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DOES THE INDONESIAN NATIONAL STANDARD (SNI) FOR PRODUCTS IN SMES INFLUENCE CLEANER PRODUCTION PRACTICES? A SNAPSHOT OF BEST PRACTICES FROM YOGYAKARTA, INDONESIA

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ABSTRACT
This article investigates the extent to which the Indonesian National Standard (SNI) for products adopted and applied by small and medium enterprises (SMEs) in Yogyakarta, Indonesia, can encourage them to effectively implement a quality management system (QMS) within their internal organizations, which eventually affects and benefits their process performance and clean production practices. Survey data collected from 44 respondents in 12 SMEs with SNI-certified products were processed and examined using descriptive analysis and regression analysis. The results showed that these could implement QMS effectively partly because it is a requirement for the SNI certification of the proposed product. The effectiveness of QMS implementation affects the achievement of process performance in that it can reduce the number of defective products, process costs, and process cycle times. According to the respondents, an effective QMS makes every activity and action taken in the production process more environmentally friendly and leads to cleaner production practices. These findings can help further research determine the model's feasibility to design and develop a better framework that promotes QMS and clean production practices, especially among SMEs in Indonesia.
Keywords: *Indonesian National Standard, ISO 9001 QMS, Process performance,Clean production*

1. Introduction

The roles of SMEs for the growth of economy in Indonesia become significant as SMEs are able to contribute to the value of the gross domestic product (GDP). Several studies have figured out the roles of SMEs for the growth of economy and employment in all countries, specifically developing countries. SMEs contribute to the economic growth of a country as there is a positive relation between GDP value with growth of SMEs number (Erdin & Ozkaya, 2020; Masroor & Asim, 2019; Woźniak et al., 2019). The growth of SMEs also has a positive impact on regional economic growth (Gherghina et al., 2020), so that the existence of SMEs for economic development in developing countries is very important (Manzoor et al., 2021). However, the growth of SMEs also creates problems in many countries. SMEs activities were found to have an impact on environmental and health damage (Chiu et al., 1999; Lewis et al., 2015; Pembi et al., 2018; Sridhar et al., 2018). The perspective and commitment of SMEs owners influence attitudes and adherence to being environmentally friendly (Hasan et al., 2020).

Clean production is a strategy for efficient use of resources (raw materials, water, energy), and an effort to reduce waste, emissions and waste recycling (Oliveira Neto et al., 2020). Clean production practices provide economic and environmental benefits for enterprises. However, SMEs often do not adopt clean production practices due to various obstacles. Previous research found technical, cultural, and financial resource problems in adopting clean production practices in SMEs (Leite et al., 2019; Oliveira Neto et al., 2020; Tanco et al., 2021). The concept and strategy for clean production is in line with the objective of implementing standardization in the

enterprises. Research that has been conducted has found that standardization applied in the industry is able to consolidate production processes and reduce waste by using better raw materials and by reducing defective products (Kumar et al., 2018; Psomas & Pantouvakis, 2015; Santos et al., 2016).

According to the 2018 Small and Medium Enterprises (SMEs) survey records, there are 18,920 SMEs in the Special Region of Yogyakarta, Indonesia Figure 1, and only 20 (0.11%) have already implemented the national standard SNI for their products. Yogyakarta, a densely populated area with 1,194 people/km2, is a leading destination for cultural tourism and the home of 136 nationally and internationally recognized universities. The region's economy is growing steadily with the burgeoning of SMEs, although most have not implemented product standards and their products are not SNI-certified. This situation can be attributed to the high cost of SNI product license and registration, inadequate capital, workforce not explicitly trained for this standard, and low awareness of the standard implementation.

Sommer (Sommer, 2017) relates product standardization to production; therefore, compliance with the standards encourages a change of production processes and technologies, whereas non-compliance implies unclean production practices that contribute to environmental impacts. In the latter, environmental impacts (e.g., pollution of liquid, solid, and gaseous wastes) and waste of raw materials and energy (electricity and fuel) cannot be evaluated precisely. Clean production is a company's management strategy to protect the environment from the harmful effects of products and manufacturing processes by utilizing raw materials and energy more efficiently while pursuing maximum productivity (da Silva & Gouveia, 2020). The objective of this research is to investigate whether Indonesian National Standard (SNI) for Product applied on SMEs is able to stimulate them to conduct clean production practice so that they become environmentally friendly SMEs.

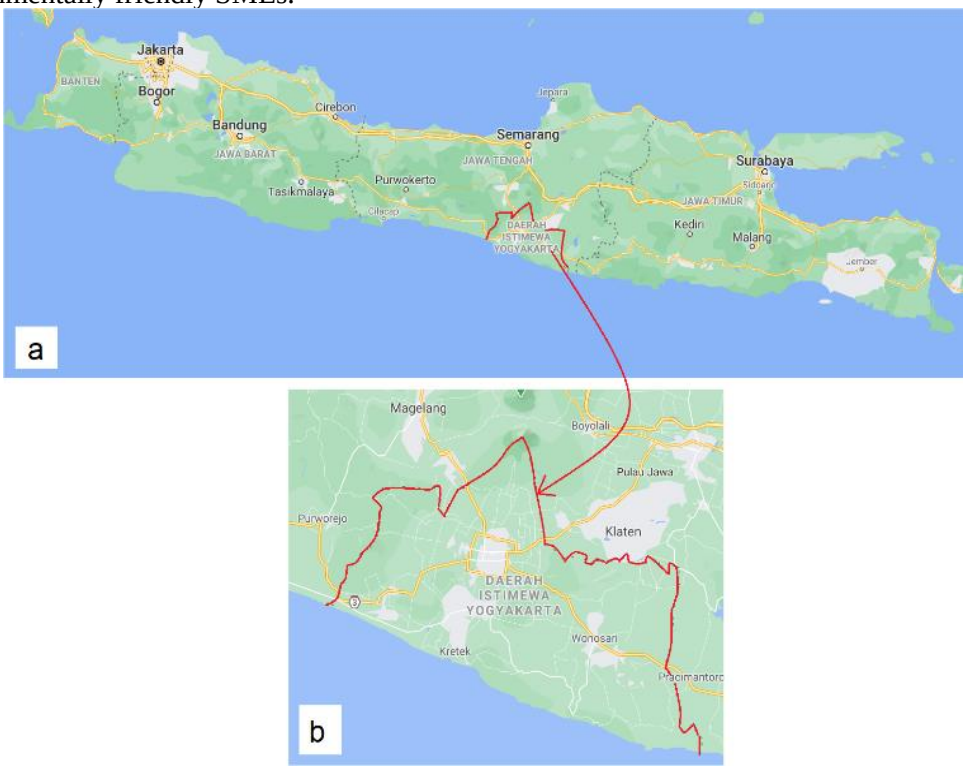

Fig. 1. in southern Java Island, Indonesia (a), Map of the research site, the Special Region of Yogyakarta (b)

The Indonesian Government regulates SNI implementation for products in Act No. 20 of 2014 on Standardization and Conformity Assessment to improve product quality assurance and efficiency for national competitiveness and ensure consumer protection and environmental function preservation. Conformity assessment determines whether or not goods, services, systems, processes, and personnel have met the standard requirements set by the government. This test gives product certification, the SNI mark, to companies that fulfill the set standards and regulations. In other words, product certification declares if a product has passed performance

and quality assurance tests and met the qualification criteria set in the contract, regulation, or specification (Saputra & Meyilani, 2015).

There is a concern that the growth of SMEs in Yogyakarta has negatively affected its spatial and regional planning as a center for education and culture and a tourism destination. Only 20 out of the 18,920 SMEs in this region (0.11%) have SNI-certified products, and there is a possibility that the production process might generate untreated wastes, contaminating the environment and hampering sustainable quality regional development. Therefore, this study has been designed to evaluate the implementation of SNI for products in SMEs to encourage an effective quality management system (QMS), efficient operating performance (i.e., reduction in the number of defective products, production costs, and cycle time), and clean production practice by using raw materials, energy, and resources efficiently. The results provide a reference for industrial actors and local governments to develop product standardization in SMEs to improve operating performance and implement clean production practices.

2. Literature Review

Effective implementation of SNI for products in certified SMEs can be seen from their consistency in practicing QMS as part of the auditing process in SNI certification and product registration (Saputra & Meyilani, 2015). Enterprises of SNI-certified products use good-quality raw materials in the production process, creating high-quality products and increasing their efficiency (Rosiawan et al., 2018), which correspond to the purpose of QMS: to prevent defects in the production process and reduce product reworking (Chiarini, 2015; Salimova & Makolov, 2016). QMS-certified companies also show better operating performance (Adalia, 2017; Hayden, 2016; Kafetzopoulos et al., 2015). The effectiveness of QMS implementation can be assessed through process performance by analyzing at least three indicators, namely the number of defective products, production costs, and cycle time (Sumaedi & Yarmen, 2015).

Clean production is a concept of increasing the effectiveness of resources used in production (da Silva & Gouveia, 2020). It attempts to reduce the environmental impact caused by the production process, products, and services by implementing better strategies, methods, and management tools. Clean production is not limited to the type and size of the industry (UNEP), but it is also an effort to achieve efficiency for sustainable production. Implementing sustainable clean production can increase the overall efficiency and risk reduction for humans and the environment (da Silva & Gouveia, 2020). It also increases production and productivity by utilizing raw materials and energy more efficiently (da Silva & Gouveia, 2020; Schaltegger et al., 2008).

Indonesian National Standard (SNI) for Products

Standardization becomes a pivotal maneuver that cannot be ignored in modern business (Foukaki, 2017), and all activities and processes it involves are quality-oriented. Standardization also aims to preserve the environment (United Nations Environment Programme, 2008). In Indonesia, the National Standardization Agency (BSN) is responsible for standardization and conformity assessment, including setting the applicable standards called Indonesian National Standard (SNI) in all regions to be implemented to various products made by both individuals and companies. In general, SNI is voluntary; however, it becomes mandatory for several products stipulated in the Regulation of the Minister of Trade. Those products must meet SNI standards; otherwise, they are not allowed to be distributed in the market. Several studies on standardization found that implementing standardization in companies can encourage innovation and provide cost efficiency (Ramdani et al., 2017; Zoo et al., 2017). Standardization plays a pivotal role in business competitiveness to provide quality products that meet customers' satisfaction and encourage the companies to innovate continuously (Wang et al., 2016; Xie et al., 2016).

Standardization in the business environment ensures that both management and technologies have been applied effectively, ultimately reducing the environmental impact (Tachi & Ohkuma, 2015). It basically helps business actors to improve product quality, security, reliability, and efficiency, ease business organization to control knowledge and technology and reduce risks. It also becomes a long-term strategy to advance the standard's adoption and innovation development (Gao et al., 2014; Xie et al., 2016).

Standardization aims to increase the effectiveness of the operating system, which is planned to meet the customers' needs (Schlickman, 2003). With standardization and innovation, companies can minimize market competition and threats to their products (Blind et al., 2020) and improve the flexibility and responsiveness to market needs to be able to carry out mass customization (Wang et al., 2016). Mass customization aims to promote responsive large-scale products suitable for customers' needs at reasonable prices; therefore, companies receive a return rate of investment costs, including the costs of implementing standardization whose processes are complex and expensive (Foukaki, 2017). The return rate is important for companies to build internal standards and changes (Hermosilla, 2015).

Standardization in Small and Medium Enterprises (SMEs)

A study on standardization in SMEs shows that it can significantly influence technical and functional service qualities (Kasiri et al., 2017). Standardization is a necessary strategy for SMEs to manage and utilize resources optimally in order to access the market and seize new opportunities (Foukaki, 2017). It is also helpful in reducing errors by involving management and employees to balance the structure and flexibility in adopting standards (Nissinboim & Naveh, 2018). Therefore, the standardization approach becomes a valuable preference for managerial parties and should be informed to all employees so that they can be actively involved in its process (Foukaki, 2017). Savings in the production process through standardization include the use of materials (main raw materials, semi-finished materials, and supporting raw materials), energy (electricity, gas, fuel, to name a few), production risks (defective product reduction), machinery and equipment, wages and salaries, administrative and communication costs, transportation, storage and warehousing, and maintenance and care (Komala et al., 2014). Although standardization provides benefits, limited resources often create barriers to its implementation in SMEs (Schlegel et al., 2017). Other challenges include problems in internal communication, technologies, capital availability, return rate, and the tendency of being closed to outside parties and input (Hermosilla, 2015). In addition, constraints of access to information on the standards and the company's lack of awareness of the standards are the main obstacles to adopting sustainability standards in SMEs (Sommer, 2017).

ISO 9001 Quality Management System (QMS)

A quality management system (QMS) is a standard mechanism arranged, agreed upon, and applied by an organization in managing its activities. ISO 9001 QMS covers all processes in a company's organization and regulates how they operate (AdrianaTisca et al., 2015). QMS becomes the basis for all activities carried out in a company to satisfy customers' requirements and expectations (Peanch et al., 2009), acts as a tool to ensure company's quality and competitiveness (Salimova & Makolov, 2016), helps to improve management and efficiency (Keng & Kamal, 2016), and ensures sustainable activities and operational regulations (AdrianaTisca et al., 2015). Good QMS design and planning will help companies to achieve their goals of fulfilling customers' satisfaction while at the same time being able to implement the production process economically and rationally (Purushothama, 2010). Previous studies found that QMS has provided Greek companies with the most significant benefits: improving customers' satisfaction, opening export opportunities, creating more effective marketing, and improving companies' image (Moschidis, 2015) and production performance (Neyestani, 2017). Companies that have implemented QMS and been certified show better operational performance, which ultimately leads to the ISO 9001 implementation (Hayden, 2016; Jang & Lin, 2008).

Clean Production

United Nations Environmental Program-Industry and Environment Office (UNEP-IEO) defines clean production as an integrated and sustainable environmental prevention strategy application in processes, products, and services to improve efficiency and reduce the risk to humans and the environment. Clean production is also defined as a set of precaution management regulations to protect the environment from the hazards of products and manufacturing processes (da Silva & Gouveia, 2020), which aims to increase production and productivity by employing more efficient ways of using raw materials, water, and energy to reduce waste and emissions

(Schaltegger et al., 2008). Several previous studies identified several factors encouraging companies to implement clean production, including awareness of environmental and labor safety (Peng & Liu, 2016; Yusup et al., 2015), market support, technological demands, and applicable regulations on waste management (da Silva & Gouveia, 2020), social responsiveness and compliance with applicable regulations (Sanz et al., 2016; Yusup et al., 2014), innovation and technological improvement (Zhou & Zhao, 2016), and the audit of clean production practices (Peng & Liu, 2016).

Clean production implementation in the company significantly improves financial savings, reduces industrial waste (Luken et al., 2016), decrease the use of raw materials and energy in the production and service processes (da Silva & Gouveia, 2020), and improve environmental performance (Khuriyati et al., 2015). Better environmental performance will encourage a positive reaction to the company's competitiveness and image (Jorge et al., 2015).

Based on the background described previously and the factual condition in the field, this study encompasses the following elaboration: based on Act No. 20 of 2014 on Standardization and Conformity Assessment, the implementation of SNI for products aims to improve quality, trade competitiveness, production efficiency, and preservation of environmental functions. The implementation of SNI for products and the audit process in SMEs as a requirement for SNI certification are realized by assessing the QMS practices in the company's internal organizations. Numerous studies found several challenges for SMEs in adopting and implementing QMS effectively, viz. knowledge, skills, financial limitations, and human resources (Schlegel et al., 2017; Sommer, 2017). SNI for products becomes a crucial requirement for SMEs to produce good-quality products that meet the Indonesian government's market requirements and regulations. At the same time, QMS is an essential requirement for SMEs to apply for audit for product certification (SNI).

This study was intended to analyze the benefits of implementing SNI for products in SMEs located in Yogyakarta and encourage effective QMS in companies with the SNI product license. To evaluate QMS effectiveness, it measured the implementation of the eight QMS dimensions and scrutinized whether effective QMS influenced the operating performance of SMEs with SNI-certified products. Lastly, it aimed to discover if good operating performance in these SMEs benefitted clean production practices as evidence that SNI's product certification (a form of compliance with Act No. 20/2014 on Standardization and Conformity Assessment) can help SMEs to achieve production efficiency while preserving environmental functions.

3. Research Methods

Research Design

This study was intended to investigate the ISO 9001 QMS implementation effectiveness, its influence on the operating performance, and its benefits to clean production practices in SMEs with SNI-certified products in Yogyakarta, Indonesia. It employed a qualitative method to describe the numerical data collected. A qualitative method can be used to describe phenomena numerically and determine the empirical relationship among variables (Stockemer, 2019) and examine psychological, economic, and social processes by exploring numerical patterns and real facts to draw the cause-effect relationship among variables using mathematic, computational, and statistical methods (Ahmad et al., 2019). To meet these objectives, this study was conducted in three stages, as described in the paragraphs below.

In the first step, the research identified and evaluated the ISO 9001 QMS implementation effectiveness in the SMEs with SNI-certified products by measuring the eight QMS dimensions adopted in ISO 9001 (Purushothama, 2010), which become the QMS basic principles (Sumaedi & Yarmen, 2015). These dimensions are: 1) focus on customers, 2) leadership, 3) personnel involvement, 4) process approach, 5) QMS approach, 6) continuous improvement, 7) factual approach for decision making, and 8) relationship with the supplier. Twenty-five questionnaire items for the eight dimensions were designed with five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = agree, 5 = strongly agree). Each item was scored from 1 to 5, making the total score 5 x 25 = 125. In addition to scoring, five levels of assessment criteria were set (i.e., very bad = < 20%, bad = 21-40%, moderate = 41-60%, good = 61-80%, and very

good = 81-100%), as stated by Purushotama (Purushothama, 2010). In this step (the identification of ISO 9001 QMS effectiveness), this study proposed the hypothesis below:

First hypothesis: The SNI certification for SMEs effectively encourages the ISO 9001 QMS implementation in the company's internals.

In the second step, a statistical regression analysis was conducted to determine the influence of effective QMS on the operating performance of SMEs with SNI-certified products. The operating performance was measured from 1) product defects per process, 2) process costs, and 3) process cycle time. The regression analysis helps to figure out how independent variables significantly influence dependent variables (Stockemer, 2019). The research assumed that the effective ISO 9001 QMS would yield a better operating performance; therefore, it proposed the hypothesis below:

Second hypothesis: Effective ISO 9001 QMS in SMEs with SNI-certified products influences the operating performance.

In the last step, a descriptive statistical analysis was conducted to describe the survey results (from 44 respondents) on the benefits of better operating performance to clean production practices. Respondents' statements describe the conditions found in the production process in the company's internal organizations and the benefits of good operating performance to the clean production practice in SMEs. The statements were rated based on five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = slightly disagree, 4 = agree, 5 = strongly agree). Several previous studies confirm that clean production practice has been able to provide benefits in terms of 1) reduction in the number of defective products, 2) energy efficiency, 3) raw material efficiency, and 4) process cost reduction (ILO, 2013; Li et al., 2016; Severo et al., 2015). Based on this elaboration, this study proposed the hypothesis below:

Third hypothesis: Good operating performance in SMEs with SNI-certified products can encourage clean production implementation.

Research Objects

In Yogyakarta, there were twenty SMEs with SNI-certified products. However, only twelve were surveyed since the rest were unwilling to participate in the study; two argued that their management was currently conducting the production relayout and employees training, while the other six did not provide clear arguments. Table 1 lists the SMEs, their locations, and their products, with product photos, manufacturer, and industrial waste are presented in Table 2.

Table 1- SMEs that have implemented quality management system (QMS) in Yogyakarta

No	Company	Regency/Province	Product
1	CV.Dewi Sri Tirta Buana	Bantul Yogyakarta	Bottled water
2	CV. TNT Corporation	Sleman Yogyakarta	Bottled water
3	PT. Mitra Tirta Buwana*	Sleman Yogyakarta	Bottled water
4	PT. Kerja Tirta Sentosa*	Sleman Yogyakarta	Bottled water
5	PT. Tirta Lancar Sejahtera*	Sleman Yogyakarta	Bottled water
6	PUSKUD Mataram	Yogyakarta	Bottled water
7	CV. Tirta Angkasa Sejahtera	Yogyakarta	Bottled water
8	PDAM Tirta Binangun	Bantul Yogyakarta	Bottled water
9	PT. Giri Tirta Mulya*	Gunungkidul Yogyakarta	Bottled water
10	CV. Anak Bangsa Cerdas*	Bantul Yogyakarta	Kids toys (PFL**)
11	Jatisae	Bantul Yogyakarta	Kids toys (PFL)
12	PT.Pustaka Insan Madani	Sleman Yogyakarta	Kids toys (PFL)
13	Yungki Edutoys	Yogyakarta	Kids toys (PFL)
14	Mataram Indah	Yogyakarta	Kids toys (PFL)
15	PT. Putra Multi Cipta Teknikindo*	Bantul Yogyakarta	Electric batic stove
16	PT. Hari Mukti Teknik	Bantul Yogyakarta	Washing machine
17	UKM Sri Lestari	Sleman Yogyakarta	Batik
18	Kenes Jogja	Sleman Yogyakarta	Batik for kids
19	CV. Marel Sukses Pratama*	Sleman Yogyakarta	Kids cloting
20	CV. Java Mas Agropos*	Gunungkidul Yogyakarta	Fertilizers

*Unwilling to be surveyed, ** Props for learning

Table 2 - Photographic view of selected product, manufacturer, and industrial waste

Photos of Products by SMEs	Products and Manufacturers	Industrial Waste
	Washing machine by: PT. Hari Mukti Teknik	Metal scraps, lathe scraps, plasma cutting granules
	Bottled drinking water by: 1. CV. Dewi Sri Tirta Buana 2. CV. TNT Corporation 3. PUSKUD Mataram 4. CV. Tirta Angkasa Sejahtera 5. PDAM Tirta Binangun	Liquid and solid wastes, plastic wastes
	Kids toys and puzzles (props for learning) by: 1. PT. Pustaka Insan Madani 2. Yungki Edutoys Yogyakarta 3. Mataram Indah Yogayakarta 4. Jatisae Yogyakarta	Wood and dye wastes
	Batik clothing by: Batik Allusan Sri Lestari	Liquid, solid, and gaseous wastes
	Batik clothing for kids by: Kenes Batik	Thread and fabric scraps

The criteria for SMEs in this study are SMEs with SNI-certified products (mandatory or voluntary), production processes taking place in Yogyakarta, and active and applicable SNI certification for the products. SMEs with expired SNI certification (and did not reactive it) were excluded from this study. The characteristics for each SME include in this study are presented in Table 3.

Table 3 - Characteristics of the sampled SMEs in Yogyakarta (n = 12)

Criteria		*n*	%
Products	Bottled water	5	41.7
	Kids toys	4	33.3
	Washing machine	1	8.3
	Batik	2	16.7
SNI certification period for the products	Less than 4 years	4	33.3
	More than 4 years	8	66.7
Certification type	Mandatory	9	75

	Voluntary	3	25
Enterprise classification	Small	5	41.7
	Medium	7	58.3

Respondents

Respondents in this study were personnel directly involved in QMS implementation in SME's management, including the management representative, the head of the production, the head of quality control, and the head of purchasing. Each respondent had the experience of being actively involved in the management of QMS and SNI certification for products and had been working in the company for more than four years. The criteria for respondents were set based on these considerations: they fully understand QMS and its implementation, its influence on the operating performance, and its benefits to the clean production practice in SMEs.

Measurements

The research used two questionnaires: 1) QMS implementation effectiveness and 2) operating performance. All questionnaire items were designed with the Likert scale system, ranging from 1 (strongly disagree) to 5 (strongly agree), and in such a way that higher scores indicate a more effective QMS implementation and better operating performance to encourage clean production practice. The total score of the first questionnaire was 5 x 25 = 125, with five assessment criteria, i.e., very bad = < 20%, bad = 21-40%, moderate = 41-60%, good = 61-80%, and very good = 81-100%. Four respondents were selected from each sampled SME to fill the questionnaires. Table 4 and Table show the results of the validity and reliability tests of the questionnaires.

Table 4 - Results of the validity and reliability tests of the first questionnaire: eight dimensions of an effective quality management system (QMS)

No	Rated Aspects	Pearson Correlation	Corrected Item-Total Correlation	Cronbach's Alpha	Remark
A. Focus on Customers					
A1	Implementing a consistent and effective identification system for customer needs	0.940	0.912		Valid and Reliable
A2	Implementing a consistent and effective measurement system for customer satisfaction	0.923	0.889	0.873	Valid and Reliable
A3	Implementing a consistent and effective customer complaint handling system	0.943	0.917		Valid and Reliable
B. Leadership					
B1	Top management involvement	0.804	0.714		Valid and Reliable
B2	Clear quality policy implementation	0.824	0.768		Valid and Reliable
B3	Consistent and effective development system for quality review objectives	0.787	0.722	0.807	Valid and Reliable
B4	Management commitment for resource provision	0.711	0.622		Valid and Reliable
C. Personnel Involvement					
C1	Clear and easily understandable job description and personnel competence	0.438	0.343		Valid and Reliable
C2	Consistent and effective training system	0.824	0.754		Valid and Reliable
C3	Consistent and effective recruitment system	0.871	0.795	0.781	Valid and Reliable
C4	Employee satisfaction	0.624	0.499		Valid and Reliable
D. Process Approach					
D1	Clear and effective implementation methods and processes	0.680	0.586		Valid and Reliable
D2	Consistent and effective measurement systems and processes	0.914	0.873	0.847	Valid and Reliable

No	Rated Aspects	Pearson Correlation	Corrected Item-Total Correlation	Cronbach's Alpha	Remark
D3	Consistent and effective process control system	0.948	0.912		Valid and Reliable
E. QMS Approach					
E1	Clear and effective business process	0.847	0.719	0.863	Valid and Reliable
E2	Consistent and effective internal communication system	0.844	0.716		Valid and Reliable
F. Continuous Improvement					
F1	Consistent and effective internal audit system	0.901	0.868	0.845	Valid and Reliable
F2	Consistent and effective correction and prevention system	0.974	0.965		Valid and Reliable
F3	Consistent and effective management review system	0.972	0.961		Valid and Reliable
F4	More effective improvement levels	0.835	0.801		Valid and Reliable
G. Factual Approach for Decision Making					
G1	Decision making based on consistent and effective data	0.941	0.902	0.916	Valid and Reliable
G2	Consistent and effective data collection	0.961	0.925		Valid and Reliable
H. Relationship with Raw Material Supplier					
H1	Selection and performance requirements for raw material supplier	0.960	0.938	0.868	Valid and Reliable
H2	Supplier satisfaction in a good working relationship	0.837	0.787		Valid and Reliable
H3	Consistent and effective selection and evaluation system for raw material suppliers	0.964	0.945		Valid and Reliable

Table 5 - Results of the validity and reliability tests of the second questionnaire: operating performance

No	Rated Aspects	Pearson Correlation	Corrected Item-Total Correlation	Cronbach's Alpha	Remark
Reduction in the Number of Defective Products					
C1	Reducing inspection during the process	0.705	0.550	0.765	Valid and Reliable
C2	Reducing product incompatibility	0.769	0.684		
C3	Reducing process errors	0.663	0.609		
C4	Reducing the defect rate	0.723	0.671		
C5	Reducing product failure	0.738	0.688		
Process Cost Reduction					
BP1	Reducing the cost of using raw materials	0.885	0.851	0.822	Valid and Reliable
BP2	Reducing the cost of using energy	0.874	0.846		
BP3	Reducing machining costs	0.908	0.885		
BP4	Reducing the cost of finding raw materials	0.891	0.861		
BP5	Reducing reworking costs	0.846	0.815		
Cycle Time Reduction					
WS1	Reducing processing time per part	0.856	0.787	0.864	Valid and Reliable
WS2	Reducing turnaround time per product unit	0.945	0.921		
WS3	Reducing the total processing time	0.921	0.883		

Based on Pearson's correlation coefficients, all items in both questionnaires were positively correlated; hence, it can be concluded that the questionnaires used were valid. Meanwhile, the reliability test results showed that Cronbach's alphas of all items were higher than 0.7 and thereby reliable. The most generally used Cronbach's alpha to determine the internal consistency of research instruments is ≥ 0.7 (Heale & Twycross, 2015). Questionnaires with Cronbach's alpha

in the range of 0.70–0.79 are also reliable research instruments with good internal consistency (Downing, 2004).

Statistical Analysis

Data obtained from the questionnaires were analyzed descriptively using bivariate regression analysis. The descriptive analysis was used to provide an overview of the characteristics of each variable, viz. the QMS implementation effectiveness in SMEs with SNI-certified products, and to figure out how the operating performance could encourage the clean production practice. The bivariate regression analysis aimed to determine the influence of the QMS implementation effectiveness on the operating performance in said SMEs. A regression analysis intends to determine the influence of an independent variable on one or more dependent variables (Stockemer, 2019). In this analysis, the statistical significance was set at $p \leq 0.05$. All analyses were carried out using the statistical software IBM SPSS 19.0. This software was selected because of its compatibility to process data with both nominal and ordinal scales and its capability to perform descriptive, correlation, and regression analyses (Yusup et al., 2015)

4. Results and Discussions

The descriptive statistics and criteria for the effective implementation of the eight QMS dimensions in SMEs with more than four years of SNI product certification are presented in Table 6 and Table 7. Meanwhile, the descriptive statistics and criteria for the effective implementation of the eight QMS dimensions in SMEs with less than four years of SNI product certification are presented in Table 8 and Table 9.

Table 6 - Descriptive statistics of the eight QMS dimensions (SMEs that have been certified for more than four years)

ISO 9001 QMS Dimension	Mean	SD	Std. Error
Focus on Customers	11.35	4.70	0.87
Leadership	17.55	2.11	0.39
Personnel Involvement	15.59	2.75	0.51
Process Approach	12.93	2.96	0.55
QMS Approach	9.17	1.14	0.21
Continuous Improvement	15.69	5.13	0.95
Factual Approach	7.86	2.37	0.44
Relationship with Supplier	12.59	2.99	0.56
n = twenty-nine respondents from eight SMEs with SNI product certification for more than four years			

Table 7 - Criteria for the effective implementation of the eight QMS dimensions in SMEs that have been certified for more than four years

ISO 9001 QMS Dimension	Dimension Value	Achieved Value	%	Criteria
Focus on Customers	15	11.35	75.67	Good
Leadership	20	17.55	87.75	Very good
Personnel Involvement	20	15.59	77.95	Good
Process Approach	15	12.93	86.20	Very good
QMS Approach	10	9.17	91.70	Very good
Continuous Improvement	20	15.69	78.45	Good
Factual Approach	10	7.86	78.60	Good
Relationship with Supplier	15	12.59	83.93	Very good
Total score of QMS implementation	125	102.73	82.18	Very good
n = twenty-nine respondents from eight SMEs with SNI product certification for more than four years				

Table 8 - Descriptive statistics of the eight QMS dimensions (SMEs that have been certified for less than four years)

ISO 9001 QMS Dimension	Mean	SD	Std. Error
Focus on Customers	11.60	3.23	0.83
Leadership	14.67	4.25	1.10
Personnel Involvement	14.27	3.94	1.02
Process Approach	12.33	2.38	0.62
QMS Approach	7.80	2.08	0.54
Continuous Improvement	16.47	2.62	0.68
Factual Approach	8.33	1.50	0.39
Relationship with Supplier	13.33	2.29	0.60
n = fifteen respondents from four SMEs with SNI product certification for less than four years			

Table 9 - Criteria for the effective implementation of the eight QMS dimensions in SMEs that have been certified for less than four years

ISO 9001 QMS Dimension	Dimension Value	Achieved Value	%	Criteria
Focus on Customers	15	11.60	77.33	Good
Leadership	20	14.67	73.35	Good
Personnel Involvement	20	14.27	71.35	Good
Process Approach	15	12.33	82.20	Very good
QMS Approach	10	7.80	78.00	Good
Continuous Improvement	20	16.47	82.35	Very good
Factual Approach	10	8.33	83.30	Very good
Relationship with Supplier	15	13.33	88.87	Very good
Total score of QMS implementation	125	98.80	79.04	Good

n = fifteen respondents from four SMEs with SNI product certification for less than four years

The measurement results of the 8 main QMS dimensions in SMEs that have had certification of SNI for products more than 4 years with an average value for each dimension are presented in Table 6. Table 7 shows the dimension values and achieved values in each dimension in the implementation of QMS ISO 9001 in SMEs studied. The total value for applying the ISO 9001 QSM dimensions is 82.18, which means that the criteria for implementing QMS in this SMEs group are very good (criteria score 81-100% = very good). Table 8 displays the results of measuring the 8 main dimensions of QMS in SMEs with SNI for product certification for less than 4 years. Table 9 shows the total value of the implementation of all ISO 9001 QMS dimensions is 79.04%, which means that the implementation of QMS in this SMEs group is in the criteria of good value (criteria score 61-80% = good).

The descriptive statistics for this evaluation are presented in Table 10. Furthermore, a statistical regression analysis was conducted to determine the influence of the effectiveness of QMS implementation on the operating performance in twelve SMEs. The regression analysis results are presented in Table 10.

Table 10 - The descriptive statistics of the measured research variables

Variable	n	Mean	Std. Deviation
Effectiveness value (of QMS implementation)	12	80.7392	13.9508
Reduction in the number of defective products	12	4.2708	0.4353
Process cost reduction	12	3.9358	0.4739
Cycle time reduction	12	3.8367	0.8698

Table 11- The regression analysis results for the influence of effective QMS implementation (predictor variable) on aspects of operating performance (dependent variables)

Predictors	Dependent Variable	Pearson Coeff.	Pearson Significance	R Square
Effectiveness value (of QMS implementation)	Reduction in the number of defective products	0.555	0.030	0.308
	Process cost reduction	0.601	0.019	0.361
	Cycle time reduction	0.411	0.092	0.169

Table 10 shows the results of the average QMS implementation effectiveness of the 12 SMEs studied is at 80.74. This average value is included in the very good criteria (scale of 81-100 = very good). Effective QMS implementation also improves process performance in SMEs with SNI-certified products. Respondents who were involved in the study stated that increasing process performance was able to reduce defective products with an average value of 4.27, reduce process costs with an average value of 3.94, and reduce process cycle time with an average value of 3.84 (the scale of values is 1-5). Table 11 displays the results of the regression analysis between the predictor variables for the effectiveness of QMS implementation on the dependent variable in the form of reducing the number of defective products with an R Square value of 0.308, on reducing process costs with an R Square value of 0.36, and on reducing process cycle time with an R Square value of 0.17.

Table 12 - The benefits of operating performance to the clean production practice in SMEs with SNI-certified products

Questionnaire Items	Percentage				
	Strongly Disagree	Disagree	Slightly Disagree	Agree	Strongly Agree
Reducing inspection during the process	-	2.3	15.9	56.8	25.0
Reducing product incompatibility	-	-	4.5	52.3	43.2
Reducing process errors	-	-	6.8	45.5	47.7
Reducing the defect rate	-	-	11.4	54.5	34.1
Reducing product failure	-	-	6.8	54.5	38.6
Reducing the cost of using raw materials	-	11.4	18.2	54.5	15.9
Reducing the cost of using energy	-	2.3	20.5	61.4	15.9
Reducing machining costs	-	2.3	18.2	68.2	11.4
Reducing the cost of finding raw materials	-	4.5	18.2	61.4	15.9
Reducing reworking costs	-	2.3	11.4	59.1	27.3
Reducing processing time per part	-	9.3	18.6	53.5	20.9
Reducing turnaround time per product unit	-	9.3	23.3	46.5	23.3
Reducing the total processing time	-	11.6	20.9	46.5	23.3

Table shows the benefits of operating performance to the clean production practice in SMEs with SNI-certified products. The implementation of SNI for products is useful for improving process performance and encouraging SMEs to practice clean production. The survey results of all research respondents shows 52.3% of respondents agree that the application of SNI for products is able to reduce product nonconformance, 47.7% of respondents strongly agree it is able to reduce process errors, 54.5% of respondents agree it is able to reduce defect rates, 54.5 % of respondents agree it is able to reduce product failures, 54.5% of respondents agree it is able to reduce the use of raw materials, 61.4% of respondents agree it is able to reduce energy use, and 68.2% of respondents agree it is able to reduce machining processes

Discussion

QMS Implementation Effectiveness in SMEs with SNI-certified Products

The study found that the longer the SMEs implemented the national standards SNI for their products, the more effective the QMS implementation in their internal organizations. The SNI certification period for products yields different criteria for effective QMS implementation. SMEs were grouped based on the length of their product's SNI certification (less than four years and more than four years). SMEs with a longer SNI certification (> 4 years) showed better QMS implementation than those with the SNI certification less than four years (< 4 years). Respondents explained that they had gained more experience in implementing standardization through QMS ever since the company implemented QMS for the first time. SMEs with the SNI certification for more than four years appointed a management representative tasked with supervising and monitoring the implementation of QMS in the company's internals. This condition aligns with the statement that standardization is a complex activity system requiring a considerably long time to implement (Xie et al., 2016);(Camacho, 2017). The longer the duration for implementing QMS and compliance with standards, the greater the benefits received (Peces et al., 2018).

Based on the QMS implementation measurement results, it was found that the two SME groups observed had implemented QMS dimensions effectively. Respondents from these two groups explained that the involvement of SMEs' owners and the enactment of quality policies in the company encouraged employees to understand their respective responsibilities and duties in building the commitment to the quality culture. The involvement of all parties to build the commitment and employees' awareness are two determining factors in the QMS implementation (Keng & Kamal, 2016); (Peces et al., 2018). SMEs' owners were able to communicate to all employees that by implementing QMS as the requirement for the SNI certification, the company was expected to reduce production costs and defective products and increase profits, ultimately leading to sustainable production. It motivated all parties in its internal organization to improve production processes, quality, and efficiency sustainably. This corresponds to a previous study that found that QMS effectiveness depends on internal motivation (Shaharudin et al., 2018). Such

motivation becomes a pivotal factor for the ISO 9001 implementation (da Fonseca & Domingues, 2018). When accompanied by technology adoption, a strong internal motivation for the QMS implementation can increase the operating performance and offer positive effects (Cai & Jun, 2018; Peces et al., 2018). Our findings in this study answer hypothesis 1 that the implementation of SNI for products to SMEs is able to encourage the implementation of QMS 9001 effectively within the enterprises.

The Influence of Effective QMS Implementation on Operating Performance

The measurement criteria used to evaluate the effectiveness of ISO 9001 QMS implementation in SMEs with SNI-certified products were then employed to determine the influence of this variable on the operating performance, including whether or not effective QMS implementation reduced the number of defective products, process cost reduction, and cycle time reduction (Sumaedi & Yarmen, 2015). Based on Table 11, the research drew three conclusions. First, effective QMS implementation in SMEs can reduce defective products up to 30.8% (R-Square = 0.308). This result is in line with the previous studies asserting that effective QMS implementation directly contributes to product quality and operating performance (Cai & Jun, 2018; Kafetzopoulos et al., 2015). SMEs with SNI-certified products in this study had effectively employed a process approach, which is a part of the eight QMS dimensions. Steps in the process approach include clear design for the production process, consistent measurement for the operating performance, and an effective process control system. The effectiveness measurement of the SMEs' process approach showed very good results (see Table 6 and Table 8), which also corresponds to the previous study pointing out that certified companies demonstrate better operating performance (Hayden, 2016). The QMS implementation can effectively improve the quality system (Moschidis, 2015), sustainable improvement and incompatibility prevention (Shaharudin et al., 2018), and eventually reduce the number of defective products and process costs (Salimova & Makolov, 2016).

Second, based on the regression analysis results, the process cost reduction in SMEs with SNI-certified products had R-Square = 0.361, indicating that the effectiveness of QMS implication in SMEs' internal organization can explain the reduction (36.1%), which can be attributed to the absence of product reworking. The QMS implementation effectiveness improves the production process and reduces product reworking and, eventually, process costs (Camacho, 2017; Chiarini, 2015; Drosos et al., 2017; Salimova & Makolov, 2016). Third, the R-Square for the process cycle reduction was 0.169, indicating that such reduction (16.9%) is influenced by the QMS implementation effectiveness in SMEs, although the former does not significantly affect the latter. This result differs from the previous studies stating that QMS implementation effectively shortens process cycle time (Neyestani, 2017; Skafar, 2019). The current study found that several SME products had to meet certain quality test requirements set by the product certification agency during the laboratory test; for example, toys for kids are not allowed to have sharp ends and surface that can harm children. In order to meet such requirements, SMEs need to add production time in several product elements or parts due to limited production equipment and technologies. SMEs need supporting technologies so that their production equipment can be used optimally effectively.

The equipment effectiveness in the production process becomes an important indicator for the QMS effectiveness. The use of simple process technologies and SMEs' size create obstacles in process performance, which is in line with the findings of a previous study explaining that company size hinders performance improvement plans and sustainable quality achievement (Ismyrlis & Moschidis, 2015). The availability of supporting production technologies or equipment became a problem in several small SMEs in this study due to their capital limitation. This is supported by the previous study, which revealed that investment in new technologies and machinery to meet the product standard requirements appears to be one of the major constraints for SMEs due to financial access (Sommer, 2017). Our findings from this research have been able to answer hypothesis 2, that the effectiveness of implementing QMS in SMEs with SNI-certified products can improve operational performance including reducing defective product, reducing process costs, and reducing process cycle times.

Operating Performance to Encourage Clean Production Practice in SMEs

Based on the survey results, respondents agreed that SNI certification for products encouraged the company to implement QMS effectively, in that the QMS implementation became one of the requirements for the certification. The certification agency set two procedures to issue SNI certification for products, namely the production process assessment followed by product testing and the quality management system audit. In this study, the influence of the QMS implementation effectiveness on the operating performance, which leads to the clean production practice, is elaborated based on the respondents' statements. There were eleven questionnaire items reflecting clean production practice in SMEs capable of implementing QMS effectively. In the questionnaires, respondents were asked to fill based on the factual conditions in the company's internal organizations–whether or not the QMS implementation, which becomes the requirement for the SNI certification, was able to encourage SMEs to provide better operating performance and ultimately perform clean production practice.

Based on the results presented in Table 12, 54.55% of the respondents agreed and 34.10% strongly agreed that the SNI certification in their company reduced the number of defective products. Also, 54.55% agreed and 38.64% strongly agreed that the SNI certification could reduce the cost of using raw materials, and 61.40% agreed and 15.91% strongly agreed that the SNI certification reduced energy consumption costs. These findings are in line with the previous study stating that adopting a certified management system, such as ISO 9001 or ISO 14001, encourages the industrial sector to increase the efficiency of its operating performance (Yusup et al., 2015). In addition, other benefits like the reduction of defective products and raw material and energy consumption costs in SMEs with SNI-certified products will encourage clean production practices. It seems plausible that the product defects in the production process will influence both resources and the environment, including the energy loss and raw materials. Such defects also demand recycling or proper disposal processes and higher energy consumption if repairs and reworking are needed (ILO, 2013).

Several previous studies point out that companies implementing clean production practice can reduce the use of raw materials and energy in the production processes (da Silva & Gouveia, 2020), decrease product defects (Li et al., 2016; Severo et al., 2015), and save overall costs (Luken et al., 2016; Yusup et al., 2015). The reduction in energy and raw material consumptions will be able to reduce the environmental impacts and provide business profits (Jorge et al., 2015). Thus, clean production principles become an effective strategy to improve environmental performance and reduce environmental impacts (Khuriyati et al., 2015; Li et al., 2016). This study also corresponds to the previous study (Yusup et al., 2015), which reveals that the management system certification owned by companies, such as ISO 9001 or ISO 14001, improves the operating performance and the integration between production process and environmental issues.

SMEs with SNI-certified products can implement QMS more effectively in order to achieve optimal operating performance. It will ultimately lead to the implementation of clean production principles for environmental performance. This condition aligns with the previous study, which shows that company size does not influence strategies adopted to generate better environmental performance and positive company's image (Jorge et al., 2015). However, these findings differ from the study (Luken et al., 2016), which explains that SMEs are less capable of implementing clean production due to financial limitations than more established and financially safe companies. It seems reasonable since the clean production implementation is believed to increase the process costs (Peng & Liu, 2016). The findings of this study are able to answer hypothesis 3, that the application of SNI products in SMEs is able to improve operational performance so that it can encourage clean production practices.

The findings of our research add to the findings of previous research that the application of SNI products in SMEs is not only to guarantee product quality, increase competitiveness and comply with Indonesian government regulations for the application of product standards in the industry, but also to make SMEs effectively implement Quality Management System (QMS). The effectiveness of QMS implementation will have an impact on improving operational performance in SMEs and ultimately be able to encourage the implementation of clean production practices in SMEs to become more environmentally friendly

5. Conclusion

This research is conducted to explore the benefits of applying the Indonesian National Standard (SNI) for products to SMEs in order to be able to encourage SMEs to practice clean production. The findings of the research show that SNI for product certification is able to encourage SMEs to effectively implement the ISO 9001 quality management system or it can be stated that the effectiveness of implementing the QMS dimensions has been very good. The effective implementation of QMS in SMEs is proven to be able to have an impact on the operating performance of SMEs in terms of reducing defective products, processing costs, and cycle times. The three operational performance benefits achieved above are able to encourage SMEs to practice clean production by reducing product defect rates, reducing raw material use, and reducing energy use.

In our view, this research has important policy implications that SME leaders in implementing standardization processes within their company's internal organizations need to form a management team that maintains and monitors QMS implementation so that it continues to run effectively and sustainably. This is because standardization is a complex activity and system so that it takes a long time to implement it in a sustainable manner. The government must conduct effective outreach and assistance to encourage SMEs to apply SNI for products, both mandatory and voluntary, because the application of SNI for products in SMEs is found to improve operational performance and encourage SMEs to practice clean production which ultimately makes SMEs environmentally friendly.

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