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Identification of driving and inhibiting factors for the success of green industry development in Indonesian Batik SMEs: A Delphi Method approach

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Abstract
Indonesian batik SMEs still face various challenges that hinder the implementation of a sustainable green industry. Although some producers have begun experimenting with environmentally friendly raw materials and production methods, their adoption remains fragmented and has not yet become a sustainable production model. This study aims to identify the variables that drive and hinder the successful development of a green industry in batik SMEs using the Delphi method. This study involved 18 expert respondents representing local government institutions, financial institutions, industry players, academics, environmental NGOs, and community leaders. A field survey was conducted at six batik companies in Cirebon Regency, West Java Province, from March to May 2026. The findings of this study indicate five dominant variables that drive success: government commitment and support, leadership commitment, access to green financing, adoption of clean production technology, and green innovation capabilities; and four dominant variables that hinder success: limited internal resources, limited access to green financing, limited green knowledge, and limited green technology capabilities. The research findings provide implications for the importance of government intervention, support from financial sources, and strong leadership commitment to building a green ecosystem that is relevant and specific to batik SMEs.

Keywords: Green industry development, Indonesian batik SMEs, Delphi method, driving factors, inhibiting factors

Introduction

The transition to sustainable industrial development has become a strategic priority for many countries seeking to balance economic growth, environmental preservation, and social welfare. In Indonesia, the manufacturing sector contributes significantly to national economic development but also generates substantial environmental pressures through energy consumption, water use, greenhouse gas emissions, and industrial waste. In response, the Indonesian government has established various policies promoting the implementation of green industry principles, encouraging manufacturing industries to improve resource efficiency, reduce pollution, adopt cleaner production technologies, and enhance competitiveness. However, the implementation of green industry practices remains uneven, particularly in the small and medium-sized industrial sector (SMEs), which constitutes the majority of industrial enterprises in Indonesia (Primandaru *et al*., 2025).

Among Indonesia's manufacturing industries, the batik industry occupies a strategic and unique position, simultaneously representing cultural heritage, regional identity, job creation, tourism development, and export potential. Since UNESCO recognized Indonesian batik as an Intangible Cultural Heritage of Humanity in 2009, demand for batik products has increased substantially, driving the expansion of batik production centers across the country (Sujiwo *et al*., 2023) [13]. However, this growth also poses environmental challenges, as the majority of batik industries rely heavily on synthetic dyes, consume large amounts of water and chemical binders, use fossil fuels for energy, and generate untreated liquid and solid waste. If these environmental issues are not adequately addressed, they threaten local ecosystems, public health, business sustainability, and the international competitiveness of Indonesian batik products (Kusumawardani *et al*., 2024) [5]. Consequently, integrating green industry principles into batik production is crucial for environmental protection, preserving Indonesia's cultural heritage, and maintaining sustainable market competitiveness.

One of the most important batik production centers in Indonesia is Cirebon Regency, West Java Province. The batik industry in this regency has developed into a nationally recognized creative industry center, characterized by distinctive motifs, strong cultural traditions, and an extensive marketing network. Batik production in this region has contributed significantly to local employment, household income, tourism, and regional economic development (Maharani & Mafruhat, 2025) [6]. However, this industry also faces various challenges that hinder the implementation of a sustainable green industry. Although some producers have begun experimenting with environmentally friendly raw materials and production methods, adoption remains fragmented and has not yet become a sustainable production model (Jabar *et al*., 2024) [3].

Several previous studies have focused on the implementation of green industry in Indonesian SMEs. However, several research gaps remain. First, previous studies have largely focused on assessing compliance with Green Industry Standards (Sujiwo *et al*., 2023) [13], evaluating environmental performance (Utami & Wardani, 2026) [14], measuring readiness levels (Kusumawardani *et al*., 2024) [5], or proposing green optimization strategies (Pinem & Listyorini, 2022) [9]. While these studies provide valuable insights into the current situation, they do not systematically identify and prioritize the key drivers and barriers that determine the success of green industry development. Furthermore, empirical research on batik SMEs in Cirebon Regency remains limited (Jabar *et al*., 2024) [3], despite its strategic importance as one of

Indonesia's largest batik production centers. Most existing research focuses on batik SMEs located in Yogyakarta (Ria *et al*., 2024) or Banyuwangi (Rahmat *et al*., 2024) [11, 12]. This is despite the fact that the socio-economic characteristics, institutional arrangements, cultural traditions, production systems, and environmental challenges in Cirebon Regency are quite different. Furthermore, most studies use quantitative surveys, case studies, or descriptive analysis rather than structured expert consensus techniques.

To address the aforementioned gap, this study aims to identify the variables that drive and hinder the successful development of green industries among Cirebon batik SMEs using the Delphi method. The findings of this study will contribute to the literature on the implementation of green industry in batik SMEs. Theoretically, by applying the Delphi method, this study aims to obtain structured expert consensus on the key driving and inhibiting factors influencing the successful development of a green industry. Thus, the findings of this study offer a set of validated variables that can then serve as inputs for advanced systems analysis methods. In practice, this study offers recommendations for stakeholders on designing targeted policies and capacity-building programs. The identified driving factors can guide intervention priorities, while the identified inhibiting factors prioritize eliminating factors that hinder the transformation of SMEs toward a sustainable green industry. Ultimately, these findings are expected to strengthen the batik industry's competitiveness, environmental sustainability, and long-term resilience in Cirebon Regency.

Research Methodology

Research Methods

This study adopted a descriptive-qualitative research approach supported by the Delphi Method. The use of this research method is appropriate because the main objective of this study is to identify, describe, and interpret factors that influence the development of the green industry, not to test causal relationships or statistical hypotheses. Rather than measuring the magnitude of the relationship between variables, this study focuses on obtaining comprehensive information from experts and stakeholders regarding the factors that facilitate or hinder the development of the green industry. This study focuses on two main aspects: the driving factors that support the successful development of the green industry, and the inhibiting factors that hinder its development in Indonesian batik SMEs.

Research Location

This research was conducted in Cirebon Regency, West Java Province, Indonesia. This region is one of the largest and most prominent centers of batik production in Indonesia. Cirebon Regency was chosen because the batik industry is one of the region's leading creative industries and contributes significantly to job creation, regional income, cultural preservation, and tourism development. The cluster in Cirebon Regency consists of small- and medium-sized companies that produce handwritten and printed batik products. Despite its important role in supporting the local economy, the batik industry in Cirebon Regency continues to face significant environmental challenges. These characteristics make Cirebon an appropriate case study to investigate the factors that support and hinder the successful development of a green industry in batik SMEs.

Research Respondents

The unit of analysis in this study is not individual companies, but rather the collective expert assessment of factors that support and hinder the successful development of the green industry in batik SMEs. Therefore, this study used purposive expert sampling, selecting participants based on their knowledge, professional experience, and involvement in green industry development, sustainable manufacturing, batik production, environmental management, and SME development. In this study, the number of experts involved was 18, representing the Cirebon Regency Industry and Trade Office (1 person), the Cirebon Regency Environment Office (1 person), village officials (1 person), environmental NGOs (1 person), academics (2 people), batik company owners (6 people), batik associations (2 people), financial institutions (2 people), and community leaders (2 people). In this context, the literature has stated that, unlike probability sampling, Delphi research emphasizes the quality and relevance of expert knowledge over statistical representativeness. As a general guideline, a sample of 10–30 experts is considered sufficient to achieve reliable consensus (Beiderbeck *et al*., 2021) [15].

Data Collection

Data collection consisted of primary and secondary data. Primary data were obtained through two rounds of electronically administered Delphi questionnaires. Prior to the Delphi process, this study conducted a literature review to identify a preliminary list of potential drivers and barriers influencing the success of green industry development in batik SMEs. In this process, a panel of experts assessed the relevance of each proposed factor using a five-point Likert scale ranging from 1 (not important) to 5 (very important). Summary statistics (mean, standard deviation, and consensus level) were also used in the Delphi process. Secondary data were collected from various documentary sources to enhance the study's credibility. These sources included various Indonesian laws and regulations relevant to green industry development, publications from the Central Bureau of Statistics, academic journal articles, and international publications discussing sustainable manufacturing. These documentary sources supported the development of the Delphi questionnaire and provided contextual understanding for interpreting the experts' assessments.

Research Variables

The research variables are grouped into two groups: those that encourage and those that hinder the successful development of green industries in batik SMEs. Table 1 presents the factors that encourage the successful development of green industries in batik SMEs, while Table 2 presents the factors that hinder their development. These variables were adapted from various relevant literature and consulted with two academics and four industry practitioners.

Table 1: Driving factors for the successful development of the green industry in batik SMEs

Coding	Driving factors
FK-1	Government commitment and support
FK-2	Availability of green industry standards
FK-3	Strong leadership commitment
FK-4	Environmental awareness of leadership
FK-5	Green culture of the organization
FK-6	Access to green finance
FK-7	Adoption of cleaner production technologies
FK-8	Green innovation capabilities
FK-9	Use of environmentally friendly raw materials
FK-10	Implementation of waste management system
FK-11	Employee green competency
FK-12	Energy and raw material efficiency
FK-13	Digital transformation and industry 4.0 technology
FK-14	Collaboration between stakeholders
FK-15	Research and development
FK-16	Changes in consumer preferences
FK-17	Association support
FK-18	Environmental certification and eco-labeling
FK-19	Green marketing

Source: adapted from the work of Sujiwo *et al*. (2023); Kusumawardani *et al*. (2024); OECD (2024); Karikari *et al*. (2025); OECD (2025) [4, 5, 13]

Table 2: Inhibiting factors for the successful development of the green industry in batik SMEs

Coding	Inhibiting factors
FP-1	Internal resource limitations
FP-2	Limited access to green finance
FP-3	Limited green knowledge
FP-4	Environmental awareness is still low
FP-5	Inadequate technical competence
FP-6	Dependence on synthetic dyes
FP-7	Inadequate waste processing infrastructure
FP-8	Limited green technology capabilities
FP-9	Inadequate technology transfer
FP-10	Weak institutional coordination
FP-11	Limited market incentives
FP-12	Complicated environmental certification procedures
FP-13	Uncertainty regarding economic benefits
FP-14	Limited monitoring and supervision

Source: adapted from the work of Sujiwo *et al*. (2023); Kusumawardani *et al*. (2024); OECD (2024); Karikari *et al*. (2025); OECD (2025) [4, 5, 13]

Results and Discussion

1. Driving Factors

This study conducted a Delphi process to obtain expert consensus on the driving factors for the success of green industry development among Indonesian batik SMEs. A panel of 18 experts representing academics, government, batik industry practitioners, environmental experts, industry associations, and SME development institutions participated in the Delphi process. Prior to the first round, nineteen potential driving variables were identified through a review of relevant literature, including those on Indonesian green industry standards, cleaner production, sustainable manufacturing, circular economy, environmental management systems, and the Indonesian batik industry. Each variable was then evaluated using a five-point Likert scale ranging from 1 (very unimportant) to 5 (very important).

The Delphi process consisted of two rounds. In the first round, respondents rated the relevance and importance of each proposed variable while providing qualitative comments and suggestions. The results of the first round showed that 12 variables received relatively high importance scores (WA > 4.50). This indicates that the majority of experts agreed that these 12 variables contribute significantly to the successful development of the green industry in batik SMEs. Meanwhile, seven variables showed moderate average scores and relatively large variability among respondents (WA: 3.40 – 4.19). This indicated the need for a second round to clarify and reassess these seven variables. In the second round, summary statistics (means and standard deviations), along with (anonymous) expert comments, were redistributed to all respondents. This feedback allowed the experts to reconsider their previous assessments while maintaining respondent anonymity.

After the second round, the analysis showed an increase in expert consensus, as reflected in higher mean scores and lower standard deviations across most variables. The decrease in standard deviations indicates that expert opinions became more homogeneous after feedback was provided. Descriptive statistics included in the Delphi round appeared to strengthen consensus among experts. Of the 19 variables accepted in the first round, 17 showed higher mean scores in the second round, accompanied by increased consensus and a significant decrease in standard deviation. This indicates that experts were increasingly convinced of the importance of these variables after reviewing the panel's collective opinion. Conversely, two variables were rejected due to a low increase in their mean scores (WA < 3.40), a relatively high standard deviation (SD > 0.80), and insufficient consensus (LC < 0.70). Based on predetermined decision criteria (WA > 4.00 and LC > 0.70), 17 variables were retained as relevant drivers, and two variables that failed to achieve consensus were removed from the final framework.

Table 3 summarizes the second round of the Delphi survey to identify the driving variables for successful green industry development among batik SMEs. As shown in Table 3, this study identified five variables that can be considered dominant in driving the successful development of a green industry in Indonesian batik SMEs (WA > 4.70 and LC > 0.90). These five variables are government commitment and support (FK-1), leadership commitment (FK-3), access to green financing (FK-6), adoption of clean production technologies (FK-7), and green innovation capability (FK-8).

Table 3: Results of the Delphi process for factors that encourage the successful development of the green industry in Indonesian batik SMEs.

Coding	Relevance					WA	LC
	1	2	3	4	5		
FK-1	0	0	1	2	15	4.78	0.94
FK-2	0	0	2	7	9	4.39	0.89
FK-3	0	0	1	3	14	4.72	0.94
FK-4	0	0	2	7	9	4.39	0.89
FK-5	0	0	3	6	9	4.33	0.83
FK-6	0	0	1	4	13	4.67	0.94
FK-7	0	0	2	3	13	4.61	0.89
FK-8	0	0	2	3	13	4.61	0.89
FK-9	0	0	2	9	7	4.28	0.89
FK-10	0	0	3	7	8	4.28	0.83
FK-11	0	0	2	6	10	4.44	0.89
FK-12	0	0	4	4	10	4.33	0.78
FK-13	0	2	6	7	3	3.61*	0.56
FK-14	0	0	3	4	11	4.44	0.83
FK-15	0	0	4	4	10	4.33	0.78
FK-16	0	0	4	6	8	4.22	0.78
FK-17	0	0	4	3	11	4.39	0.78
FK-18	0	0	2	6	10	4.44	0.89
FK-19	0	2	7	6	3	3.56*	0.50

The first dominant variable is government commitment and support (WA = LC =). As noted in the literature, the transition to a green industry often requires regulations, fiscal incentives, technical assistance, environmental standards, research support, and financing mechanisms that exceed the capacity of individual SMEs (OECD, 2024) [7]. As found in the survey, many batik SMEs in Cirebon Regency operate with limited internal resources. Therefore, government intervention is crucial to increasing SMEs' capacity to develop green infrastructure and comply with environmental regulations. This support can encompass a range of measures, including subsidies for cleaner technologies, tax incentives, and low-interest green financing schemes, technical training, and environmental monitoring. Government commitment also encourages pentahelix coordination, thereby strengthening the overall green industry ecosystem.

The second dominant variable is the green commitment of company leaders (WA = LC =). As found in the literature, strong leadership is needed to define the organization's vision, strategic priorities, resource allocation, and commitment to developing sustainable green initiatives. Leaders with a green orientation are more likely to establish organizational policies that support a sustainable green transition. Green commitment also facilitates organizational change by encouraging employee participation, allocating budgets for cleaner technologies, and pursuing green certification. The literature also suggests that green commitment from company leaders is one of the determining variables for the successful implementation of environmental management that transforms organizational policies into concrete green practices. In this regard, the survey results also show that batik company owners generally serve as the primary decision-makers. Therefore, their commitment directly influences the implementation of green practices into SME business processes.

The third dominant variable is access to green financing (FK-6), which is one of the biggest practical challenges faced by Indonesian batik SMEs. Green industrial transformation often requires significant investments in cleaner production technologies, wastewater treatment facilities, renewable energy systems, environmentally friendly raw materials, employee training, and environmental certification. However, many SMEs face financial constraints that limit their ability to make these investments. Access to affordable green financing enables companies to overcome these financial barriers by providing capital specifically dedicated to environmentally sustainable investments. Green loans, sustainability-linked financing, government grants, and preferential credit schemes reduce investment risks while accelerating the adoption of environmental technologies and innovation. Furthermore, greater access to financing enhances SME resilience and competitiveness by enabling the modernization of sustainable production processes. International evidence shows that financial support significantly improves SME environmental performance, technology adoption, and sustainable innovation capabilities, particularly in developing countries (OECD, 2025).

The fourth dominant variable is the adoption of cleaner production technology (FK-7), which is the operational core of green industry development. Clean production technology enables batik SMEs to minimize environmental pollution while increasing production efficiency by reducing water, chemicals, energy, and raw material consumption. Technologies such as wastewater treatment systems, water recycling equipment, energy-efficient heating systems, environmentally friendly dyeing technologies, and digital production monitoring directly contribute to pollution prevention and resource conservation. Beyond environmental benefits, clean technology improves production consistency, reduces operational costs, enhances product quality, and strengthens compliance with environmental regulations and Green Industry Standards. The adoption of clean technology also supports the implementation of circular economy principles by reducing waste and recovering resources. According to the OECD (2025), clean production technology simultaneously generates environmental, economic, and social benefits, making it a key pillar of sustainable industrial development.

The fifth dominant variable is green innovation capability (FK-8), which enables SMEs to continuously adapt to changing environmental regulations, technological developments, and consumer preferences. Green innovation extends beyond technological innovation to include environmentally friendly product development, process improvement, organizational innovation, marketing innovation, and sustainable business model transformation. Batik SMEs with strong green innovation capabilities are better able to develop natural dye products, increase production efficiency, reduce waste, utilize renewable materials, and respond to rising consumer demand for environmentally responsible products. Innovation capability also strengthens long-term competitiveness by enabling continuous learning and adaptation in a highly dynamic market. Furthermore, green innovation fosters synergies with leadership commitment, accessible financing, research and development, and stakeholder collaboration, thereby strengthening the overall green industry ecosystem. Previous research consistently shows that green innovation positively influences environmental performance, firm competitiveness, and sustainable business growth among SMEs (OECD, 2024) [12]

2. Inhibiting Factors

This study also conducted a Delphi process to identify factors that could potentially hinder the successful development of a green industry in Indonesian batik SMEs. To this end, the study involved 18 experts representing various parties, including government agencies, academics, batik entrepreneurs, environmental practitioners, and batik entrepreneur associations. The Delphi process consisted of two iterative rounds. The first round aimed to evaluate the relevance of the proposed inhibiting factors identified in the literature review, while the second round was conducted to re-evaluate variables that had not yet reached strong consensus and to strengthen overall agreement among the experts.

Following the work of Franc *et al*. (2023) [16], in the first round, this study asked a panel of experts to assess the relevance of the proposed research variables as obstacles to the successful development of the green industry in batik SMEs . In this case, the expert panel's responses were measured using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Descriptive statistics were calculated using the mean and standard deviation of the experts' responses. In addition, the questionnaire in the first round also provided the expert

panel with the option to add other inhibiting variables if necessary. Furthermore, this study determined that variables with an average agreement value (WA) ≥ 4.20 were designated as highly relevant and accepted, variables with a WA value of 3.40–4.19 were deemed moderately relevant and re-evaluated in the second round, and variables with a WA value < 3.40 were deemed irrelevant and rejected.

In the first Delphi round, analysis results showed that of the 14 inhibiting factors identified and proposed in this study, nine variables immediately achieved expert consensus. These variables demonstrated high mean agreement values accompanied by an acceptable level of consensus (WA > 4.40; LC > 0.70). This indicates strong agreement among respondents on these nine variables. Meanwhile, five variables received only moderate mean agreement. Consequently, these five variables were included in the second Delphi round for reassessment.

The second Delphi round involved a reassessment of five variables that had not achieved sufficient consensus during the first round. Each expert received a statistical summary of the first round's findings and was asked to reconsider their previous responses in light of the collective opinion. In the second round, decisions about the relevance of inhibiting factors were based on two parameters: the mean agreement (WA) score and the consensus level. In this case, a variable was accepted if its WA score was higher than 4.20 and its consensus level was higher than 0.70. Table 3 presents the mean agreement score and consensus level among respondents regarding the relevance of inhibiting factors to the successful development of the green industry in Indonesian batik SMEs.

Table 4: Results of the Delphi process on inhibiting factors influencing the success of green industry development in Indonesian batik SMEs.

Coding	Relevance					WA	LC
	1	2	3	4	5		
FP-1	0	0	1	2	15	4.78	0.94
FP-2	0	0	1	3	14	4.72	0.94
FP-3	0	0	1	4	13	4.67	0.94
FP-4	0	0	2	5	11	4.50	0.89
FP-5	0	0	4	5	9	4.28	0.78
FP-6	0	0	3	6	9	4.33	0.83
FP-7	0	0	3	4	11	4.44	0.83
FP-8	0	0	1	5	12	4.61	0.94
FP-9	0	0	1	7	10	4.50	0.94
FP-10	0	0	2	6	10	4.44	0.89
FP-11	0	0	1	7	10	4.50	0.94
FP-12	0	0	4	6	8	4.22	0.78
FP-13	0	0	2	8	8	4.33	0.89
FP-14	0	4	4	4	6	3.67*	0.56*

As shown in Table 3, the results of the second Delphi round indicate a significant increase in expert consensus. All five variables increased in mean, accompanied by decreases in standard deviation. Furthermore, the analysis revealed four variables as the most dominant obstacles to the successful development of a green industry among batik SMEs. These four variables are limited internal resources, limited access to green financing, limited green knowledge, and limited green technology capabilities.

The first dominant variable hindering the successful development of a green industry in the first batik SMEs is limited internal resources (FP-1). This variable has an average agreement value of 4.78 and a consensus level of 0.94. This variable will have several implications, including inhibiting SMEs' investment in cleaner production technologies and environmental infrastructure, weakening their capacity to develop their employees, reducing their readiness to innovate, and limiting their ability to collaborate effectively with external stakeholders. As a result, SMEs continue to rely on conventional production methods that have significant environmental impacts.

The second dominant variable hindering the successful development of the green industry in batik SMEs is limited access to green financing sources (FP-2). This variable has an average agreement value of 4.72 and a consensus level of 0.94. The literature suggests that the green transition in SMEs requires significant investment across various areas, including cleaner production equipment, wastewater treatment facilities, and environmentally friendly raw materials (OECD, 2025). However, this study's findings indicate that most batik SMEs still face limited access to green financing due to various factors. As a result, many of them delay or avoid green investments despite recognizing their long-term benefits. These conditions create significant barriers for SMEs in developing green production systems and achieving compliance with increasingly stringent environmental standards.

Limited green knowledge (FP-3) is the third most dominant variable hindering the successful development of the green industry in batik SMEs. The analysis results, as shown in Table 4, show that this variable has an average agreement value of 4.67 and a consensus level of 0.94. According to Sujiwo *et al.* (2023) [13], green knowledge includes awareness of environmental regulations, cleaner production techniques, sustainable raw materials, resource efficiency, waste reduction, green technology, and the economic benefits of environmental management. The implications of this variable cover several aspects, including low adoption of environmentally friendly production practices, dependence on environmentally damaging materials, poor waste management practices, limited ability to implement green technology, difficulty complying with environmental regulations and green industry standards, decreased competitiveness and market opportunities, lower innovation capabilities, weak environmental awareness among employees, and reduced effectiveness of government support programs.

Finally, the analysis results show that the fourth dominant variable hindering the successful development of the green industry in the first batik SMEs is limited green technology capability (FP-8). This variable has an average agreement value of 4.61 and a consensus level of 0.94. According to respondents, this variable will affect low adoption of cleaner production technologies, low resource efficiency, inadequate pollution prevention and waste management, and a low ability to produce environmentally friendly products. In this regard, the literature emphasizes that green technology capability encompasses not only the availability of green technology but also the technical skills, operational expertise, maintenance capacity, and managerial capabilities needed to implement it effectively (OECD, 2024) [7].

Conclusion

This study aims to identify the driving and inhibiting factors influencing the successful development of green industry practices in batik SMEs in Cirebon Regency, West Java Province, Indonesia. To this end, this study conducted a

two-round Delphi process involving a panel of 18 experts representing academics, government agencies, environmental practitioners, SME associations, and batik entrepreneurs. The study findings indicate that green industry development in batik SMEs is influenced by several variables. Of the 19 proposed driving variables, the expert panel reached consensus that 17 are relevant to supporting the successful development of a green industry. Although these 17 variables contribute to the successful development of a green industry in Indonesian batik SMEs, this study identified five as the most dominant: government commitment and support, leadership commitment, access to green financing, adoption of clean production technologies, and collaboration among stakeholders. The expert panel's agreement score for these five variables was above 4.50, with a consensus level above 0.70. Collectively, these five dominant variables form an integrated framework that supports the development of a green industry in Indonesian batik SMEs. Furthermore, the findings of this study indicate that of the 14 proposed inhibiting variables, four dominant variables hinder the successful development of a green industry in batik SMEs. These variables are limited access to green financing, limited green technology capabilities, limited green knowledge, and limited internal resources. The expert panel's agreement score for these five variables was above 4.50, with a consensus level above 0.70. These four factors represent fundamental obstacles that not only hinder the development of a sustainable green industry but also impede its growth.

The findings of this study provide several important managerial implications for stakeholders involved in green industry development in the Indonesian batik sector, including government agencies, batik SME owners and managers, industry associations, and financial institutions. For government agencies, the results indicate the need to strengthen an integrated policy framework that combines environmental regulations with financial incentives, technical assistance, and ongoing capacity-building programs. For batik SME owners and managers, this study highlights the importance of organizational leadership in driving sustainability transformation. Company leaders should invest in employee training, environmental awareness programs, cleaner production technologies , and innovation activities while integrating sustainability goals into strategic business planning. Financial institutions also play a strategic role in accelerating green industry development by developing financing products tailored to environmentally sustainable SMEs. Flexible financing mechanisms, lower borrowing costs, longer repayment terms, and green investment incentives will reduce the financial barriers currently limiting technology adoption among small businesses. Furthermore, industry associations should facilitate knowledge sharing, the dissemination of best practices, and collective learning among batik entrepreneurs. Collaborative networks can reduce information asymmetries, accelerate technology diffusion, expand market access, and strengthen collective bargaining power when accessing government assistance or green financing programs.

Although this study successfully identified driving and inhibiting factors through expert consensus using the Delphi method, several opportunities remain for future research. In this regard, future research should investigate the structural relationships between identified variables using quantitative approaches such as Structural Equation Modeling (SEM), Interpretive Structural Modeling (ISM), Decision-Making Trial and Evaluation Laboratory (DEMATEL), Analytic Network Process (ANP), or MICMAC analysis to determine causal relationships and prioritize factors influencing green industry implementation. Furthermore, future research should expand the geographic scope beyond Cirebon Regency to include batik-producing regions such as Pekalongan, Solo, Yogyakarta, Lasem, Madura, and other traditional batik clusters across Indonesia. Comparative analysis across regions will provide greater insight into contextual differences influencing green industry development.

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