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Analysis of Driving Factors for the Implementation of Clean Technology to Optimize Green Manufacturing in the Wiradesa Batik Small and Medium Enterprises (SMEs)

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ABSTRACT

Purpose of the study: This research aims to improve green manufacturing in the batik SME environment. It must also improve clean technology.

Methodology: Give name, brand, type of tools, methods, software, review, and survey that has been used to do this study. No discussion or explanation.

Main Findings: The results of the study show that the highest weight is the need for a supply chain (F6) with a weight of 0.443, then the second most important factor is the good name factor of batik SMEs (F2) which is ranked second with a weight of 0.241. Next, the third most important factor is the internal motivation factor (F9) which is ranked third with a weight of 0.088. Followed by other factors until the least important factor is the competitor factor (F11) which is ranked seventh with a weight of 0.036.

Novelty/Originality of this study: what is new in this study that may benefit readers and how it is advancing the existing knowledge or creating new knowledge in this subject.

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1. INTRODUCTION

Batik is a traditional Indonesian art form with high aesthetic value and a cultural identity [1]-[3]. Batik motifs are applied not only to clothing, sarongs, or long cloths, but also to various other decorative products [4], [5]. The island of Java, particularly the areas of Pekalongan, Surakarta, and Yogyakarta, is known as the center of batik culture, giving rise to distinctive patterns such as Pekalongan batik, Surakarta batik, and Yogyakarta batik [6]. With their distinct characteristics, batik has become an important part of Indonesia's cultural heritage [7], [8].

Pekalongan Regency has the largest number of batik industries compared to Solo and Yogyakarta [9]. A total of 645 batik industries are recorded across 19 sub-districts, 13 urban villages, and 272 villages, employing 4,475 workers out of a total population of 882,092. In terms of distribution per sub-district, Wiradesa holds the top spot for the largest number of small and medium enterprises (SMEs), with 154 units employing 1,137 workers [10]-[12]. Meanwhile, Tirto sub-district has the largest workforce, at 1,529, despite having fewer businesses, at 143. This indicates that Pekalongan, particularly Wiradesa, is a highly potential center for batik production.

Based on production techniques, batik is classified into three types: hand-drawn batik, stamped batik, and printed batik [13]. Hand-drawn batik uses a canting (hand-drawn batik) and takes a relatively long process of two to three months [14]-[16]. Stamped batik uses a stamp pattern and a shorter production time of around two to three days [17], [18]. Meanwhile, printed batik uses a screen-printing technique, making the process faster, even completing it in a matter of minutes. These differences in production techniques impact efficiency, production capacity, and the potential for waste generation.

However, the high number of batik industries in Pekalongan poses serious environmental problems. Liquid waste from the batik dyeing process contains synthetic chemicals that are difficult to decompose and can pollute aquatic environments. Furthermore, the excessive use of chemicals such as wax, synthetic dyes, and bleach often degrades the quality of the surrounding environment, including polluting surface water and producing unpleasant odors [19]-[21]. This problem demands efforts to manage batik production in a more environmentally friendly manner through a green manufacturing approach [22], [23].

Various previous studies have demonstrated the importance of implementing clean technology in the batik industry. [16] emphasized that clean technology can range from simple measures, such as recycling wax and reusing used dyeing water, to more complex ones, such as replacing synthetic dyes with natural dyes and building wastewater treatment plants (WWTPs). That clean technology can include the use of natural dyes from plants, replacing kerosene with LPG, and building special channels to reduce clean water consumption [24], [25]. These findings strengthen the evidence that clean technology can be a practical solution to support green manufacturing in the batik industry.

Although extensive research on clean technology in the batik industry has been conducted, studies on the factors for successful implementation of this technology are still limited, particularly in batik SMEs in Wiradesa, Pekalongan. This research is novel in identifying key factors driving the successful implementation of clean technology, while also prioritizing the factors most influential in achieving green manufacturing [26]. Thus, this study not only examines the application of clean technology but also provides a strategic overview of important aspects that SMEs need to consider.

The urgency of this research lies in the urgent need to address environmental pollution caused by batik industry activities while simultaneously increasing the competitiveness of SMEs in facing global market demands that increasingly emphasize sustainability. Therefore, this study aims to evaluate the factors for successful implementation of clean technology in green manufacturing of Batik SMEs in Wiradesa. The results are expected to serve as a reference for local governments, batik entrepreneurs, and other policymakers in formulating strategies for developing an environmentally friendly, sustainable, and economically valuable batik industry.

2. RESEARCH METHOD

This research uses a quantitative approach with a survey method combined with in-depth interviews and observations. This method uses a quantitative approach through surveys to collect numerical data from respondents, then supplemented with in-depth interviews to dig up more detailed information, as well as observations to directly see the phenomena in the field [27]-[30]. The focus of the research is to evaluate the success factors of clean technology implementation in realizing green manufacturing in batik SMEs in Wiradesa District, Pekalongan Regency. To analyze the priority of driving factors, this study applies the Analytical Hierarchy Process (AHP) method.

The study population was all batik SMEs in Wiradesa District, totaling 154 units based on data from the Pekalongan Regency Industry and Trade Office in 2019. The sampling technique used stratified random sampling, Stratified random sampling is a sampling technique by dividing the population into several strata (groups) based on certain characteristics, then selecting a random sample from each stratum [31], [32]. Stratification based on the category of small and medium business scale (80%:20%). The determination of the number of samples was carried out using the Slovin formula at a 10% error rate, resulting in 61 respondents consisting of 49 small SMEs and 12 medium SMEs.

Data collection is carried out through two types of sources, namely primary data and secondary data.

Table 1. Types of research data

Data Types	Sources/Instruments	Objectives
Primary Data	1. In-depth interviews with MSME owners or managers	To explore information related to clean technology implementation.
	2. Likert-scale questionnaire	To measure the level of clean technology adoption and the drivers of green manufacturing.
Secondary Data	3. Direct observation at production sites	To validate the actual conditions of clean technology implementation.
	Official documents, reports from relevant agencies, scientific literature, and MSME administrative records	To support and complement findings from primary data.

The research instruments used in this study consisted of a structured questionnaire, an interview guide, and an observation sheet. The questionnaire was divided into two parts: a preliminary questionnaire (initial questionnaire) to identify the level of clean technology adoption, and a main questionnaire (main questionnaire) to assess the driving factors of clean technology adoption using a 1–5 Likert scale. The in-depth interview guide was used to gather qualitative information related to internal motivations and external factors, while the observation sheet was used to validate the actual implementation of clean technology at the production site. Table 2 below presents the preliminary questionnaire grid to identify the level of clean technology adoption.

Table 2. Initial Questionnaire Instrument Grid

Aspects	Indicators	Item
Level of clean technology adoption	Use of environmentally friendly materials	1
	Implementation of energy efficiency	2
	Management of production waste	3
	Use of energy-efficient equipment	4

Table 3 presents the main questionnaire grid to assess driving factors using a Likert scale:

Table 3. Main Questionnaire Instrument Grid

Driving Factors	Indicators	Item	Skala Likert (1–5)
Supply chain (F6)	Availability of raw materials, distribution, and suppliers	5–6	
Reputation/Good name (F2)	Positive image of batik MSMEs in the market	7–8	
Internal motivation (F9)	Owner/manager awareness of innovation	9–10	Strongly Disagree – Strongly Agree
Government support (F4)	Access to assistance and regulations	11–12	
Technological support (F3)	Availability of modern equipment	13–14	
Consumer support (F5)	Demand for environmentally friendly products	15–16	
Competitor factors (F11)	Competitive pressure from other batik MSMEs	17–18	

The collected data were analyzed in two stages. First, a descriptive analysis was conducted to provide an overview of clean technology adoption in the Wiradesa batik SME. Second, an AHP analysis was used to determine the importance of each driving factor for green manufacturing. Pairwise comparisons were conducted by key respondents (SME owners/managers) to prioritize factors.

The following is a diagram of the research procedure:

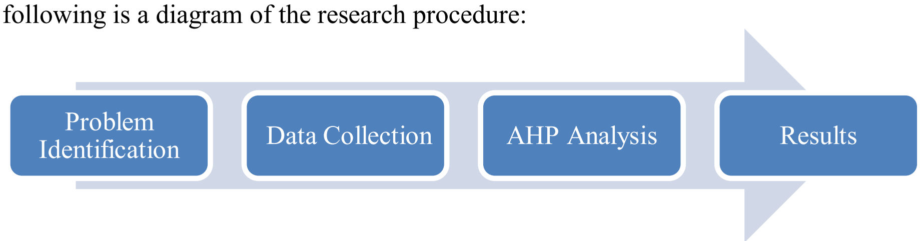

Figure 1. Research Procedure

The research procedure begins with problem identification through field studies and a literature review. Next, the problem is formulated to establish the research focus, which focuses on evaluating the success factors of clean technology. The next stage is data collection through interviews, questionnaires, and observations. After the data is collected, it is processed using the AHP method to determine factor priority weights. Finally, the data is analyzed and interpreted to produce conclusions and recommendations regarding strategies for optimizing green manufacturing at the Wiradesa batik SME.

3. RESULTS AND DISCUSSION

This research begins with identifying the problems that occur in the environment of the Wiradesa batik SMEs, then conducting a literature study to solve the problems that are in accordance with the previous study case, as well as data collection and data processing methods that are appropriate for the research. In collecting data, this research uses primary data that aims to determine the description of clean technology and the factors that influence the Wiradesa batik SMEs in implementing clean technology, then a questionnaire was distributed to small and medium-scale Wiradesa batik SMEs. The batik industry is grouped based on small and medium scale, this is done because there are differences in the characteristics of the two scales. Based on the results of the preliminary study, it has been known that there are differences in the understanding of SME owners regarding the importance of clean technology analysis and differences in the level of environmental awareness. The following is an explanation of each green manufacturing factor:

Table 4. Green Manufacturing Factors

Green Manufacturing Factors	Explanation
Financial Benefits	Clean technology is achieved through the optimal use of resources and energy, increasing financial returns.
Corporate Image	Having a good company name and brand can be a competitive advantage and positively impact customer satisfaction.
	Companies have a responsibility to protect the environment due to the depletion of natural resources and are concerned about environmental sustainability.
Environmental Conservation	The company's willingness to follow and comply with environmentally focused specifications, standards, and regulations in clearly regulated manufacturing processes, when regulations are issued by authorized agencies.
	New innovations in environmental manufacturing processes are being created by companies or SMEs to improve green manufacturing.
Regulatory Compliance	Supply chain needs encourage companies to design products with environmental impact considerations, for example, by considering the use of waste as an input in the production process or utilizing waste supplies from other companies.
	Consumer environmental awareness forces companies to improve production processes, resulting in a lack of sensitivity to environmental issues.
Green Innovation	Worker demands for clean technology are driven by several activities in the production process that can pollute the environment and threaten worker safety.
	Improving green manufacturing creates a positive vibe among workers, which ultimately leads to employee commitment.
Supply Chain Needs	This allows traders and investors to profit. Green products are a popular trend these days and are supported by all external parties. This trend puts pressure on manufacturers to produce "green products."
	To survive in the market, companies must be able to monitor competitor forecasts and capitalize on market opportunities before competitors do. Manufacturers must introduce innovative "green ideas" to compete in the market.

After identifying the driving factors for green manufacturing, the next step is to weight the various driving factors. This weighting is done using the Analytical Heterarchy Process (AHP) method, where each variable is compared using pairwise comparisons by the owner of the Wiradesa batik SME. After obtaining the weighting results for each factor, a prioritization of clean technology factors will be generated to encourage green manufacturing in the Wiradesa batik SME. This will also lead to the formulation of strategies aimed at optimizing a healthy and clean environment.

Based on the 5Rs (rethink, reduce, reuse, recovery, and recycle), clean technologies that can be implemented in the Wiradesa batik SME are classified as follows:

Table 5. Clean Technology in the Wiradesa Batik SME

No.	Clean Technology	Code
1	Recovering wax residue stuck to the stamping table for collection and reuse.	TB1
2	Recovering floating wax residue during the rolling process for collection and reuse.	TB2
3	Reusing water left over from dyeing or coloring.	TB3
4	Using natural dyes (such as leaves, bark, and plant roots).	TB4
5	Reusing used washing and rolling water twice.	TB5
6	Replacing kerosene with LPG.	TB6
7	Constructing a wax collection tank (kowen) to collect crushed wax during the rolling process.	TB7
8	Constructing rain gutters to reduce clean water use during the washing process.	TB8
9	Constructing a drainage channel for liquid waste before it flows into rivers or landfills.	TB9
10	Constructing a chimney to direct wood burning smoke to a higher altitude to reduce the negative impact on worker health.	TB10

The clean technology described above is interpreted as a questionnaire statement with a Likert scale of 1 to 5. A score of 1 indicates the technology is never implemented, and a score of 5 indicates that the clean technology is always implemented. The following is a description of the clean technology implemented by the Wiradesa batik SMEs for each small-scale batik industry in Table 6.

Table 6. Results of the description of clean technology by the Wiradesa batik SMEs

Statement Code	Total Score	Average
TB1	240	4.89
TB2	241	4.91
TB3	136	2.77
TB4	92	1.87
TB5	124	2.53
TB6	184	3.75
TB7	228	4.65
TB8	77	1.57
TB9	163	3.32
TB10	168	3.43

Based on the table above (Table 3), clean technologies with scores above 4 are TB1, TB2, and TB7. This indicates that almost all small-scale batik SMEs in Wiradesa District have collected the wax that spilled on the stamping table and collected the floating wax during the rolling process. Many of these SMEs have also constructed wax catcher tanks (kowen) to collect the wax crumbs during the rolling process.

A sample of 12 medium-scale batik SMEs was selected as respondents across Wiradesa District, Pekalongan Regency. The following is a description of the clean technologies implemented by these SMEs:

Table 7. Results of the clean technology description by the medium-scale Wiradesa batik SMEs

Statement Code	Total Score	Average
TB1	55	4.58
TB2	53	4.41
TB3	28	2.33
TB4	23	1.91
TB5	31	2.58
TB6	45	3.75
TB7	57	4.75
TB8	34	2.83
TB9	43	3.58
TB10	41	3.41

Based on Table 7, it can be seen that clean technologies that have a value above 4 are TB1, TB2, and TB7. Many batik SMEs in Wiradesa sub-district have already collected the wax that was scattered on the stamping table and collected the floating wax during the wax rolling process and have made a wax catcher tank during the rolling process. The mode of one type of clean technology for medium-scale batik SMEs in Wiradesa sub-district is shown in type (TB7) because it can be seen that the highest number of scores for this type of clean technology is shown in Table 7, namely 57. So it can be concluded that the medium-scale batik industry in

Wiradesa sub-district has had a wax catcher tank (kowen) in the rolling process. By looking at the results of data processing in the analysis of the clean technology description of batik SMEs in Pekalongan Regency, Wiradesa sub-district, it can be said that the conditions in the description of clean technology that have been implemented by small and medium-scale batik SMEs have the same selected results (values above 4), namely (TB1), (TB2), and (TB7). Regarding environmental pollution that occurs in the Wiradesa batik SME, so it requires studies and literature according to research by Irwan Sukendar, Govindan et al., Kasman Makkasau, Fahrur Razy, Cahyaning Kilang Permatasari, Sumadi, Mengdi Gao, and Hapsari, the driving factors for green manufacturing in SMEs consist of 11 factors which can be seen as follows Table 8.

Table 8. Factors driving green manufacturing

No.	Factors	Code
1	Financial Benefits	F1
2	Batik SMEs' Reputation	F2
3	Environmental Conservation	F3
4	Regulatory Compliance	F4
5	Green Innovation	F5
6	Supply Chain Needs	F6
7	Consumers	F7
8	Employee Demand	F8
9	Internal Motivation	F9
10	Market Trends	F10
11	Competitors	F11

The eleven factors above were applied to a questionnaire posed to SME owners, each with a code assigned to facilitate data processing. The purpose of distributing the questionnaire on green manufacturing factors was to validate the factors influencing Wiradesa batik SMEs, both small and medium-scale, in implementing clean technology for green manufacturing. A score of 1 = the factor is categorized as very unimportant and not suitable for further analysis; a score of 1 to 2 = the factor is categorized as unimportant and not suitable for further analysis; a score of 2 to 3 = the factor is categorized as less important and not suitable for further analysis; a score of 3 to 4 = the factor is categorized as quite important and suitable for further analysis; and a score of 4 to 5 = the factor is categorized as important and suitable for further analysis.

Respondents to the paired comparison questionnaire used to determine the weighting of the green manufacturing factors from Wiradesa batik SME owners in Table 9.

Table 9. Questionnaire Results

Factor	Comparative Value	Factor
F1	1/5	F2
F1	3	F4
F1	1/3	F6
F1	1/5	F9
F1	1	F10
F1	1/7	F11
F2	5	F1
F2	5	F4
F2	1/5	F6
F2	1/7	F9
F2	7	F10
F2	5	F11
F4	1/7	F1
F4	1/7	F2
F4	1/3	F6
F4	1	F9
F4	1/5	F10
F4	1/7	F11
F6	7	F1
F6	5	F2
F6	5	F4
F6	3	F9
F6	7	F10
F6	5	F11

Factor	Comparative Value	Factor
F9	1/5	F1
F9	1	F2
F9	1/7	F4
F9	1/5	F6
F9	1/5	F10
F9	3	F11
F10	1/3	F1
F10	1/7	F2
F10	1/5	F4
F10	1	F6
F10	1/7	F9
F10	3	F11
F11	1/3	F1
F11	1/3	F2
F11	1/5	F4
F11	1/7	F6
F11	1/5	F9
F11	1/3	F10

The consistency value is used to determine the consistency of the pairwise comparison matrix. The pairwise comparison matrix is said to be consistent if it has a value less than or equal to 0.1 or 10%. Consistency is described as something that is done in the same way for a long time. When something happens again and again, it happens consistently. Consistent is most often used to describe something that is reliable (Saaty, T & Luis, G. V, 1994). The following are the calculations and results of pairwise comparisons Table 10.

Table 10. Results of the pairwise comparison questionnaire

Factor	F1	F2	F4	F6	F9	F10	F11
F1	1	1/5	3	1/3	1/5	1	1/7
F2	5	1	5	1/5	1/7	7	5
F4	1/7	1/7	1	1/5	1	1/5	1/7
F6	7	5	5	1	3	7	5
F9	1/5	1	1/7	1/5	1	1/5	3
F10	1/3	1/7	1/5	1	1/7	1	3
F11	1/3	1/3	1/5	1/7	1/5	1/3	1
Total	14.009	7.815	14.542	3.209	5.684	16.730	17.285

The following are the calculations and weighting results for each factor, resulting in the following priority matrix in Table 11.

Table 11. Priority Matrix Calculation

FACTOR	F1	F2	F4	F6	F9	F10	F11
F1	1 / 14,009 = 0,071	1/5 / 7,815 = 0,026	3 / 14,542 = 0,206	1/3 / 3,209 = 0,104	1/5 / 5,684 = 0,035	1 / 16,730 = 0,060	1/7 / 17,285 = 0,008
F2	5 / 14,009 = 0,357	1 / 7,815 = 0,128	5 / 14,542 = 0,344	1/5 / 3,209 = 0,062	1/7 / 5,684 = 0,025	7 / 16,730 = 0,418	5 / 17,285 = 0,289
F4	1/7 / 14,009 = 0,010	1/7 / 7,815 = 0,018	1 / 14,542 = 0,069	1/3 / 3,209 = 0,104	1 / 5,684 = 0,176	1/5 / 16,730 = 0,012	1/7 / 17,285 = 0,008
F6	7 / 14,009 = 0,500	5 / 7,815 = 0,640	5 / 14,542 = 0,344	1 / 3,209 = 0,312	3 / 5,684 = 0,528	7 / 16,730 = 0,418	5 / 17,285 = 0,298

FACTOR	F1	F2	F4	F6	F9	F10	F11
F9	$\frac{1/5}{14,009}$ = 0,014	$\frac{1}{7,815}$ = 0,028	$\frac{1/7}{14,542}$ = 0,010	$\frac{1/5}{3,209}$ = 0,062	$\frac{1}{5,684}$ = 0,176	$\frac{1/5}{16,730}$ = 0,012	$\frac{3}{17,285}$ = 0,174
F10	$\frac{1/3}{14,009}$ = 0,24	$\frac{1/7}{7,815}$ = 0,018	$\frac{1/5}{14,542}$ = 0,014	$\frac{1}{3,209}$ = 0,312	$\frac{1/7}{5,684}$ = 0,025	$\frac{1}{126730}$ = 0,060	$\frac{3}{17,285}$ = 0,174
F11	$\frac{1/3}{14,009}$ = 0,024	$\frac{1/3}{7,815}$ = 0,042	$\frac{1/5}{14,542}$ = 0,014	$\frac{1/7}{3,209}$ = 0.045	$\frac{1/5}{5,684}$ = 0,035	$\frac{1/3}{16,730}$ = 0,320	$\frac{1}{17,285}$ = 0,237

Based on the calculations above, the consistency ratio (CR) value is ≤ 10%, i.e., 0.0032 < 0.1, thus the questionnaire results can be considered consistent. After obtaining the weights for each green manufacturing factor, the most important and least important factors can be determined by ranking each factor. The ranking of each green manufacturing factor is as follows Table 12.

Table 12. Weighted ranking of each factor

Factor-Factor	Rating	Weight
Financial Benefits (F1)	0.074	5
Batik SMEs' reputation (F2)	0.241	2
Regulatory Compliance (F4)	0.051	6
Supply Chain Needs (F6)	0.443	1
Internal Motivation (F9)	0.088	3
Market Trends (F10)	0.068	4
Competitors (F11)	0.036	7

The table above shows that the most important green manufacturing factor is supply chain needs (F6), which ranks first with a weight of 0.443. The second most important factor is the reputation of batik SMEs (F2), which ranks second with a weight of 0.241. Furthermore, the third most important factor is internal motivation (F9), which ranks third with a weight of 0.088. This is followed by other factors, with the least important factor being the competitor factor (F11), which ranks seventh with a weight of 0.036. Therefore, the researcher suggests that if SMEs wish to make improvements in the future, they should start with the supply chain needs (F6), the reputation of batik SMEs (F2), internal motivation (F9), and the competitor factor (F11).

The results show that most batik SMEs in Wiradesa District, both small and medium-scale, have implemented some form of clean technology. The most consistently employed technologies are reclaiming spilled wax (TB1 and TB2) and constructing a wax catcher (TB7). This demonstrates that efforts to conserve raw materials and control solid waste have become an ingrained habit in batik production practices. However, more complex clean technologies such as the use of natural dyes (TB4) and rainwater utilization (TB8) remain under-implemented, primarily due to limited costs, technical knowledge, and difficult-to-change production habits.

From the analysis of factors driving green manufacturing using the AHP method, it was found that the supply chain requirement factor (F6) was the most important factor with the highest weight (0.443). This confirms that the sustainability of batik production is highly dependent on connectedness to a supply chain that supports environmentally friendly practices, for example through the availability of alternative raw materials or the utilization of waste from other companies. The next prominent factor was the image or reputation of batik SMEs (F2) with a weight of 0.241, indicating that awareness of reputation in the eyes of consumers and the market is a crucial motivation for batik entrepreneurs to transform towards green manufacturing.

Furthermore, internal motivation (F9) emerged as the third most important factor (0.088), indicating that both employers' and workers' commitment to sustainability also plays a significant role. Conversely, the competitor factor (F11) ranked last (0.036), indicating that market competition was not the primary driver for Wiradesa batik SMEs in implementing clean technology. This finding suggests that the transformation to green manufacturing is more influenced by internal drivers and supply chain pressures than external pressures from competitors [33], [34]. Therefore, policy development strategies need to be directed at strengthening supply networks, increasing image awareness, and fostering internal motivation among business actors [35], [36], [37].

Compared with previous research, That sustainable supply chains have a significant influence on encouraging small and medium-sized enterprises to adopt environmentally friendly practices [38]. Emphasized that internal motivation and regulatory compliance are key to implementing green manufacturing in the batik industry [39], [40]. Emphasized the role of market competition as the primary driver, this study shows that the competitor factor is insignificant for Wiradesa batik SMEs [41], [42]. This demonstrates contextual variations between developed and developing countries, where environmental orientation is more influenced by supply chain needs and image than market pressures.

The novelty of this research lies in the combination of analysis of clean technology implementation with mapping of green manufacturing drivers using the AHP method in the context of Wiradesa batik SMEs. Unlike previous research that tends to emphasize a single aspect, this study provides a comprehensive overview of actual clean technology practices, while also prioritizing drivers in a measurable manner. This approach allows for more strategic decision-making in determining the focus of interventions, for example, starting with supply chain factors before strengthening company image and internal motivation. Thus, this research provides both scientific and practical contributions that can serve as a reference in developing sustainable batik industry policies.

The implementation of these findings can be used as a basis for local governments, batik associations, and other stakeholders to design programs to increase the capacity of SMEs to adopt a wider range of clean technologies, particularly in the use of water, energy, and environmentally friendly raw materials. However, this study is limited by its sample size of only 61 SMEs and its focus on the local context of Wiradesa, so generalizing the results to other regions requires caution. Furthermore, this study focuses more on internal factors and the supply chain, while aspects of government policy and external technological support have not been explored in depth. Therefore, further research is recommended to expand the scope and incorporate more comprehensive external variables.

4. CONCLUSION

The conclusion from the results of the analysis and discussion regarding the driving factors and strategies for Optimizing green manufacturing at the Wiradesa Batik Small and Medium Enterprises (SMEs) shows that there are three clean technologies that are often applied, namely re-collecting the wax stuck residue on the stamping table for reuse, re-collecting the floating wax residue during the rolling process, and making a wax catcher (kowen) to collect the wax crumbs during the rolling process. In addition, there are seven factors that play an important role in driving the realization of green manufacturing, namely financial gain, the reputation of the batik SMEs, compliance with regulations, supply chain needs, internal motivation, market trends, and competitor factors. Of these seven factors, supply chain needs are the most dominant factor with a score of 0.443, followed by the reputation of the batik SMEs (0.241), internal motivation (0.088), financial gain (0.074), market trends (0.068), compliance with regulations (0.051), and competitor factors (0.036). Based on these findings, further research is recommended to conduct a more comprehensive strategy analysis by considering all driving factors so that the implementation of green manufacturing at the Wiradesa Batik Small and Medium Enterprises (SMEs) can be more optimal.

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