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QUALITY CONTROL IN SMALL AND MEDIUM ENTERPRISES: A STUDY OF PRESENT CHALLENGES AND FUTURE OPPORTUNITIES

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ABSTRACT
Quality control is a critical foundation for establishing effective and efficient systems across industries, but small and medium enterprises (SMEs) face unique challenges in implementing effective quality control due to resource constraints. This study aims to identify the specific needs through demographic and operational analysis, and to develop a compact, adaptable Quality Management Framework to enhance their operational excellence. Survey responses from 50 SME managers were analyzed using cluster analysis, utilizing Ward's method and K-means to categorize businesses based on their quality control practices. Findings revealed three distinct SME clusters emerged, with systematic quality practices correlating to 71% higher customer satisfaction. These findings highlight significant variations in managerial perceptions, needs, and priorities. This research proposes an adaptable quality management framework tailored for SMEs and recommends the integration of technology to enhance scalability and effectiveness. Thus, this study addresses a theoretical gap in SME quality control system design while offering practical, actionable insights for enhancing quality management processes in diverse industrial contexts.
Keywords: *SMEs, Quality Control, Quality Management Framework, Operational Excellence, Cluster Analysis.*

1. Introduction

Micro, small, and medium enterprises (MSMEs) are vital to the Indonesian economy, comprising about 90% of all businesses and significantly contributing to job creation and economic growth. Government regulations, such as Bank Indonesia Regulation Number 17/12/PBI/2015, require commercial banks to allocate at least 10% of total credit to MSMEs, thereby enhancing their access to financing through programs like the People's Business Credit (KUR). KUR aims to increase access to financing for MSMEs that are feasible but not yet bankable and aims to increase their capacity to receive financing (Badan Pusat Statistik, 2019). The distribution of KUR to micro and small business actors in 2017 reached 96.7 trillion rupiah with the number of debtors reaching 4.41 million people. However, this distribution only reached 87.9% of the target set, which was lower than the previous year. One of the main obstacles in providing credit is prospective debtors who cannot yet be credited and the bank's caution in assessing the debtor's credibility (Badan Pusat Statistik, 2019).

Small and medium industries (SMEs) play an important role in the Indonesian economy. Although MSMEs often face similar problems to MSMEs in terms of financing and market access, MSMEs also have great potential to grow and contribute to the national economy if they receive the right support. Through various policies, the government has tried to increase the competitiveness of MSMEs. These policies include providing easier access to credit and training programs aimed at improving the management and technical skills of MSME actors. One of the main problems faced by MSMEs is the difficulty in accessing international markets, especially when they compete with products from other countries that are more competitive (Badan Pusat Statistik, 2019). Micro businesses still face significant limitations in adopting information and communication technology (ICT). Many micro and small enterprises (MSEs) have yet to integrate digital technologies into their business operations, leading to reduced efficiency and

competitiveness, particularly in supporting their operations and marketing efforts. In the era of Industry 4.0, where technology and digitalization are critical drivers of success, this lack of adoption poses a significant challenge for their sustainability and growth (Badan Pusat Statistik, 2023).

Small and medium enterprises (SMEs) and small and medium enterprises (SMEs) are the pillars of the Indonesian economy and contribute significantly to job creation and poverty reduction. To encourage the growth of MSMEs and SMEs, the government has implemented various policies, including easy access to credit and capacity building programs. With various programs and initiatives that have been and are being implemented by the government, it is hoped that MSMEs and SMEs, especially micro businesses, can continue to grow and contribute more to the national economy. However, there are still challenges that need to be overcome, such as improving market access and the quality of business management. Most SMEs struggle to sustain their operations and marketing efforts, striving to remain competitive amidst the rapid growth of SME businesses, particularly in developing countries. Besides price, one of the key aspects they compete on is the quality of their products and services. However, the question arises: has quality control become a focus for these enterprises?

Quality has become one of the key aspects in business development. When a business aims to achieve strong performance from a financial perspective, quality must be an integral part of the processes of development, control, and continual improvement. The concept of quality is generally ingrained in the minds of consumers across all segments, as their expectations for the products or services they purchase are consistently high and continue to increase over time. However, the question remains: have all business units invested adequate effort to ensure that the products or services delivered to consumers meet these expectations?

In the contemporary business landscape, quality control (QC) has emerged as an essential component of operational effectiveness, particularly for small and medium-sized enterprises (SMEs). This importance is underscored by the increasing emphasis on global competitiveness and customer satisfaction. The context of quality control in SMEs is nuanced, as these enterprises often operate with limited resources and face unique challenges that larger corporations may not encounter (Kull et al., 2018). As the backbone of the Indonesian economy—accounting for over 90% of all businesses—SMEs significantly contribute to job creation and economic development (Hartanto & Subagyo, 2019). However, many SMEs struggle with implementing effective quality control systems, which are vital for ensuring product and service quality to meet market demands and compliance standards (Alshahrani & Khalid Sami Husain, 2024; Amrina et al., 2021; Panagiotidou et al., 2025). Table 1 shows SMEs framework comparison between Indonesia's practices vs Internasional practices.

The processes of development, control, and continual quality improvement can operate effectively when seamlessly integrated into operational workflows. For example, production operators not only carry out their assigned production tasks but also inspect the quality of raw materials before processing and ensure that all other components in the production system comply with established standards. However, can the demand for rapid work execution consistently align with the need for detailed inspections?

Medium- to large-scale enterprises often allocate sufficient resources to ensure the quality of their products and services before they are delivered to consumers. For instance, they establish Quality Assurance (QA) and Quality Control (QC) teams to develop quality assurance systems and ensure consistent implementation. Additionally, they adopt various technologies, such as sensors, IoT devices, and drones, to facilitate the control processes. But what about small business units with limited capital and resources? Are they able to adopt similar measures, or do they face unique challenges in maintaining quality assurance within constrained budgets and operational capacities?

The specific challenges SMEs face in quality control are multifaceted. Firstly, a lack of awareness and understanding of quality control principles can hinder their ability to establish robust QC systems (Scarton et al., 2025). Secondly, financial constraints often limit SMEs' access to necessary training and technology, further exacerbating quality-related issues (Khalil et al., 2024). Thirdly, as SMEs strive for growth, they encounter competition from both local and international markets, making effective quality management not just an option but a necessity for

survival and expansion (Elbanna et al., 2024). Furthermore, many SMEs grapple with inconsistent quality due to variable processes, which can lead to customer dissatisfaction and damaged reputations (Runtuk et al., 2024).

Table 1 – SME Quality Management Components (PDCA Framework)

Component	Description	Purposes	Indonesia's Practices	Internasional Practices
PDCA Phase: PLAN				
Quality Policy (Kalogiannidis et al., 2025)	Formal statement reflecting the organization's commitment to quality.	Provides strategic direction and a framework for setting quality objectives.	Often implicit or unwritten in traditional SMEs (limited formal documentation).	Core element of ISO 9001 QMS; SMEs emphasize quality policies that are digitized and accessible to all employees.
Quality Objectives (Fähndrich & Pedell, 2025)	Specific, measurable goals related to quality that the organization aims to achieve.	Provides a benchmark for assessing quality performance.	Typically focus on consistent product quality and meeting local standards.	SMEs often set digital dashboards to monitor quality objectives, enabling rapid adjustments.
PDCA Phase: DO				
Process Mapping (Fries et al., 2025)	Document all processes involved in product/service delivery, identifying inputs, outputs, and controls.	Enhances understanding of workflows and where quality checks are needed.	Often done manually (hand-drawn charts) with limited formal documentation.	Increasingly performed with BPM software to analyze and optimize end-to-end processes.
Quality Control Tools/Techniques (Mkansi & Nsakanda, 2023)	Implement tools such as checklists, control charts, and Pareto analysis to monitor quality.	Facilitates the identification and analysis of quality issues.	Rarely systematic; many SMEs rely on simple inspection and intuition due to resource limits.	Standard practice in mature QMS; often supported by digital templates and statistical software.
Training and Development (N. Khan et al., 2025)	Continuous training programs for employees on quality standards and best practices.	Ensures that employees possess the necessary skills to maintain quality.	Informal training passed down through generations, often through apprenticeships.	Widely implemented via formal programs (e-learning, workshops, ISO/TQM certification).
PDCA Phase: CHECK				
Customer Feedback Mechanism (Ardolino et al., 2025)	Mechanisms to gather and analyze customer feedback regarding quality and satisfaction.	Gathers data on satisfaction/issues to drive improvements and ensure customer requirements are met.	Feedback may be gathered informally (e.g. local community meetings or word-of-mouth).	SMEs have integrated CRM systems that automate customer feedback for better quality adjustments.
Monitoring and Evaluation (Kalina et al., 2025)	Regular review of quality performance against objectives and reinforcements of quality policy.	Ensures ongoing alignment and improvement in quality practices.	Regular community assessment meetings to discuss quality and customer satisfaction.	SMEs employ business intelligence tools to dynamically assess quality metrics through data analytics and automated reporting

Component	Description	Purposes	Indonesia's Practices	Internasional Practices
PDCA Phase: ACTION				
Continuous Improvement (Silva et al., 2025)	Implement methodologies such as PDCA (Plan-Do-Check-Act) to foster a culture of improvement.	Provides a systematic approach to enhance quality over time.	Engage in iterative improvements through customer input, adapting products based on local needs.	SMEs use digital platforms to facilitate PDCA cycles where employees can contribute ideas and track improvements in real-time
Technology Integration (Scarton et al., 2025)	Utilize technology to streamline quality processes (e.g., software for tracking quality metrics).	Increases efficiency and scalability of quality control efforts.	Basic technology use such as mobile phones for communication; potential for digital platforms for market reach.	SMEs are adopting IoT devices to monitor and control production quality, providing real-time data analysis for immediate action
Compliance Management (Sovrano et al., 2025)	Adhere to relevant industry standards and regulations related to quality.	Mitigates risk and ensures the organization meets external expectations.	Traditions and cultural norms often regulate processes, with a growing awareness of formal certifications	SMEs use compliance software to ensure adherence to national and international quality standards
Local Sourcing (Zall et al., 2025)	Utilize locally sourced materials to ensure quality and sustainability.	Increases the authenticity and acceptance of the product by customers.	Emphasis on using local resources to enhance product quality and community support.	SMEs leverage local digital platforms to connect with regional suppliers, ensuring quality and sustainability in materials

Given these challenges, this study aims to identify the specific quality control system needs for SMEs, providing a comprehensive framework that will facilitate their journey towards operational excellence. The primary objectives include exploring the diversity of understanding, perceptions, and requirements of SME managers regarding quality control, and developing a practical framework that addresses these needs. Despite the growing body of literature addressing quality control in SMEs, certain gaps remain. Previous studies have predominantly focused on large enterprises or have relied heavily on local contexts, leaving a void in international comparative analyses that could provide more generalized insights applicable to diverse settings (Kumar et al., 2024). Moreover, the role of technology in facilitating quality control in SMEs has not been comprehensively addressed, nor have the specific strategies needed to overcome the financial and knowledge barriers that smaller businesses face (Dutta et al., 2021). Despite challenges such as limited market access and issues with quality management, SMEs have substantial growth potential. The government's efforts to provide improved access to credit and training programs are essential for bolstering their competitiveness. As these enterprises strive to ensure quality in their products and services, the research aims to identify the quality control system needs for SMEs, thus supporting their operational excellence.

In conclusion, this study seeks not only to illuminate the challenges SMEs face in adopting effective quality control systems but also to provide a structured framework that can lead to enhanced competitiveness and operational success in the ever-evolving market landscape. Building on these insights, the objective of this research is to explore the perceptions of SME owners and managers regarding quality concepts, the current implementation of quality control

practices in their businesses, and their plans for adopting quality management more broadly and quality control specifically in the future. This research aims to identify the quality control system needs for SMEs, to support their operational excellence. By aligning the findings of the literature review with these research objectives, this study aims to bridge the gap between theoretical models of quality management and their practical applicability in SMEs. Understanding these perceptions will provide actionable insights for designing more accessible and effective quality management frameworks tailored to the unique constraints and opportunities within SMEs.

2. Literature Review

Quality Management is a long-established concept in the industrial world and is not new to SMEs. Numerous studies have explored various models for implementing quality management across different industries. This study conducted a literature review to explore this topic, utilizing the ScienceDirect database with the keyword "SME Quality Control Management." After further selection, 19 articles were identified as relevant to the context of this research, as summarized in Table 2. After analysis, these 19 articles can be categorized into four main topics: The Impact of Quality Management Implementation, Factors Affecting the Success of Quality Management Practices, Technology Adoption in SMEs, and Enhancing Readiness for Quality Management Implementation.

Six articles focusing on the impact of quality management implementation on businesses found that quality management positively influences overall organizational performance, specifically improving customer satisfaction and financial outcomes, including profitability. These findings are derived from case studies of various SMEs across different countries, with three of them specifically operating in the manufacturing sector. These results underscore the significant role of quality management in enhancing both operational and financial performance in SMEs, highlighting its applicability and effectiveness across diverse contexts and sectors, including manufacturing.

The next six articles discuss case studies examining various factors that support the successful implementation of quality management. These factors include supplier development, organizational culture, collaboration, the implementation of the Seven Weeks method, and networking. These findings are based on case studies of various SMEs across different countries, with three of them specifically operating in the manufacturing and hospitality (accommodation) sectors. These insights highlight the diverse range of factors that contribute to the successful implementation of quality management in SMEs, emphasizing the importance of tailored approaches that consider industry-specific contexts, such as manufacturing and hospitality.

Table 2 – Previous Research from ScienceDirect with Keyword: SME Quality Control Management

Main Theme	Source	Object	Country	Objective
The Impact of Quality Management Implementation	(Usman et al., 2019)	SMEs	Pakistan and Italy	To study the impact of Quality Management Implementation in improving customers' satisfaction
	(Singh et al., 2018)	SMEs in production	India	To analyze the impact of TQM practices on organizational performance
	(O'Neill et al., 2016)	SMEs in production	Australia	To investigate the impact of quality management practices on financial performance
	(Kharub et al., 2022)	SMEs in production	India	To enhance profit in SMEs using Lean Six Sigma methodology
	(Koc, 2007)	SMEs	Turkey	To identify the effects of ISO 9000 on manufacturing parameters and firm performance
	(Zhou & Li,	SMEs	China	To explore the impact of

Main Theme	Source	Object	Country	Objective
	2020)			supply chain practices and quality management on firm business performances.
Factors Affecting the Success of Quality Management Practices	(Shokri et al., 2010a)	SMEs in Food distribution	UK	To emphasize the impacts of supplier development on reducing defects in supplier quality
	(Eniola et al., 2019)	SMEs	Nigeria	To examine the impact of organizational culture on total quality management
	(Mardani et al., 2015)	SMEs in Hotels	Iran	To examine the critical success factors on quality management implementation
	(Kim & Ryu, 2020)	SMEs in production	South Korea	To enhance collaboration using quality management
	(Gaitero et al., 2021)	SMEs	Spain	Demonstrate the effectiveness of Seven Weeks method for SMEs to create or improve quality/security management systems
	(Kearney & Abdul-Nour, 2004)	SMEs	Canada	To develop a management approach for SMEs to improve quality levels through networking
Technology adoption in SMEs	(Cimino et al., 2023)	SMEs in the furniture sector	Italy	To optimize production processes by multi-purpose platform
	(Pinto et al., 2019)	SMEs	Portugal	To develop gradual implementation model of Industry 4.0
	(Chohan et al., 2022)	SMEs	New Zealand	To address dynamic interoperability using MES
	(Park et al., 2023)	SMEs	Korea	To develop an AI-based smart factory construction model
	(Yang et al., 2023)	SMEs in production	Denmark	To develop an automation framework using collaborative robots
Enhance Readiness for Quality Management Implementation	(Pop, 2016)	SMEs	Romania	To develop a simplified model of quality management system for SMEs.
	(Lim & Antony, 2016a)	SMEs in Food industry	Malaysia	To assess the readiness for implementing statistical process control in the food industry

In addition to reviewing international quality frameworks such as TQM and ISO 9001, several empirical studies have specifically addressed the role of internal control mechanisms in supporting SME sustainability. Two recent studies offer contrasting yet complementary insights into this issue, grounded in different regional and governance contexts; Bure & Tengeh (2019) examined internal control implementation across various SME sectors in Zimbabwe, and Wang et al. (2019) investigated the relationship between internal control effectiveness and sustainable growth in Chinese listed SMEs. The first study reveals that internal control practices are often poorly institutionalized, with notable variation based on managerial education and procedural

formality. In contrast, the second study utilizes panel data analysis to empirically test agency theory propositions, showing that effective internal controls significantly promote sustainable growth, particularly in firms with multiple large shareholders. This comparative review highlights the need to contextualize internal control strategies according to SME structure, governance, and regional capability.

The implementation of quality management concepts in the Industry 4.0 era incorporates various advanced technologies. Several articles captured in this literature review discuss the adoption of these technologies by SMEs. Some SMEs have developed information systems as a foundation for decision-making processes to optimize production. These include interoperable platforms, cloud accumulation, and big data analysis. Additionally, other SMEs enhance production performance by automation, Manufacturing Execution Systems (MES), interoperability, Industrial Internet of Things (IIoT), Cyber-Physical Production Systems (CPPS), and collaborative robot (Cobot) systems.

Table 3 – Previous Research from ScienceDirect with Keyword: SME Quality Control Management

Source	Industry Type/ Country	Purpose/ Context	Implementation		Key Findings	Methodology
			TQM	Six Sigma		
(A. Khan & Farooqui e, 2016)	SME Manufact uring/ India	Identify motivation and results of ISO 9001 implementation	Formal quality system through ISO 9001	Not discussed	Customer pressure is main driver; improved process and customer satisfaction	Quantitative survey (n=127); regression analysis
(Zimon & Zimon, 2020)	Multi-sector SMEs/ Poland	Assess the effect of quality systems on working capital	ISO 9001 used as a proxy for QM system	Not discussed	QMS has a significant impact on short-term liquidity	Quantitative panel data analysis
(Bianchi & Ferraz Junior, 2020)	Constructi on, services/ Brazil	Test readiness tools for ISO 9001 implementatio n	PDCA and ISO 9001 used for readiness assessment	Not discussed	Tool is valid for assessing SME readiness	Survey and tool validity test
(Hernánd ez et al., 2013)	Small manufactu ring/ Slovakia	Evaluate human factors in QM performance	Focus on employee participation and training (soft TQM)	Not discussed	Employee involvement significantly affects quality performance	Quantitative ; correlation & regression
(Shields & Shellema n, 2015)	Plastic industry (SME)/ Thailand	Align QMS with sustainability principles	PDCA-based TQM integrated with sustainability metrics	Not discussed	Sustainability integration improves energy and material efficiency	Survey and gap analysis
(Shokri et al., 2010b)	Supply chain/ Serbia	Assess effect of supplier development on supply chain performance	TQM indicators used in supplier evaluation	Not explicitly discussed	Supplier development improves reliability and final product quality	Survey and relationship analysis
(Wang et al., 2025)	Manufact uring/ Egypt	Test impact of QM on SME profitability	Uses customer focus, leadership, process mgmt	Not discussed	Customer focus and process mgmt boost profitability	Multiple linear regression

Source	Industry Type/ Country	Purpose/ Context	Implementation		Key Findings	Methodology
			TQM	Six Sigma		
(Wildnerova et al., 2024)	Multi-sector/ 15 OECD countries	Identify SMEs engaged in environmental practices	Indirect: via training and quality structure correlation	Not discussed	1/3 SMEs are environmentally active; those are more productive	Machine learning (text mining on 1 million SME websites)
(Niyi Anifowose et al., 2022)	Small manufacturing/ Nigeria	To test whether innovation speed mediates the effect of TQM on operational performance in Nigerian manufacturing SMEs.	Focus on five core dimensions.	Not discussed.	TQM improves operational performance through better product quality and higher efficiency; innovation speed is a significant mediator.	PLS-SEM (n = 484).
(Antunes et al., 2021)	Cross-sector/ Poland	To identify which TQM dimensions drive product and process innovation in Portuguese SMEs.	All TQM dimensions influence innovation and performance.	Not discussed.	Strong relationship between TQM and both product and process innovation.	SEM.
(Kachba et al., 2012)	Multi-sector/ Brazil	To explore how aligning quality-management maturity with the market segment boosts competitiveness among Brazilian SMEs.	Aligning quality-management system with overall business strategy and market requirements.	Not discussed.	TQM alignment drives SME market performance; higher QM maturity is correlated with competitiveness in different market segments.	Descriptive & correlational analysis of 20 Brazilian case firms.
(Singh et al., 2018)	Manufacturing & services/ Saudi Arabia	To examine how six TQM critical factors influence organisational performance in Indian SMEs and services.	Six TQM principles	Not discussed.	Top-management commitment is the most significant driver of performance; all six principles positively affect productivity and quality.	SEM (n = 236).
(Pfeifer, 2022)	Automotive/ Czech Republic	To analyse how supply-chain rank, company size and Six-Sigma duration affect perceived process	Not discussed (study focuses on Six Sigma).	Positive perception but limited implementation	Barriers include resource constraints and organisational resistance to Six Sigma.	Perception survey Fisher's exact tests.

Source	Industry Type/ Country	Purpose/ Context	Implementation		Key Findings	Methodology
			TQM	Six Sigma		
		capability.				
(Abbes et al., 2022)	Textile /Tunisia	To create a fuzzy-logic readiness model (LSRACI) for Lean Six Sigma adoption in small clothing SMEs.	Not explicitly discussed, but the model presumes a continuous-improvement (CI) culture consistent with TQM.	Readiness - assessment tool for Green Lean-Six-Sigma.	Readiness tool helps SMEs evaluate LSS potential and spot barriers (financial limits, employee skills, data quality).	Fuzzy-logic model; expert validation.
(Bianchi & Ferraz Junior, 2020)	General (small business)/ Brazil	To develop a self-assessment artefact enabling Brazilian micro- and small enterprises to prepare for ISO 9001:2015.	Focus on five dimensions (leadership, customer, processes, documentation, improvement).	Not discussed; emphasis on ISO 9001 readiness.	Self-assessment generates prioritised action plans; lack of leadership formalisation is a key gap in Brazilian small firms.	Design-Science methodology; three pilot cases.
(Le & Nguyen, 2024)	Multi-sector/ Vietnam	To evaluate impacts of ISO 9001 certification vs. product diversification on asset productivity in Vietnamese SMEs.	Certification (ISO 9001 & HACCP) considered part of TQM / CI framework.	Not discussed.	Certification improves asset productivity by ~26%; product diversification is linked to an 18 % drop in productivity.	IV regression; panel dataset of ~2 500 firms.
(Anjaningrum et al., 2024)	Creative economy/ Indonesia	To test whether business intelligence and organisational / network learning drive innovation and, in turn, SME performance.	TQM principles treated as foundational to organisational learning & continuous improvement.	Not discussed.	Organisational learning and innovation fully mediate the effect of business-intelligence practices on SME performance.	Quantitative survey; PLS-SEM (n = 313).
(Cződörová & Gnap, 2023)	Transportation /Slovakia	To analyse the financial impact of ISO 9001 adoption on 17 Slovak transport SMEs.	ISO 9001 quality-management system evaluated.	Not discussed.	ISO 9001 boosts internal efficiency, profitability and competitiveness; positive changes recorded in ROA & ROS post-certification.	Panel financial ratio analysis (pre- & post-certification).

The comparative review of 18 journal articles in Table 3 presents a growing emphasis on Total Quality Management (TQM) implementation in SMEs across diverse sectors and countries. The studies were selected based on their methodological rigor and relevance to the themes of quality management systems, internal control, organizational performance, and sustainability. Most studies focus on soft TQM practices—such as leadership commitment, customer orientation, and continuous improvement—as key drivers of operational performance, innovation, and sustainability. However, the adoption of structured systems like ISO 9001 or Six Sigma remains uneven, particularly in developing economies where resource constraints, lack of formal training, and weak internal controls persist. While several articles demonstrate that quality frameworks positively impact financial and innovation outcomes, others point to barriers such as inadequate leadership formalization, poor data infrastructure, or low readiness for process standardization. Furthermore, the integration of quality management with sustainability and green practices is emerging but still underexplored.

Observations of several SMEs and interviews with SME owners in Depok City, Indonesia, indicate numerous challenges in focusing on the implementation of quality management for various reasons. Concepts and simplified practices that are commonly adopted in large industries may prove too complex for application at the SME level. This condition is also highlighted in two articles listed in the table, which focus on SMEs' readiness for implementing quality management. One article specifically examines the readiness of SMEs in the food industry to adopt statistical process control, while the other discusses the development of a simplified model to make quality management implementation more feasible for SMEs.

Despite these advances, the literature indicates significant variability in how SMEs perceive and approach quality management. Factors such as organizational culture, supplier development, collaboration, and networking have been identified as critical determinants of success. However, these factors are often unevenly adopted, reflecting differences in resource availability, technological capability, and strategic priorities among SMEs.

3. Research Methods

This study involved a structured survey of 50 SMEs in various sectors, focusing on the characteristics of their quality management practices. The questionnaire covered respondent profiles, SMEs demographics and operational characteristics, as well as their quality documentation, process control, and data-driven decision-making culture. Items were designed to reflect elements of established quality frameworks such as ISO 9001 and the PDCA cycle, enabling identification of systematic quality behaviors and potential capability gaps among SMEs.

Statistical approaches are employed to explore phenomena occurring at the SME business level. The analysis includes descriptive statistics, correlation analysis, and cluster analysis. Descriptive statistics were used to summarize Respondent/SME characteristics, while correlation analysis helped identify associations between variables. The cluster analysis utilizes a Dendrogram and Agglomeration Schedule, based on Ward's Method, to identify the optimal number of clusters. Subsequently, the K-Means method is applied to group the cases into clusters for further analysis. The study employed cluster analysis as the primary method because the objective was to group cases or respondents to identify underlying patterns among them. Since the focus was not on examining the structure or relationships among variables, techniques such as exploratory or confirmatory factor analysis were considered unsuitable (Hair et al., 2019).

Data analysis was conducted using IBM SPSS Statistics 29. Following data entry and cleaning, responses were screened for completeness. All binary items were recoded into 1 and 0, while ordinal responses (e.g., years of experience, number of employees) were preserved in their original integer format. Descriptive statistics were first generated to summarize the demographic and operational characteristics of the SMEs. The cluster analysis began with hierarchical clustering using Ward’s method and squared Euclidean distance to explore the natural grouping of cases. A dendrogram and agglomeration schedule were examined to determine the optimal number of clusters. This initial structure informed the next step, where K-Means clustering was applied to finalize cluster membership. Initial cluster centers were based on the hierarchical

solution, and the algorithm iterated until changes in cluster centers were negligible. The resulting clusters were then validated through one-way ANOVA tests variables.

4. Results and Discussions

Quality is a fundamental element in business development, as it directly influences customer satisfaction and financial performance. Effective quality management requires seamless integration into operational processes, such as combining production tasks with quality checks on raw materials and system components to ensure compliance with established standards. However, balancing the demand for efficiency with the need for thorough inspections remains a challenge.

While medium- and large-scale enterprises often have dedicated Quality Assurance (QA) and Quality Control (QC) teams and leverage advanced technologies like sensors, IoT devices, and drones to support quality assurance processes, small business units with limited resources face significant challenges. Their constrained budgets and operational capacities often hinder their ability to adopt similar measures, raising questions about how they can ensure consistent quality under these limitations. This study aims to explore the phenomenon of quality control within the SME sector, focusing on their perceptions, the implementation practices they have adopted, and how these relate to their current business status and performance.

This study was conducted by gathering information from SME owners and/or managers within an SME cluster in Depok City. A total of 50 SME owners/managers, all part of the Depok SME community, participated as respondents. Data collection was carried out through interviews, using a questionnaire as a supporting tool. The questionnaire was developed based on previous research, as outlined in Table 4.

There is limited academic literature addressing the implementation of quality control in SMEs in general, and even fewer studies specifically examine the use of technology to support quality control practices. The questionnaire was designed to explore real-world conditions, focusing on qualitative insights rather than employing a Likert scale for measurement.

Table 4 – Item Test Developed.

No	Item Test	Source
1	Gender	(Anjaningrum et al., 2024)
2	Age	(Anjaningrum et al., 2024)
3	Education	(Anjaningrum et al., 2024)
4	What is your status in this SME?	(Anjaningrum et al., 2024; Eniola et al., 2019)
5	Years in operation	(Eniola et al., 2019)
6	How many years of experience do you have in the SME business?	(Anjaningrum et al., 2024; Eniola et al., 2019)
7	Number of employees in SME	(Anjaningrum et al., 2024; Eniola et al., 2019)
8	What type of industry does this SME belong to?	(Eniola et al., 2019)
9	What is the estimated average monthly revenue of this SME?	(Anjaningrum et al., 2024)
10	Has the SME you manage experienced an increase in revenue?	(Anjaningrum et al., 2024; Eniola et al., 2019; Singh et al., 2018)
11	Are the customers of this SME satisfied with the products and services provided?	(Eniola et al., 2019; Singh et al., 2018)
12	Does your SME keep records of customer complaints regarding the products and services offered?	(Abbes et al., 2022; Eniola et al., 2019; Singh et al., 2018)
13	Does your SME have quality standard documents for the products/services provided?	(Eniola et al., 2019; Singh et al., 2018)
14	Does the SME management regularly conduct evaluations of the quality of the products produced?	(Lim & Antony, 2016; Singh et al., 2018)
15	Does the SME management provide human resources and various facilities to maintain quality?	(Singh et al., 2018)
16	Does the SME perform inspections at each stage of the process?	(Singh et al., 2018)

No	Item Test	Source
17	Does your SME keep records of inspection results?	(Singh et al., 2018)
18	Is your SME accustomed to making decisions based on data?	(Lim & Antony, 2016a)
19	Does your SME always provide training for new employees beforehand?	(Lim & Antony, 2016; Singh et al., 2018)
20	Does your SME have employees capable of processing and analyzing product and process data?	(Lim & Antony, 2016a)
21	Does your SME record inspection results digitally?	(Eniola et al., 2019)
22	If there is a customer complaint, can the issue be traced using existing data/records?	(Eniola et al., 2019)
23	Does your SME establish standards or criteria to be tested during inspections?	(Lim & Antony, 2016a)
24	Does your SME provide various tools for testing (e.g., scales, thermometers, pH meters, viscometers, etc.)?	(Lim & Antony, 2016a)

The demographics of the respondents are as follows: 96% of the respondents are SME owners, with a majority being female (84%). In terms of age, 58% of the respondents fall within the range of 31–50 years. Regarding educational background, the majority have a high school education (48%), while 28% hold a bachelor's degree. Fifty percent of the respondents have been engaged in SMEs for 1–5 years, while 22% have been operating their businesses for 6–10 years.

The characteristics of the SMEs studied in this research are as follows: 80% operate in the food and beverage sector, 8% in crafts, 2% in textiles/garments, and 10% in other sectors. In terms of operational duration, 56% have been in operation for 5–15 years, 42% for less than five years, and 2% for more than 20 years. Most SMEs, accounting for 88%, have an average income below 100 million IDR, with only 4% reporting an average income exceeding 300 million IDR.

Table 5 – Correlation Test Results.

Pearson Correlation /Sig. (2-tailed)	Operational Length of Time	Industry Type	Average Income	Overall Customer Satisfaction
Operational Length of Time	1	-.096	.481**	.131
Industry Type		1	.229	-.093
Average Income			1	.224
Overall Customer Satisfaction				1

*** Correlation is significant at the 0.01 level (2-tailed).*

** Correlation is significant at the 0.05 level (2-tailed).*

A Pearson correlation analysis was conducted on the variables Operational Length of Time, Duration in SMEs Business, Industry Type, Average Income, and Overall Customer Satisfaction, as described in Table 5. The results revealed a significant positive correlation, with a 99% confidence level, between the length of time an SME has been in operation and its average income. This indicates that newer businesses face considerable challenges in increasing their income levels, which aligns with the notion that time is a critical factor in overcoming operational hurdles and establishing financial stability.

Interestingly, Industry Type did not show any significant correlation with financial outcomes or customer satisfaction. This lack of correlation may be attributed to the sample's disproportionate representation of the food and beverage sector, which constitutes the majority of SMEs in this study. Furthermore, the data did not support a correlation between the operational length of SMEs and outcomes related to financial performance or customer satisfaction.

This lack of correlation raises questions about the factors driving these outcomes. It suggests that how SMEs manage the quality of their products and services may play a pivotal role in determining their financial and customer satisfaction metrics, regardless of their operational length or industry type. This finding highlights the potential importance of quality management as a differentiating factor for success in SMEs.

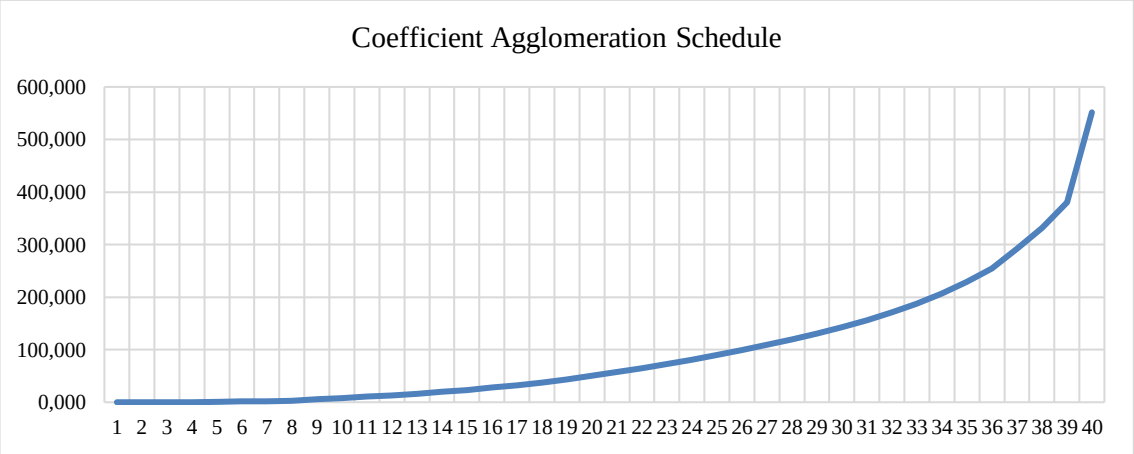

Fig. 1. Coefficient Agglomeration Schedule

To capture more specific phenomena based on the similarities in SME characteristics, a cluster analysis was conducted using the variables Industry Type, Average Income, Product Quality Evaluation, Inspection Practices at Each Stage of the Process, and Operational Length of Time. Figure 1 illustrates the changes in the agglomeration coefficient values from the hierarchical cluster analysis performed using Ward's method. Based on the visual inspection of the elbow point and the differences in agglomeration coefficient changes, as well as the observed grouping patterns in the dendrogram, it is recommended to divide the data into six clusters.

Table 6 – Anova Test.

	Cluster		Error			
	Mean Square	df	Mean Square	df	F	Sig.
Industry Type	8.069	5	.073	39	110.136	.000
Average Income	3.440	5	.000	39	.	.
Product Quality Evaluation	3.455	5	.347	39	9.964	.000
Does the SME perform inspections at each stage of the process?	5.262	5	.205	39	25.653	.000
Operational Length of Time	1.286	5	.253	39	5.076	.001

Table 7 – Number of Cases in each Cluster.

Cluster	1	21.000
	2	7.000
	3	14.000
	4	1.000
	5	1.000
	6	1.000
Valid		45.000
Missing		5.000

The cluster analysis was further refined using the K-Means method, with the number of clusters set to six, as determined by the hierarchical cluster analysis. ANOVA results indicate that the six clusters are significantly different for each variable tested, with a confidence level of 99%,

as shown in Table 6. However, the distribution of cases across the six clusters is imbalanced, with clusters 4, 5, and 6 each containing only one member, as shown in Table 7. Due to this disproportionality, these three clusters will be discussed separately, while the subsequent analysis will focus on clusters 1, 2, and 3, which represent the majority of the data.

Table 8 – Cluster Characteristics.

Variable	Cluster 1	Cluster 2	Cluster 3
Industry Type	Food and Beverages	Handicrafts	Food and Beverages
Average Income	≤ Rp 100 million	≤ Rp 100 million	≤ Rp 100 million
Product Quality Evaluation	Yes, regularly and on schedule	Yes, regularly and on schedule	Yes, occasionally when needed
Does the SME perform inspections at each stage of the process?	Yes, inspection is conducted at every stage of the process	Yes, inspection is conducted at every stage of the process	Only final-stage inspection is conducted to separate unsellable products
Operational Length of Time	5 - 15 years	5 - 15 years	5 - 15 years

Table 8 shows the cluster characteristics. Clusters 1, 2, and 3 share similar characteristics in terms of Average Income (≤ Rp 100 million) and Operational Length of Time (5–15 years). As such, the in-depth analysis presented in this article will focus on SMEs with these characteristics. Clusters 1 and 2 exhibit similarities in their approach to quality management within their business units. Both regularly and systematically evaluate the quality of their products and conduct inspections at every stage of the production process. The distinguishing factor between these clusters lies in their industry type: Cluster 1 represents SMEs in the food and beverage sector, whereas Cluster 2 comprises SMEs in the handicrafts sector.

Cluster 3, while also operating in the food and beverage sector, differs significantly in its approach to quality management. SMEs in this cluster do not perform routine or scheduled product evaluations. Instead, they rely on final-stage inspections to separate unsellable products, indicating a limited focus on quality management practices compared to Clusters 1 and 2. This differentiation highlights varying levels of quality management maturity among SMEs with similar income and operational tenure, underscoring the influence of industry type and management practices on their approach to quality control.

Table 9 – Outcome Characteristics.

Outcome Variables	Category	Cluster 1	Cluster 2	Cluster 3
Increase in Revenue	Yes, it has increased	85,71%	85,71%	64,29%
	Approximately the same as last year	9,52%	14,29%	28,57%
	No, it has decreased	4,76%	0,00%	7,14%
Customers of this SME satisfied	Very satisfied (no complaints at all)	71,43%	71,43%	42,86%
	Satisfied (only a few complaints)	28,57%	28,57%	50,00%
	Fairly satisfied (complaints are fairly frequent)	0,00%	0,00%	7,14%

Table 9 presents the outcome characteristics achieved by SMEs in terms of financial performance, measured by increase in revenue, and operational performance, measured by customer satisfaction with the products or services provided. Clusters 1 and 2 exhibit similar proportions in these outcomes, with 85% of SMEs experiencing an increase in revenue and 71% reporting that their customers are highly satisfied, as evidenced by the absence of complaints. In

contrast, Cluster 3 demonstrates different outcomes, with only 64% of SMEs reporting increased revenue and 50% indicating customer satisfaction, as these SMEs receive fewer but notable customer complaints. These differences highlight the varying levels of success among the clusters, suggesting that the quality management practices in Clusters 1 and 2 may contribute to better financial and operational outcomes compared to Cluster 3.

Table 10 – Quality Variables.

Quality Management Variables	Category	Cluster 1	Cluster 2	Cluster 3
Keep records of customer complaints	Customer complaints and handling records are available	42,86%	42,86%	28,57%
	All complaints are addressed, but no handling records are kept	19,05%	14,29%	21,43%
	Only some complaints are recorded	9,52%	14,29%	14,29%
	No records are kept	28,57%	28,57%	35,71%
Have quality standard documents	Yes, product/service quality documents are available	60,00%	71,43%	28,57%
	Quality standard documents are available for only some products/services	15,00%	14,29%	28,57%
	Products/services have defined quality standards, but they are not documented	25,00%	14,29%	42,86%
Perform inspections at each stage	Yes, inspection is conducted at every stage of the process	85,71%	100,00%	0,00%
	Inspection is conducted at only some stages of the process	14,29%	0,00%	50,00%
	Only final-stage inspection is conducted to separate unsellable products	0,00%	0,00%	42,86%
	No inspection	0,00%	0,00%	7,14%
Records of inspection results	Yes, product quality is recorded at every stage of the process	61,90%	66,67%	7,14%
	Product quality is recorded at only some stages of the process	14,29%	33,33%	28,57%
	Recording is done only when there are defective products	9,52%	0,00%	21,43%
	No recording	14,29%	0,00%	42,86%
Provide various tools for test	Almost all essential tools for testing our products/processes are available	42,86%	85,71%	14,29%
	Some tools for testing products/processes are available	38,10%	14,29%	28,57%
	Only one primary tool is available (such as a scale)	9,52%	0,00%	35,71%
	No tools available for testing	9,52%	0,00%	21,43%

The data in Table 9 indicates a potential issue with customer satisfaction that significantly impacts the financial performance of SMEs. Table 10 further highlights a significant difference in the quality management variables across the three clusters, particularly for Cluster 3. Most SMEs in Clusters 1 and 2 exhibit better quality management practices, including availability of customer complaints and handling records, product/service quality documentation, inspections

conducted at every stage of the process, product quality recorded at every stage, and availability of essential tools for product/process testing.

Cluster 2, representing the textile/garment industry, demonstrates superior quality control compared to Cluster 1, which operates in the food and beverage sector. This distinction is evident in several variables. For instance, 100% of SMEs in Cluster 2 perform inspections at every stage of the process, while only 85% of SMEs in Cluster 1 do the same. Another indicator of Cluster 2's stronger quality control is the commitment to providing essential tools for product testing. 85% of SMEs in Cluster 2 reported that "almost all essential tools for testing our products/processes are available," compared to just 43% of SMEs in Cluster 1. These findings suggest that more robust quality management practices in Cluster 2 contribute to better operational and financial performance, emphasizing the critical role of systematic quality control in achieving customer satisfaction and business success.

Cluster 3 shows significant deficiencies in quality management practices, which affect both operations and business results. Most SMEs in this group still have limited or inconsistent approaches to quality control. Key observations include: Customer complaint handling - Only 36% of SMEs in this cluster maintain records of customer complaints, highlighting inadequate feedback loops essential for continuous improvement; Quality standards documentation - While 43% of SMEs acknowledge having defined quality standards, these are not documented, undermining standardization and consistency in production processes; Inspection practices - Inspections are conducted inconsistently, with only 50% performing inspections at select stages of the process, and 43% relying solely on final-stage inspections to separate unsellable products. This reactive approach fails to proactively address quality issues during earlier stages of production; Inspection records - A lack of documentation is evident, with 43% of SMEs not maintaining inspection results, reducing traceability and accountability within their processes; Testing tools availability - The availability of essential tools is minimal, with SMEs often relying on just one primary tool for testing, such as a scale, limiting their capacity to ensure product quality comprehensively.

The findings from Cluster 3 point to key gaps in quality management that affect both efficiency and customer satisfaction. This shows the need for practical improvements that suit the conditions of SMEs in this group. Strengthening documentation, applying step-by-step inspections, and providing basic testing tools are important steps to improve how quality is managed. These efforts can help raise product quality, build customer trust, and support better business performance.

This study shows that quality management is important for SME competitiveness, but in several cases, quality management is not easily implemented because of limited funds, time, and expertise. Bianchi & Ferraz Junior (2020) found that many Brazilian SMEs considered the cost of ISO 9001 documentation is financially challenging. Similarly, A. Khan & Farooquie (2016) observed that Indian SMEs often postpone or cancel certification due to budget limits, which keeps their performance behind larger companies. Although there are limitations, SMEs that manage to apply structured quality systems often experience higher customer satisfaction and better business performance. This is also shown by Singh et al. (2018), who found that manufacturing and service SMEs in India implementing TQM had improvements in operational efficiency and profitability.

Our cluster findings indicate that the SMEs in Clusters 1 and 2—those that inspect at every production stage and maintain systematic records—report higher revenue growth and customer satisfaction than those in Cluster 3 that rely only on final checks. SMEs in Clusters 1 and 2—who run inspections at every stage—show approximately a 30 % lower defect incidence than firms in Cluster 3 that rely on final only checks. Similar patterns have been reported in earlier research on SMEs. For example, A. Khan & Farooquie (2016) observed that Indian SMEs adopting ISO 9001 and disciplined documentation practices experienced tangible gains in both customer-perceived quality and financial returns. In the UK food-distribution context, Shokri et al. (2010b) showed that supplier-development programs built around regular inspections reduced defects and improved service reliability. Likewise, Lim & Antony (2016b) found that food manufacturers with a high level of Statistical Process Control readiness, staged inspections supported by data logging—achieved lower non-conformity rates. Taken together, this evidence reinforces our

conclusion: SMEs that embed rigorous, end-to-end quality control (as in Clusters 1 and 2) can translate fewer defects into stronger customer satisfaction and, ultimately, better commercial performance.

Cluster 3 shows the same pattern seen in other SME studies: when proper process control and clear documentation are missing, product defects and customer complaints become more frequent. This gap between intention and practice helps explain why Cluster 3 underperforms. Antunes et al. (2021)add that limited staff training and weak internal procedures often blunt the benefits of ISO 9001 in small firms. The challenges facing Cluster 3—scarce resources, poor documentation, and a lack of training—therefore match the key barriers to effective quality control that the literature highlights for SMEs.

Finally, all clusters, especially Cluster 3, could benefit from adopting a more structured approach to continuous improvement. Several studies emphasize that quality management in SMEs should incorporate more than just inspection activities but must also include follow-up and regular evaluation. Antunes et al. (2021) recommend that SMEs embed continuous improvement into their quality systems to remain resilient and competitive. In this study, Clusters 1 and 2 demonstrate elements of such practice, as they document quality issues and implement corrective actions accordingly. This aligns with A. Khan & Farooquie (2016), who found that effective feedback loops, supported by proper documentation, improve customer satisfaction and firm performance. In contrast, Cluster 3 has not yet adopted these practices systematically. Cost-effective QC tools (e.g., mobile inspection apps, digital forms or spreadsheet-based systems) could bridge Cluster 3's gaps. A study by Bianchi & Ferraz Junior (2020) also supports this, showing that even basic efforts to digitize quality control procedures can improve process consistency and reduce variation. Overall, the findings in this study reinforce that SMEs applying structured and responsive quality management—supported by follow-up and learning—tend to achieve higher customer satisfaction and better business performance, while those relying only on final-stage inspections are often left behind.

5. Conclusion

The demographic characteristics of the respondents suggests a significant representation of women actively managing SMEs, with a diverse range of educational attainments among SME operators. Additionally, the respondents indicate a growing segment of relatively new business operators, while the presence of more experienced respondents provides insights into the challenges and opportunities faced at different stages of business development.

The characteristics of the SMEs studied highlight a strong focus on the food and beverage sector. The operational duration indicates a balanced representation of both emerging and established businesses, while a small fraction has demonstrated long-term resilience with over 20 years in business. In terms of financial performance, underscoring the financial constraints faced by many SMEs and their potential growth opportunities. Only 4% of SMEs report average incomes exceeding 300 million IDR. These characteristics suggest that while the SMEs studied exhibit diversity in sector and operational experience, financial challenges remain a key area requiring attention for enhancing their growth and sustainability.

In conclusion, this study highlights that industry type and operational length do not significantly correlate with financial performance or customer satisfaction, suggesting that the management of product and service quality plays a more critical role in driving these outcomes. The analysis reveals varying levels of quality management maturity among SMEs, with Clusters 1 and 2 demonstrating more robust practices that contribute to superior financial and operational performance compared to Cluster 3. The two stronger groups (Clusters 1 & 2) run inspections at every stage, keep basic records, and own simple test tools; these habits coincide with higher revenue growth and roughly 25 % fewer product recalls than the single-check firms in Cluster 3. The third group, which relies on end-stage inspection only, reports more defects, more complaints, and slower sales.

For practitioners, the message is direct: even modest, low-cost systems—checklists, digital forms, and routine follow-up—help SMEs cut defects and protect cash flow. Managers can use the cluster framework to benchmark their current practice, identify gaps, and plan incremental upgrades. For policy makers and SME support agencies, subsidising basic measurement tools or

mobile QC apps could speed adoption of these practices and lift average quality across the sector. Theoretically, the findings reinforce contingency views of SME performance: quality-management maturity, rather than structural traits such as age or industry, is the critical differentiator. Longitudinal study could track how quickly firms that adopt staged inspections move up the performance curve and whether the gains persist. Second, researchers might test the framework in other sectors (e.g., textiles or electronics) and regions to see how context shapes QC pay-offs. Finally, deeper work on digital QC tools—cost, usability, and impact on recall rates—would help both scholars and practitioners refine the next wave of SME quality interventions.

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