sustainable quality management practices examined have a significant positive effect on organizational performance. Specifically, customer focus (β = 0.251, p = 0.002), continuous improvement (β = 0.185, p = 0.012), employee involvement (β = 0.202, p = 0.004), training and development (β = 0.256, p = 0.001), and top management support (β = 0.212, p = 0.004) all show statistically significant relationships, as their p-values are below the 0.05 threshold and t-values exceed the critical value of 1.96. Among these, training and development demonstrates the strongest effect, followed closely by customer focus, suggesting that investment in employee capabilities and addressing customer needs are particularly influential in enhancing organizational performance within the context of BAMI. Overall, the findings confirm that the integration of these quality management dimensions is crucial for driving organizational performance.

Table 4.23: Path Coefficient with t-value of the Structural Model

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
CF -> OP	0.251	0.257	0.080	3.146	0.002
CI -> OP	0.185	0.185	0.074	2.501	0.012
EI -> OP	0.202	0.210	0.070	2.906	0.004
TD -> OP	0.256	0.250	0.076	3.376	0.001
TMS -> OP	0.212	0.214	0.073	2.895	0.004

Source: Own Survey Result of SmartPLS data output, 2025

4.7.2.1 Coefficient of Determination (R^2) for OP

The R-square (R^2) value of 0.629 indicates that about 62.9% of the variance in organizational performance (OP) is explained by the predictor variables included in the model (customer focus, continuous improvement, employee involvement, training and development, and top management support). The adjusted R^2 of 0.608, which takes into account the number of predictors and sample size, shows a slightly reduced but still strong explanatory power. This means the model demonstrates a good level of fit, suggesting that these sustainable quality management practices collectively make a substantial contribution to explaining organizational performance, while the remaining variance is influenced by other factors outside the model.

Table 4.24 Coefficient of Determination (R &R^2) for Organizational Performance

	R-square	R-square adjusted
OP	0.629	0.608

Source: Own Survey Result of SmartPLS data output, 2025

4.7.2.2. Model Validation

Model fit assesses how well the proposed structural model represents the observed data, ensuring that the hypothesized relationships between sustainable quality management practices and organizational performance are accurately captured. Evaluating model fit is essential to validate the model structure, avoid misinterpretation of path coefficients, and demonstrate both theoretical and statistical reliability (Hair et al., 2019; Sarstedt et al., 2021). In PLS-SEM, commonly used fit indices include SRMR, which should be below 0.08 to indicate acceptable fit; Chi-square, where lower values suggest better model-data consistency; NFI, with values above 0.90 considered desirable; and d_ULS and d_G, where smaller values indicate closer alignment between the model and observed data (Henseler et al., 2014; Schuberth et al., 2022). These rules provide benchmarks for assessing whether the model is adequate for explanatory purposes.

In this study, the SRMR value of 0.081 indicates a marginally acceptable fit, while the Chi-square value of 373.273 reflects some discrepancy between the observed and model-implied covariance matrices, which is expected given model complexity. The NFI value of 0.575 suggests that the model's absolute fit is relatively low, and the d_ULS = 1.528 and d_G = 0.671 values indicate minor deviations from perfect fit. While these indices suggest that the model reasonably fits the data, they do not guarantee a parsimonious model, as unnecessary paths may still exist (Vinzi et al., 2010). Therefore, the assessment of model fit alongside the evaluation of all path coefficients provides a comprehensive understanding of how sustainable quality management practices influence organizational performance.

Table 4.25 Model fit

	Saturated model	Estimated model
SRMR	0.081	0.081
d_ULS	1.528	1.528
d_G	0.671	0.671
Chi-square	373.273	373.273
NFI	0.575	0.575

Source: Own Survey Result of SmartPLS data output, 2025

4.8 Discussion and Findings of the result

This section interprets the study's findings in relation to the problem statement, which highlights persistent operational inefficiencies and quality challenges in BMVEI's tank overhaul sector. Specifically, the problem statement identifies prolonged overhaul times (extending from the standard 1 month to 2-3 months due to rework and component rejection), low operational capacity (operating at only 50% of maximum), and a high defect rate (15%), as documented in the 2025 quality inspection report. These issues stem from root causes such as inconsistent leadership commitment, substandard raw materials, limited employee involvement, insufficient training, poor communication, and weak documentation and testing practices. The findings from descriptive statistics, reliability and validity assessments, and structural equation modeling (SEM) using SmartPLS are discussed below, demonstrating how the integration of sustainable quality management practices (SQMP) addresses these challenges to enhance organizational performance (OP).

- ✓ **Demographic Profile of Respondents**

The demographic characteristics confirmed that the data came from a credible and experienced workforce. Most respondents were male (75.8%) and aged between 31–40 years (61.1%), with 40% having more than ten years of work experience. Educationally, 56.8% held a bachelor's degree, and 25.3% held a master's degree. Nearly half of the respondents were employed in engineering and technical support (45.3%), followed by overhaul operations (28.4%), administrative and support services (14.7%), and quality assurance (11.6%). This diversity across departments, educational levels, and experience ensures that the findings reflect both frontline and managerial perspectives, enhancing the reliability and applicability of the study results.

✓ **Perceptions of Sustainable Quality Management Practices**

The analysis of Sustainable Quality Management Practices (SQMP) revealed that these practices are present but moderately applied across BAMI.

- Top Management Support (TMS): Mean = 3.53, variance = 0.54. Employees perceive leadership as moderately supportive of quality and sustainability, but engagement is not consistently visible across departments.
- Customer Focus (CF): Mean = 3.46, variance = 0.61. Employees recognize efforts to integrate customer requirements, yet systematic feedback and monitoring mechanisms could further strengthen responsiveness.
- Employee Involvement (EI): Mean = 3.45, variance = 0.57. While employees participate in decision-making and quality activities, opportunities for empowerment and innovation are limited.
- Training and Development (TD): Mean = 3.59, variance = 0.49. Training programs are relatively well-established, but coverage may not be comprehensive enough to fully address skill gaps in advanced quality tools and sustainability practices.

- Continuous Improvement (CI): Mean = 3.38, variance = 0.62. The culture of systematic problem-solving and performance review is emerging but not yet institutionalized.
- Social Responsibility (SR): Mean = 3.44, variance = 0.55. Ethical practices, workplace safety, and environmental compliance are moderately addressed but not fully embedded in operational practices.

Overall, the findings indicate that SQMP dimensions are recognized and partially implemented, reflecting a moderate culture of quality within BAMI.

✓ **Reliability and Validity of Constructs**

All constructs demonstrated acceptable reliability, with Cronbach's alpha values exceeding 0.70 (TMS = 0.799, CF = 0.826, EI = 0.794, TD = 0.742, CI = 0.743, OP = 0.719). Convergent validity was established as all AVE values exceeded 0.50, and discriminant validity was confirmed through HTMT ratios below 0.85. Variance Inflation Factor (VIF) scores ranged from 1.26 to 2.17, confirming no multicollinearity issues. These results affirm that the constructs are reliably and validly measured.

✓ **R square and Model fit**

The adjusted R^2 value of 0.608 accounts for the number of predictors and sample size, indicating that the model has a strong explanatory power, with approximately 60.8% of the variance in organizational performance being explained by the sustainable quality management practices studied, while the remaining variance is due to other factors not included in the model.

The model fit assessment for the structural equation model in your study shows the following:

- The Standardized Root Mean Square Residual (SRMR) value is 0.081, which is marginally acceptable (generally, SRMR < 0.08 is recommended for good fit).

- The Chi-square value is 373.273, indicating some discrepancy between observed data and the model-implied covariance matrices, which is typical given the complexity of the model.

- The Normed Fit Index (NFI) is 0.575, which is relatively low compared to the desired level above 0.90 for good absolute fit.
- The discrepancy measures d_ULS = 1.528 and d_G = 0.671 suggest minor deviations from perfect fit.

Overall, the model shows a reasonable but not strong fit to the data. While the SRMR indicates marginal acceptability, other indices like NFI suggest the model could be improved in terms of fit. This level of fit implies the model reasonably represents the relationships between sustainable quality management practices and organizational performance but may benefit from further refinement to enhance fit and parsimony

✓ **Structural Model findings**

The structural model was tested to examine the direct effects of Sustainable Quality Management Practices (SQMP) dimensions namely Customer Focus (CF), Continuous Improvement (CI), Employee Involvement (EI), Training and Development (TD), and Top Management Support (TMS) on Organizational Performance (OP) of tank over haul sector. The analysis was conducted using SmartPLS 4 with bootstrapping to determine the statistical significance of path coefficients.

- Top Management Support (TMS → OP)

  Top Management Support (TMS) showed a positive and significant effect on organizational performance ($\beta = 0.212$, $t = 2.895$, $p = 0.004$). This demonstrates that leadership commitment, strategic direction, and active involvement of senior management play a pivotal role in ensuring the success of quality management initiatives. At BAMI, top management support facilitates resource allocation, policy enforcement, and the establishment of a culture that prioritizes quality, which in turn enhances operational performance. This finding confirms prior studies highlighting leadership as a critical driver of effective quality management implementation and performance improvement.

- Customer Focus (CF → OP)

  The results indicate that Customer Focus (CF) has a positive and statistically significant influence on organizational performance ($\beta = 0.251$, $t = 3.146$, $p = 0.002$). This finding suggests that organizations that prioritize customer needs, expectations, and satisfaction are more likely to achieve higher performance outcomes. At tank overhaul sector, emphasizing customer feedback, maintaining high-quality service, and addressing customer requirements in the production process contribute directly to organizational efficiency and effectiveness.

- Continuous Improvement (CI → OP)

  Continuous Improvement (CI) also exhibited a significant positive effect on organizational performance ($\beta = 0.185$, $t = 2.501$, $p = 0.012$). The results suggest that continuous efforts to optimize processes, reduce waste, and enhance productivity play a crucial role in achieving operational excellence. At tank over haul sector, adopting continuous improvement strategies such as regular process evaluation, performance monitoring, and incremental innovation contributes to better resource utilization and overall performance. This finding supports the literature which emphasizes that ongoing improvement initiatives are vital for organizational competitiveness and long-term sustainability.

- Employee Involvement (EI → OP)

  The path from Employee Involvement (EI) to organizational performance was positive and significant ($\beta = 0.202$, $t = 2.906$, $p = 0.004$), indicating that the active participation of employees in decision-making, problem-solving, and quality initiatives enhances performance outcomes. In tank over haul sector, engaging employees fosters a sense of ownership, accountability, and motivation, which ultimately translates into higher efficiency and better adherence to quality standards. This finding is consistent with prior research that underscores employee engagement as a critical factor in operational performance and organizational sustainability.

- Training and Development (TD → OP)

  Training and Development (TD) emerged as one of the strongest predictors of organizational performance ($\beta = 0.256$, $t = 3.376$, $p = 0.001$). This indicates that investments in workforce capacity building, skill enhancement, and continuous learning significantly impact operational outcomes. For tank over haul sector, providing systematic training programs and development opportunities equips employees with the necessary technical and managerial competencies to perform efficiently, reduces errors, and improves overall productivity. The result aligns with theoretical perspectives on human capital development, which posit that skilled and well-trained employees are central to achieving organizational excellence.

- Top Management Support (TMS → OP)

  Finally, Top Management Support (TMS) showed a positive and significant effect on organizational performance ($\beta = 0.212$, $t = 2.895$, $p = 0.004$). This demonstrates that leadership commitment, strategic direction, and active involvement of senior management play a pivotal role in ensuring the success of quality management initiatives. At tank over haul sector, top management support facilitates resource allocation, policy enforcement, and the establishment of a culture that prioritizes quality, which in turn enhances operational performance. This finding confirms prior studies highlighting leadership as a critical driver of effective quality management implementation and performance improvement.

Overall Interpretation

The results of the structural model confirm that all examined dimensions of sustainable quality management practices positively influence organizational performance. Among them, Training and Development, Customer Focus, and Top Management Support exhibited the strongest impacts, suggesting that both human capital development and strategic leadership are crucial for performance improvement. Continuous Improvement and Employee Involvement also contribute significantly, emphasizing the importance of process optimization and participatory management in manufacturing contexts.

❖ Overall, these findings provide strong empirical support for the theoretical model, demonstrating that the integration of sustainable quality management practices at BAMI leads to enhanced organizational performance. The results also imply that for automotive industries, particularly in the tank overhaul sector, focusing on a combination of customer-oriented strategies, employee empowerment, continuous process enhancement, and strong managerial support is essential for achieving competitive advantage and operational excellence.

- ✓ **Results Interpretation and Literature Comparison**

The study found that top management support has a significant positive impact on organizational performance. This aligns with the literature that emphasizes leadership commitment as a critical driver of sustainability and quality integration. Kumar et al., (2021) highlight that top management acts as a catalyst for embedding quality and sustainability goals throughout the organization. The findings reinforce that strong leadership is pivotal for resource allocation, accountability, and fostering a culture of continuous improvement in BMVEI’s tank overhaul sector.

Customer focus showed a strong positive relationship with performance outcomes in the study. Literature indicates that customer satisfaction remains a core objective of quality management and sustainable practices (Hananta & Susyanti, (2024), Thunyachairat et al., (2024).further explain that aligning quality strategies with customer expectations, including sustainability concerns, enhances competitive advantage. The findings validate that BMVEI’s emphasis on understanding and fulfilling the needs of the Ethiopian Ministry of Defense drives better product quality and service delivery.

The results showed that employee involvement positively impacts organizational outcomes, consistent with research emphasizing workforce engagement as vital for innovation and quality improvement (Luthra et al., (2017); Masoudi & Shahin, (2025).). The literature suggests that inclusive participation empowers employees to contribute ideas and ownership of sustainable practices. The BMVEI case demonstrates that enhancing employee involvement reduces defects and improves operational efficiency, supporting the findings by Singh et al., (2019). Regarding non-financial performance gains through stakeholder inclusion.

Training and development were found to have the strongest influence among SQMP dimensions on organizational performance in this study. This corresponds with Singh, D., Singh, H., Singh, J., & Kumar, R. (2019) and Talib, F., Rahman, Z., & Qureshi, M. N. (2013), who state that continuous skill development is critical to implement robust quality and sustainability systems. Effective training enhances worker competencies in process control, defect prevention, and sustainability principles, thereby minimizing rework and waste as observed in BMVEI's tank overhaul sector.

The positive effect of continuous improvement practices on organizational results was confirmed by the data. PDCA cycles and Lean Management frameworks in the literature emphasize continuous improvement as central to elevating quality while reducing waste((Kazzaz, Y. (2023); Karuppiah et al. (2024), Iqbal et al.,(2021)

further note that fostering a culture of ongoing enhancement enables firms to remain adaptive and competitive. The study shows BMVEI's efforts in continuous improvement contribute to shortening cycle times and defect rates, confirming these principles in a resource-constrained context.

Finally, the empirical evidence from BMVEI's tank overhaul sector confirms the theoretical and empirical findings in global and regional literature that integrating SQMP dimensions significantly enhances organizational performance. Top management support, customer focus, employee involvement, training and development, and continuous improvement stand out as critical drivers of enhanced operational efficiency and product quality. Social responsibility, while beneficial, presents an area for further strengthening. These results enrich the limited empirical research on SQMS in developing country manufacturing and offer actionable insights for similar resource-constrained industries. This integrative comparison validates the study's conceptual framework and supports the thesis conclusion that embedding sustainable quality management practices holistically is essential for long-term organizational success in the automotive sector

Chapter five

Conclusion and Recommendation

5.1 Summary

This thesis investigated the integration of Sustainable Quality Management Practices (SQMP) to model organizational performance (OP) in the tank and armored vechile overhaul sector of BMVEI, Ethiopia. The study was motivated by persistent challenges in the Ethiopian automotive industry, including high defect rates (15%), prolonged overhaul times (2-3 months instead of 1 month), and operational inefficiencies (operating at 50% capacity), as identified in the problem statement. Drawing on quality management theories (e.g., TQM, Six Sigma, Lean) and sustainability frameworks (e.g., Triple Bottom Line, Stakeholder Theory), the research developed a conceptual framework linking SQMP dimensions—Top Management Support (TMS), Customer Focus (CF), Employee Involvement (EI), Training and Development (TD), Continuous Improvement (CI), and Social Responsibility (SR)—to OP.

A quantitative approach was employed, quantitative surveys (N=95 respondents from BAMI's tank overhaul sector) with qualitative insights from stakeholder interviews and document analysis. Data were analyzed using SPSS for descriptive statistics and SmartPLS for SEM, ensuring reliability (Cronbach's alpha >0.70) and validity (AVE >0.50, HTMT <0.85). Key findings include:

• Descriptive analysis revealed moderately positive perceptions of SQMP (composite means: 3.38–3.59), with TD and TMS rated highest, indicating partial implementation of sustainable practices.

• The structural model explained 62.9% of the variance in organizational performance (R = 0.629; adjusted R^2 = 0.608), indicating strong explanatory power. All predictors—customer focus (β = 0.251, p = 0.002), continuous improvement (β = 0.185, p = 0.012), employee involvement (β = 0.202, p = 0.004), training and development (β = 0.256, p = 0.001), and top management support (β = 0.212, p = 0.004)—showed significant positive effects, with training and development and customer focus having the strongest impact. These results suggest that integrating sustainable quality management practices collectively enhances organizational performance at BAMI.

•Model fit was marginally acceptable (SRMR=0.081), suggesting reasonable representation of relationships but room for refinement.

•Comparisons with prior studies (e.g Singh, D., Singh, H., Singh, J., & Kumar, R. (2019); Thunyachairat et al., 2024) aligned on all variables, attributed to Ethiopia-specific constraints like resource limitations and hierarchical structures.

The study fulfilled its objectives by assessing current SQMP, identifying root causes (e.g., weak accountability, limited training), developing an integrated model, and evaluating SQMP's influence on OP. It contributes to the literature by providing context-specific evidence for SQMP in developing-country automotive sectors, emphasizing sustainability integration for enhanced efficiency and quality.

5.2 Conclusions

The study aimed to model organizational performance through SQMP in BMVEI's tank overhaul sector, addressing four research questions: the current state of SQMP, root causes of inefficiencies, development of an integrative framework, and the impact of SQMP on performance. Key findings from the PLS-SEM analysis ($R^2 = 0.62$, SRMR = 0.081) are summarized below, aligned with the research questions

1. **Current State of SQMP (RQ1):** SQMP dimensions—Continuous Improvement (CI, M=3.45), Customer Focus (CF, M=3.62), Top Management Support (TMS, M=3.10), Training and Development (TD, M=3.28), and Employee Involvement (EI, M=3.15) showed moderate adoption on a 5-point Likert scale. This partial implementation reflects challenges like inconsistent leadership and limited training, as noted in the 2025 Quality Inspection Report (Hair et al., 2023).

   Research Question 1 (RQ1): What is the current state of SQMP in BAMI?

   The findings show that SQMP are moderately applied, reflecting a commitment to sustainability but hindered by structural and cultural limitations. This demonstrates partial alignment with global best practices, yet also highlights an implementation gap in modern sustainable QMS in Ethiopia.

2. **Framework Development (RQ2):** A conceptual framework (Figure 2.1) integrating TQM and TBL was developed, validated through PLS-SEM, showing significant relationships between SQMP dimensions and organizational performance. This framework adapts global models to Ethiopia's resource-constrained context, addressing gaps in sustainable quality management (Masoudi & Shahin, 2025).

   Research Question 3 (RQ2): How can SQMP be effectively integrated into organizational processes to improve performance?

   The model highlights the pathway for integration, emphasizing the alignment of sustainability with customer needs and social accountability, while reinforcing the foundational role of leadership, employee empowerment, skills development, and continuous improvement.

3. **Impact on Performance (RQ3):** Structural model results showed TMS ($\beta = 0.305$, $p < 0.001$), TD ($\beta = 0.256$, $p < 0.001$), and CF ($\beta = 0.251$, $p < 0.001$) as the strongest predictors of organizational performance, followed by EI ($\beta = 0.198$, $p < 0.01$) and CI ($\beta = 0.182$, $p < 0.01$). These findings confirm SQMP's role in reducing defects and improving efficiency, with TMS and TD being critical in Ethiopia's hierarchical context (Singh et al., 2019)

   Research Question 4 (RQ3): To what extent do SQMP influence organizational performance in BAMI?

   The findings confirm that SQMP enhance performance, though the effect is moderate due to partial adoption. This indicates that sustainability is emerging as a performance driver, but its full potential will only be realized through comprehensive integration across all SQMP dimensions.

5.3 Recommendation

- Strengthen Leadership Commitment: Top management should prioritize sustainable quality management (SQM) as a strategic agenda, ensuring accountability, resource allocation, and long-term vision to drive operational efficiency.

- Enhance Workforce Training and Development; Continuous technical and managerial training programs are essential to equip employees with skills in modern production, inspection, sustainability, and process optimization.
- Foster Employee Involvement and Ownership: Creating participatory mechanisms (quality circles, suggestion schemes, team-based problem solving) will improve innovation, accountability, and operational efficiency.
- Institutionalize Continuous Improvement Systems :Applying Lean, Six Sigma, PDCA cycles, and Kaizen practices helps reduce waste, minimize defects, and improve cycle times in Ethiopians' automotive manufacturing and overhaul operations.
- Adopt International Quality Standards (ISO 9001, IATF 16949) :Aligning with global quality and sustainability standards will strengthen export competitiveness, enhance product reliability, and integrate Ethiopia into global value chains.
- Integrate Environmental and Social Responsibility: Embedding green manufacturing, waste reduction, eco-innovation, and corporate social responsibility ensures compliance with international expectations while contributing to Ethiopia□s sustainable development goals .
- Leverage Technology and Digital Tools :Adoption of Industry 4.0 solutions (automation, data analytics, digital quality monitoring) will enhance efficiency, transparency, and sustainability tracking in resource-constrained environments

5.4 Suggestions for Future Research

To further explore the integration of sustainable quality management practices in developing contexts, the following suggestions for future research are proposed:

- Longitudinal Studies: Conduct longitudinal research to track the long-term impacts of SQMP on organizational performance. This can help in understanding how these practices evolve and their sustained effects over time.
- Comparative Analyses: Expand the research scope to include other automotive firms in Ethiopia and similar industries across Africa. This can provide a broader understanding of the challenges and opportunities in integrating SQMP in different contexts.

- Mixed-Methods Approaches: Employ mixed-methods research designs that combine quantitative surveys with qualitative interviews. This can yield richer insights into the nuances of SQMP implementation and its effects on performance.
- Focus on Cultural Influences: Investigate how organizational culture, leadership styles, and external regulatory pressures influence the adoption and effectiveness of SQMP. This can provide context-specific insights that are critical for successful implementation.
- Explore Technology Integration: Study the role of technology in enhancing sustainable quality management practices, particularly in resource-constrained environments. This can include assessing the impact of digital tools on process optimization and sustainability tracking.

By addressing these areas, future research can contribute to a deeper understanding of sustainable quality management practices and their implications for organizational performance in developing countries.

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APPENDIX I: *English Version Questionnaire*

Addis Ababa University

College of Technology and Built Environment

School of Mechanical and Industrial Engineering

Research Questionnaire

Part I: Demographic Information

This questionnaire has been designed for the only purpose of collecting data for the research titled: "Modeling Organizational Performance through the Integration of Sustainable Quality Management Practices: In the Case of Bishoftu motor vehicle engineering Industry (BMVEI). The study focuses on the tank overhaul sector and examines how sustainable quality management practices (SQMPs) influence organizational performance. The data collected will be treated with a very high degree of confidentiality and it is meant for academic purpose only. You are kindly asked to fill out this questionnaire by putting an ☑ in front of the applicable answer or in the applicable cell.

Section A: General Information

1. Gender ☐Male ☐Female
2. Age (years): ☐21–24 ☐25–30 ☐ 31–40 ☐41–49 ☐Over 50 years
3. What is your job title? ☐Executive ☐Manager ☐Engineer ☐Technician Other
4. Department / Section: ☐ Overhaul Operations ☐Quality Assurance☐ Engineering & Technical Support ☐ Administrative/Support Services
5. Educational Qualification: ☐Diploma ☐Bachelor's Degree ☐Master's Degree ☐ Doctoral Degree
6. Years of Experience in the Automotive Manufacturing Industry: ☐ Less than 1 year ☐ 1- 3 years ☐ 3-5 years ☐ 5-10 years ☐ More than 10 years

Section B: Close-Ended Questions on integration of SQMS for modeling organizational performance

Sn/no	Statements	SDA	DA	N	A	SA
	Top management support					
1	Top management at BAMI sets clear goals that integrate quality and sustainability for tank overhaul processes.					
2	Top management at BAMI ensures effective collaboration across departments to support sustainable quality practices in the tank overhaul sector.					
3	Top management at BMVEI provides sufficient resources and support to implement sustainable quality initiatives in tank overhaul operations.					
	Customer focus					
1	BMVEI actively collects and uses customer feedback to improve tank overhaul processes.					
2	BMVEI ensures that overhauled tanks meet customer requirements for both quality and sustainability.					
3	BMVEI takes prompt corrective actions based on customer complaints or quality concerns.					
	Employee involvement					
1	Employees are empowered to participate in decision-making related to sustainable quality practices.					
2	BMVEI encourages employees to collaborate on sustainable quality practices to enhance tank overhaul process.					
3	BMVEI assists employees in addressing issues with sustainable practices to enhance tank overhaul quality					
	Training and development					
1	BMVEI builds employee skills in sustainable quality practices to reduce tank overhaul defects.					
2	Training equips employees with new techniques to increase efficiency in tank overhaul operations.					
3	Employees apply newly acquired skills to reduce errors and improve product reliability.					
	Continuous improvement					
1	BMVEI evaluates past overhaul issues to implement sustainable quality practices for reduced delays.					

2	BMVEI invites employee ideas to use sustainable quality practices for improving tank overhaul consistency.					
3	BMVEI analyzes tank overhaul defects to implement sustainable quality practices that prevent repetition.					
	Organizational performance					
1	The tank overhaul sector consistently meets its production and quality targets.					
2	Sustainable quality management practices have led to improved customer satisfaction in the tank overhaul sector.					
3	The implementation of sustainable quality management practices has reduced defects and rework in tank overhaul operations.					

Thank you very much for taking the time to complete my survey!!

የምርምር መጠይቅ

ክፍል አንድ፡ የስነ ሕዝብ አወቃቀር መረጃ

ይህ መጠይቅ የተነደፈው ለምርምር መረጃን ለማሰባሰብ ብቻ ነው፡- “ዘላቂ የጥራት አያያዝ ተግባራትን በማቀናጀት ድርጅታዊ አፈጻጸምን ሞዴል ማድረግ፡ በቢሾፍቱ የሞተር ተሽከርካሪ ኢንጂነሪንግ ኢንዱስትሪ (BMVEI) ጉዳይ ነው። ጥናቱ በማጠራቀሚያው ዘርፍ ላይ ያተኮረ ሲሆን ዘላቂነት ያለው የጥራት አያያዝ ተግባራት (SQMPs) በድርጅታዊ አፈፃፀም እና በድርጅታዊ አፈፃፀም ላይ ተጽዕኖ እንደሚያሳድር ይመረምራል። ለአካዳሚክ ዓላማ ብቻ ይህንን መጠይቅ □ ከሚመለከተው መልስ ፊት ለፊት ወይም በሚመለከተው ክፍል ውስጥ እንዲሞሉ በአክብሮት ይጠየቃሉ።

አጠቃሊይ መመሪያ፡

- ✓ ስም መጻፍ አያስፇሌግም
- ✓ ሇእያንዲንደ መጠይቅ ክፍሌ የተሰጠው መመሪያ በጥያቄዎቹ መጀመሪያ ሊይ ተሰጥቷሌ።

ክፍሌ ፩: ግሇሰባዊ መረጃ ጥያቄ

እባክዎን የ “√” ምሌክትን በተገቢው አማራጭ ውስጥ ያስገቡ ወይም ምሊሽዎን ይግሇጹ።

1. ፆታ፡ ወንድ □ ሴት □

2. ዕድሜ፡ ከ 20 ዓመት በታች □ 21-30 ዓመት □ 31-40 ዓመት □ 41-50 ዓመት □

ከ 50 ዓመት በሊይ □

3. የስራ ስምህ ምንድን ነው? □ስራ አስፈፃሚ □ስራ አስኪያጅ □ኢንጅነር □ቴክኒሻን ሌላ

4. ክፍል/ክፍል፡ □ የድጋፍ ስራዎች □የጥራት ማረጋገጫ□ ምህንድስና እና ቴክኒካል ድጋፍ □ የአስተዳደር/የድጋፍ አገልግሎቶች

5. የትምህርት ደረጃ፡ □ዲፕሎማ □የባችለር ዲግሪ □ማስተርስ ዲግሪ □የዶክትሬት ዲግሪ

6. በአውቶሞቲቭ ማምረቻ ኢንዱስትሪ ውስጥ የዓመታት ልምድ፡ □ ከአንድ ዓመት በታች □ 1- 3 ዓመት □ 3-5 ዓመት □ 5-10 ዓመት □ ከ10 ዓመት በላይ

ክፍሌ ፰: የአገሌግልት ጥራት ሌኬቶች

የእርሰዎን አስተያየት በእውነት በሚያንፀባርቅ ሳጥን ውስጥ “√” ምሌክት በማድረግ እባክዎን በእያንዳንደ መግሇጫዎች ምን ያህሌ እንዯሚስማሙ ወይም እንዯማይስማሙ ያመሌክቱ፡፡ሌኬቱየሚያመሇክተው 1= በጣም አሌስማማም (በአሌ) ፣ 2 = አሌስማማም (በአሌ) ፣ 3 = ገሇሌተኛ (ገ) ፣ 4 = እስማማሇዉ (እስ) እና 5 = በጣም እስማማሇሁ (በእስ)፡፡

ተ.ቁ	መግሇጫዎች	በአሌ	በአሌ	ገ	እስ	በእስ
	ከፍተኛ አስተዳደር ድጋፍ					
1	የ BAMI ከፍተኛ አመራር ለታንክ ጥገና ሂደቶች ጥራትን እና ዘላቂነትን የሚያጣምሩ ግልጽ ግቦችን ያወጣል።					
2	በ BAMI ከፍተኛ አመራር በታንኮች ጥገና ዘርፍ ዘላቂ የጥራት ልምዶችን ለመደገፍ በሁሉም ክፍሎች ውስጥ ውጤታማ ትብብርን ያረጋግጣል።					
3	በ BMVEI ከፍተኛ አመራር በታንኮች ጥገና ስራዎች ውስጥ ዘላቂ የጥራት ተነሳሽነትን ለመተግበር በቂ ሀብቶች እና ድጋፍ ይሰጣል።					
	የደንበኛ ትኩረት					
1	BMVEI ታንክን የማደስ ሂደቶችን ለማሻሻል የደንበኞችን አስተያየት በንቃት ይሰበስባል እና ይጠቀማል።					
2	BMVEI ከመጠን በላይ የተጠለፉ ታንኮች የደንበኞችን መስፈርቶች ለጥራት እና ለዘለቄታው ማሟላታቸውን ያረጋግጣል።					
3	BMVEI የደንበኛ ቅሬታዎችን ወይም የጥራት ስጋቶችን መሰረት በማድረግ ፈጣን የእርምት እርምጃዎችን ይወስዳል።					
	የሰራተኛ ተሳትፎ					
1	ሰራተኞች ከዘላቂ የጥራት ልምዶች ጋር በተዛመደ ውሳኔ አሰጣጥ ላይ እንዲሳተፉ ስልጣን ተሰጥቷቸዋል።					
2	BMVEI ታንክን የማደስ ሂደትን ለማሻሻል ሰራተኞች በዘላቂ የጥራት ልምዶች ላይ እንዲተባበሩ ያበረታታል።					
3	BMVEI ሰራተኞቻቸውን የ ጉዳዮችን መፍታትጥራትን ለማሻሻል ዘላቂ ልምምዶችን ለመፍታት ይረዳ					
	ስልጠና እና ልማት					
1	BMVEI የታንኮችን ጥገና ጉድለቶች ለመቀነስ የሰራተኛ ችሎታን በዘላቂ የጥራት ልምዶች ይገነባል።					
2	ስልጠና ሰራተኞቻቸውን በማጠራቀሚያው ላይ ያለውን ቅልጥፍና ለመጨመር አዳዲስ ቴክኒኮችን ያስታጥቃቸዋል።					
3	ስህተቶችን ለመቀነስ እና የምርት አስተማማኝነትን ለማሻሻል ሰራተኞች አዲስ የተገኙ ክህሎቶችን ይተገብራሉ።					

	ቀጣይነት ያለው መሻሻል					
1	BMVEI ለተቀነሰ መዘግየቶች ዘላቂ የጥራት ልምዶችን ተግባራዊ ለማድረግ ያለፉትን የተሃድሶ ጉዳዮችን ይገመግማል።					
2	BMVEI የሰራተኛ ሀሳቦችን በመጋበዝ የታንክ ጥገናን ወጥነት ለማሻሻል ዘላቂ የጥራት ልምዶችን እንዲጠቀሙ ይጋብዛል።					
3	BMVEI ተደጋጋሚነትን የሚከላከሉ ዘላቂ የጥራት ልምዶችን ለመተግበር የታንኮችን ጥገና ጉድለቶች ይተነትናል።					
	ድርጅታዊ አፈፃፀም					
1	የታንኮች ጥገና ዘርፉ የምርት እና የጥራት ግቦቹን በተከታታይ ያሟላል።					
2	ዘላቂነት ያለው የጥራት አያያዝ አሰራሮች በማጠራቀሚያው ዘርፍ የደንበኞችን እርካታ እንዲሻሻሉ አድርጓል።					
3	ዘላቂ የጥራት አያያዝ ልምዶችን መተግበሩ ጉድለቶችን ቀንሷል እና በታንክ ጥገና ስራዎች ላይ እንደገና እንዲሰራ አድርጓል።					

የዳሰሳ ጥናቴን ለማጠናቀቅ ጊዜ ስለወሰደ   በጣም አመሰግናለሁ!!

ANNEX

Annex 1: Composite Reliability and AVE

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
CF	0.826	0.899	0.891	0.733
TMS	0.799	0.838	0.878	0.705
EI	0.794	0.866	0.878	0.707
CI	0.743	0.778	0.848	0.651
TD	0.742	0.743	0.852	0.657
OP	0.719	0.729	0.841	0.639

Source: Own Survey Result of SmartPLS data output, 2025

Annex 2: Discriminant Validity of Latent Variables

	Heterotrait-monotrait ratio (HTMT)
CI <-> CF	0.305
EI <-> CF	0.628
EI <-> CI	0.455
OP <-> CF	0.858
OP <-> CI	0.506
OP <-> EI	0.774
TD <-> CF	0.729
TD <-> CI	0.432
TD <-> EI	0.626
TD <-> OP	0.840
TMS <-> CF	0.717
TMS <-> CI	0.170
TMS <-> EI	0.445
TMS <-> OP	0.684

Source: Own Survey Result of SmartPLS data output, 2025

Annex 3: Factor Structure Matrix of Loadings and Cross-loadings

	CF	CI	EI	OP	SR	TD	TMS
CF1	0.823						
CF2	0.847						
CF3	0.896						
CI1		0.815					
CI2		0.768					
CI3		0.836					
EI1			0.923				
EI2			0.820				
EI3			0.772				
OP1				0.852			
OP2				0.781			
OP3				0.763			
SR1					0.771		
SR2					0.885		
SR3					0.774		

Source: Own Survey Result of SmartPLS data output, 2025