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Research article

Readiness in implementing green industry standard for SMEs: Case of Indonesia's batik industry

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ABSTRACT

Green Industry Standard (GIS) acts as a guideline for industries, including the Small and Medium Enterprises (SMEs) to preserve the environment and economy in their production process. This study aims to assess the industry's readiness in the case of Indonesia's batik industry, to adopt the GIS and optimize its implementation. The method used in this study is survey and interviews. The survey and interviews involved 25 respondents, comprising owners or managers of the batik industry engaged in handcrafted, stamped, or combined batik production, from pattern-making to finishing stages. The analysis has been done using the Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES) instrument to evaluate the industry's readiness and employing TOWS (Threats, Opportunities, Weaknesses, Strengths) analytical tool to formulate optimization strategies. The results of this study show that an assessment of the batik industries' compliance with Green Industry Standards revealed that they have not yet adopted sustainable practices in their production processes concerning materials, energy, water, products, and waste. The SOCRATES analysis also indicates that the batik industry's readiness to meet the technical requirements of the GIS is currently low. In conclusion, the primary approach in applying green industry principles should focus on rectifying existing weaknesses concerning craftsmen's awareness and understanding of green industry practices. After the industry's awareness emerges, utilizing GIS can boost production, improve raw material efficiency, and provide customers with greater "green" value.

1. Introduction

Many businesses nowadays start to integrate environmental aspects through their production and supply chains towards greener and sustainable industries, integrating the circular economy concept [1,2] and contributing to one of the goals of sustainable development to promote and empower sustainable production and consumption (SDGs 12) [3,4]. Nevertheless, transitioning to greener industries, known as the 'sustainability transition' was challenging [5]. Various barriers from lack of commitment from top

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management, lack of new technology/materials toward a greener industry to lack of green consumer purchasing emerged and need to be tackled [6].

Diverse institutional arrangements have been introduced from set policies and incentives to raise stakeholder's awareness regarding sustainable production and consumption [7,8]. Nevertheless, larger companies are more engaged with green initiatives compared to smaller ones, including Small and Medium Enterprises (SMEs) [9]. Despite the availability of various Green Industry Standards, the willingness of SMEs to embrace change remains a significant factor in successfully implementing environmental sustainability programs [10]. Evaluating the preparedness of SMEs to adopt such standards becomes crucial to address any potential shortcomings and ensure compliance with eco-friendly industry requirements.

Green SMEs play an important role in job creation and economic development as well as contributing to environmental improvement in a country [11,12]. In Indonesia, one of the emerging SMEs that massively produced and also emphasizes eco-friendly practices, promoting environmentally sustainable activities and preserving artistic traditions is the Batik industry [13,14]. Batik holds a significant position as a symbol of Indonesian culture and has been recognized by UNESCO as a 'Humanitarian Heritage for Oral and Intangible Culture' in 2009. Despite its eco-friendly value, the production process of batik still faces a critical challenge in terms of sustainability, for instance, its wastewater management [15]. An alarming eighty-five percent of clean water used in the process ends up as wastewater, characterized by its large volume, thick color, and pungent smell [16]. The disposal of this untreated wastewater directly into infiltration wells or water bodies by numerous producers further exacerbates the problem, posing a threat to nearby water source pollution [17].

To promote the green batik industry, it is essential to prioritize resource efficiency and effectiveness from the early stages of production, rather than solely relying on end-of-pipe management. The green industry concept emphasizes sustainable resource usage throughout the production process, aiming to strike a balance between industrial development and environmental preservation while benefiting the community. To implement the green industry principle, the Green Industry Standard (GIS) plays a crucial role. This standard, regulated by the Ministry of Industry, sets specific limits on resource utilization and waste generation, while also outlining necessary company management practices. In line with this Batik sector has recently been covered under the Green Industry Standard for the Batik Industry, as per the Ministry of Industry Regulation Number 39 of 2019 [18].

This study aims to seek how far Indonesia's batik SMEs implementing the green standards. This study also aims to analyze the readiness of Batik SMEs in implementing GIS Batik SMEs in the DI Yogyakarta Province, Indonesia, particularly Bantul Regency, and how to optimize it. Bantul Regency hosts the majority of the batik industry in the province. Moreover, it is worth noting that Bantul Regency received recognition in 2017 as one of the 'Creative Independent Regencies' in Indonesia.

Numerous studies have been conducted in the batik industry focusing on its wastewater treatment [16,19], cleaner production alternatives for batik [20], and emission of batik industry [21], as well as the impact of the batik industry's waste on human health [22]. The aforementioned research, aims to create a more eco-friendly and sustainable batik industry by considering environmental aspects, but still has limited consideration of economic and social aspects. Moreover, research on the application of green industry principles for Batik is scarce, despite its potential to address challenges related to production processes and company management. This research serves as a crucial step in supporting the Batik Industry, particularly in Indonesia, given the relatively new nature and novelty of GIS implementation in this sector, enhancing the literature on sustainable transition for SMEs through the readiness of the industry. By recognizing the current readiness of Batik SMEs, relevant stakeholders can formulate appropriate strategies to implement these standards effectively. Additionally, this study will shed light on the unique challenges faced by the textile industry in emerging economies when adopting green standards, in comparison to traditional textile industries in other countries [23].

This paper is divided into five sections. After the Introduction section, the theoretical background is presented in the second section. This includes sections related to the green industry readiness for GIS and a description of the Indonesian Batik Industry. The third section describes material and methods which are divided into sub-sections namely the design of research, data collection type and strategies, and how the analysis was conducted. The results are presented in the fourth section which is followed by the conclusions of the study in section five.

1.1. Green industry readiness

The green industry is defined as an industry that promotes sustainable production and consumption patterns, focusing on several aspects including energy and resource efficiency, the use of green technology, low-carbon and low-waste, zero pollution, and producing eco-friendly products [24]. Transitioning to green industries provides several advantages such as contributing to higher revenue, improving working conditions, creating new jobs, and lowering production costs by investing in clean technologies that use fewer resources as well as increasing competitive advantage [25]. Nevertheless, applying the GIS in industries, particularly in SMEs is not an easy task. There are a lot of challenges in implementing GIS, for example, lack of initial green investment, limited technology, difficulties towards changes (social and cultural problems), and competition with the companies who are not applying the GIS [26,27].

Realizing the transition to sustainability industries or manufacturing, needed various strategies and capability management to realize the goals. However, the performance improvement also depends on the capability and efforts of internal stakeholders (i.e. the industries; and the management) [28]. Readiness in implementing sustainability can include awareness, willingness, and capacity toward green practices [29]. The green industry readiness can be assessed by an indicator derived from a combination of elements found in the Green Industry Standard, the eco-innovation screening tool developed by Pigosso et al., in 2018 [30], and the indicators from Resource Efficient and Cleaner Production (RECP) guidelines by the United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Programme (UNEP) in 2010. These sources collectively encompass four key areas to assess SMEs' readiness to adopt eco-innovation and industrial symbiosis programs. These areas include company characterization, business model description, input and output flow analysis, and readiness assessment, all of which play important roles in determining the SMEs' ability to implement and embrace such initiatives [30]. The Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES) instrument, developed by Miller and Tonigan in 1996 is suitable for assessing green industry readiness [31]. Initially designed to assess an individual's motivation to overcome alcohol-related issues, this theory has found applications beyond the health field, such as in academic coaching [32] and obesity problems [33], but has not been applied to the environmental field.

1.2. Indonesian Batik Industry

Batik, an ancestral Indonesian heritage, is defined as a handcrafted product resulting from resist dyeing that uses hot wax (batik wax) as a color-resistant material [15,16]. The main tools for applying batik wax are "canting tulis" and/or "canting cap", forming specific motifs that carry meanings [18].

The batik industry in Indonesia currently relies on traditional and simple technologies for its production processes. However, these traditional methods, such as coloring and washing, have been deemed inefficient as they generate substantial waste from raw materials and production processes [16]. One concerning aspect of the batik industry is its heavy dependence on kerosene fuel and electricity, leading to significant greenhouse gas emissions compared to other Small and Medium-Sized Enterprises [34]. This dependence results in air emissions containing particulates and gases like NO_2, CO_2, and SO_2, which contribute to environmental pollution [35].

Furthermore, the organizational and management structure within the batik industry is relatively disorganized, particularly for micro and small-scale industries that are mostly family-owned businesses. The workforce typically comprises family members or casual workers who are compensated based on their work. In contrast, medium-sized batik industries usually exhibit clearer organizational structures and management systems [36,37]. The batik industry, particularly the small and medium enterprises, is often run as a family enterprise, with family members working together. The success of these businesses heavily relies on the owner or manager. Therefore, the willingness of the individual in charge to adapt and change significantly impacts the industrial process.

2. Material and methods

2.1. Research design

This study adopts a mixed-method approach, specifically a converging parallel or concurrent design, which involves collecting qualitative and quantitative data. These data sets are analyzed separately and compared to validate or refute each other's findings [38]. The results obtained from the quantitative phase were used to complement the analysis from the qualitative phase, creating what is known as an *embedded concurrent mixed method* [39]. Fig. 1 describes the research flowchart in this study. The quantitative phase aimed to determine (1) the level of fulfillment for GIS and also (2) the level of readiness of the batik industry to meet the technical requirements of the GIS using surveys and interviews with the batik industry's owner or manager. During the qualitative phase, more interviews were conducted with various stakeholders in the batik industry to analyze strategies to optimize the readiness in implementing GIS using the TOWS matrix, a planning tool that assesses a company's challenges, opportunities, vulnerabilities, and strengths.

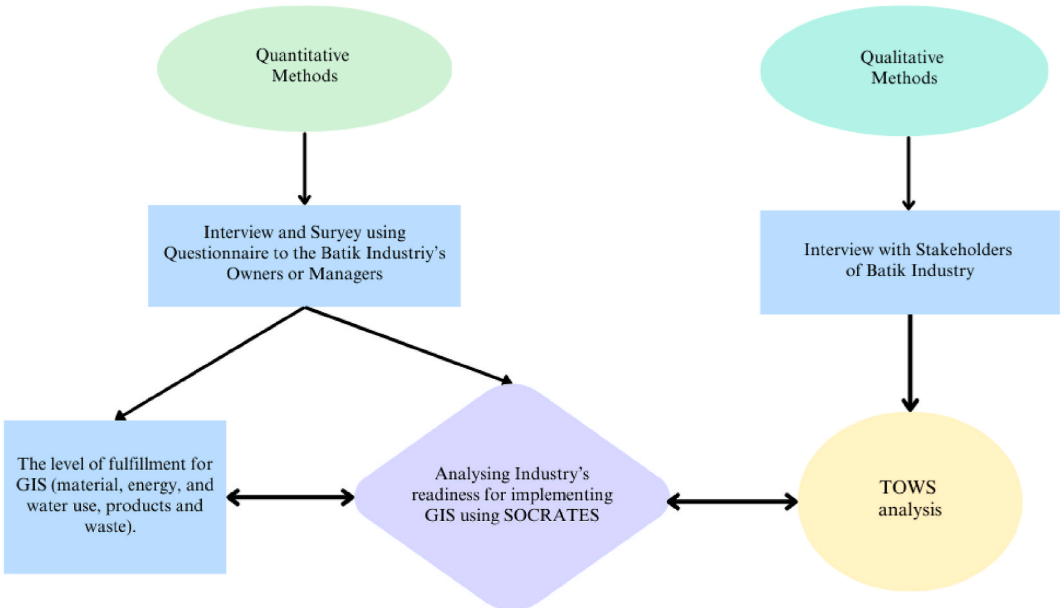

Fig. 1. Research flowchart.

2.2. Data collections

The primary data for this study was collected from the Batik industry in Bantul Regency who operate independently and is not part of a centralized or group management structure. These industries produce hand-drawn, stamped, or combination batik, handling the entire process from pattern-making to completion. They use either natural or synthetic dyes. The data in this study were collected from 25 industries, including responses obtained from the owners or staff members.

In selecting research respondents, several criteria were used, namely (1) industries that are managed individually or are not incorporated into centers or groups whose management is carried out together with other members, and (2) batik industry of hand-written batik, stamped batik or combined batik who carried out all the stage of batik production. Based on these criteria, of the 400 batik industries in Bantul Regency, only 30 industries were not incorporated into batik centers and were managed individually. Of the 30 batik industries, 5 did not engage in all stages of batik production (e.g., they only performed batik coloring or pattern-making). Consequently, only 25 batik industry respondents met the specified criteria.

The data collection focuses on input-output flow analysis, specifically examining the following sub-aspects of the green industry: material use, energy use, water use, products and packaging, and waste. The collected data is then compared to the Green Industry Standard (GIS) based on Ministry of Industry Regulation Number 39 of 2019. Additionally, data from other aspects, such as company profile and business model description, are used to complete the comparison analysis. In addition to the above data set, respondents were given a questionnaire (with Likert Scales) containing statements related to their level of readiness based on the SOCRATES instrument [31].

Data collection for the TOWS analytical tool was conducted through semi-structured interviews with 5 key informants. These informants were selected through purposive sampling, which involves choosing individuals based on their quality or competence, also known as judgment sampling [40]. The key informants in this study represented various groups and agencies, including (1) the Association of Indonesian Batik Craftsmen and Entrepreneurs; (2) the Center for Green Industry, Ministry of Industry; (3) the Center for Crafts and Batik, Ministry of Industry; (4) Bantul Regency Cooperatives and Industry Cooperatives Service; and (5) Environmental Agency of Bantul Regency. Additionally, secondary data collection was conducted, including scientific papers, journals, activity reports, and other relevant documents related to the research problem. After conducting the TOWS analysis, the most suitable strategy for the batik industry in Bantul Regency was identified.

2.3. Analysis

In the analysis section of this study, the Green Industry Standards' limitations were compared with the answers provided by respondents in questionnaires and interviews to perform a conformity analysis. A descriptive study was conducted to evaluate the degree to which the production method used in the batik industry complies with the technical specifications of the Green Industry Standard. The results were displayed in tables or graphs.

Subsequently, a readiness analysis was carried out by collecting answers from a questionnaire given to the respondents. The selected Likert scale values were calculated and then interpreted against the reference provided in the SOCRATES instrument. This analysis reveals the batik industry's level of readiness to implement changes and meet the technical requirements outlined in the GIS.

Data from stakeholder interviews was used to construct the TOWS matrix. The opportunities and threats (external factors) faced by the batik industry as well as the strengths and weaknesses of the batik industry (internal factors), were compiled. These factors were then entered into the TOWS matrix. Afterwards, alternative strategies were generated. From the alternative strategies, the most suitable strategy was chosen to be implemented by the batik industry in Bantul Regency.

3. Results

3.1. State of application of the green industry Standard (GIS)

SMEs producing batik in Bantul Regency primarily create hand-drawn batik (76 %), followed by stamped batik (8 %), and a combination of hand-painted and stamped batik (16 %). In terms of dye usage, 72 % of artisans still rely on synthetic dyes (naphthol, indigo sol, and Remazol), while 16 % use both synthetic and natural dyes. Additionally, 12 % solely use natural dyes derived from bark, fruit peels, leaves, or plant roots. The process of obtaining natural dyes involves extraction or fermentation methods. The application of the GIS is divided into five components, namely (1) the utilization of materials, consisting of the use of raw materials (cloth), wax, and dyes and fixatives; (2) energy use; (3) water use; (4) products and packaging; and (5) waste. Each of these components will be discussed in more detail below.

3.1.1. Material use

Craftsmen use cotton and silk as raw materials for making various classes of batik cloth. Sixty-four per cent of the batik cloth items produced are defective. Most craftsmen choose to repair these defects (36 %), while some sell them at a lower price (16 %), or create smaller-sized products from them (8 %). Only one craftsman stockpiled the defective items, resulting in waste and loss of value.

In the batik industry, use of raw materials is assessed based on the product-to-raw-material ratio, which should be at least 98 % [18]. According to the data in Table 1, only 36 % of craftsmen met this GIS limit, while the remaining 64 % did not. The amount of wax used depends on the complexity of the batik motifs. The study shows that 96 % of craftsmen producing 'batik tulis' (hand-drawn batik using only the canting) and 83 % of those making stamped batik meet the GIS limits for batik wax use.

Sixty-four per cent of craftsmen met the limits set in the GIS for use of recycled wax. They reuse wax waste by mixing it with fresh wax or creating ornaments from it. However, some craftsmen prefer to sell the waste to avoid expending the labor required to treat it. Unfortunately, not all the wax waste is of good quality so only a portion of it can be reused; the rest is discarded on the ground. This wax waste has environmental impacts, including disrupting water absorption in the soil and forming hydrophobic areas, slowing down the environmental metabolism of pollutants. Additionally, its insoluble nature leads to surface coverage, blocking oxygen from reaching the surface [41].

The craftsmen do not use precise measurements when preparing and applying dye. If the resulting color is not as expected, additional dye is used to achieve the desired shade. Different types of dye, whether synthetic or natural, require specific fixatives for proper application. However, craftsmen rely solely on their instincts rather than precise measurements when applying fixatives. Consequently, assessment of the GIS limitations on the use of dyes and fixatives is challenging. It is important to note that both fixatives and synthetic dyes fall under the "hazardous" category, and thus working with them requires adherence to certain regulations. Despite this, many craftsmen lack a proper understanding of the risks involved and use them without following the guidelines. The environmental impacts of the use of these chemicals include ecotoxicity in both fresh and marine waters, as well as toxicity in humans [42, 43]. Although natural dye waste is safer than synthetic dye waste, waste treatment remains necessary as the wastewater from natural dye application still contains compounds derived from the chemicals used for mordanting and fixation [43].

3.1.2. Energy use

The energy-consuming steps in the process involve melting the wax to be applied to the designed fabric and boiling water to release the wax. The fuels most commonly used for these processes are shown in Table 2. A significant majority of batik craftsmen (60 %) continue to use kerosene as their fuel of choice. This preference is attributable to the age of the workers, as they fear that liquid petroleum gas (LPG) or electric stoves could cause explosions. Nevertheless, the adoption of alternative methods is increasing, with 28 % of craftsmen using LPG-fueled stoves and 12 % opting for electric stoves. For the wax releasing stage, firewood dominates as the primary fuel source (56 %). The decision to use firewood is mainly driven by cost considerations: some craftsmen utilize wood from their gardens, eliminating the need for additional expenses.

The prevalent use of kerosene and firewood in the batik industry poses significant environmental risks, leading to the depletion of natural resources and contributing to global warming. There is currently no restriction on kerosene usage in the GIS, and this concern should be addressed by encouraging the batik industry to transition towards more eco-friendly fuel options like electricity or LPG. Studies have demonstrated that the adoption of electric stoves in the batik process results in a remarkable 40 % increase in productivity while significantly reducing the industry's environmental impact [44].

In this study, industries using kerosene as fuel for the batik process were examined. The amount of energy used was converted to the calorific value of LPG, with a maximum limit of 3.7 MJ per m^2 of cloth, and for firewood, the maximum limit is 2.3 MJ per m^2 of cloth. When comparing these limits to the data in the GIS, it was found that only 20 % of the craftsmen met the energy use limits specified in the GIS. The main issue here is the lack of recorded data, which prevents the calculations to assess whether producers comply with the limits set out in the GIS.

3.1.3. Water usage

Water plays a crucial role in the batik industry, particularly during the coloring and color fixation stages. It acts as a solvent for dissolving dyes and fixatives, and is used in the rinsing process after applying the dye, releasing the wax, and completing the batik design. Although water usage is significant, businesses tend to assume it to be negligible and overlook the need to measure it. In the batik industry, the amount of water used varies depending on the type of dye employed. For natural dyes, the GIS limit is set at 10L per m^2, while for synthetic dyes is 50L per m^2. Currently, batik businesses using synthetic dyes (at 73 % concentration) adhere to the GIS limits. On the other hand, those using natural dyes do not meet the GIS requirements. Despite this, overall water consumption for products colored with natural dyes remains lower than for those colored with synthetic dyes.

3.1.4. Product and packaging

The batik industry is subject to regulations set out in the GIS, which aims to ensure product quality as well as quality packaging. These regulations can be met either by possessing an Indonesian National Standards (SNI) product certificate or conducting laboratory testing of the products according to SNI parameters. The interviews conducted revealed that all craftsmen surveyed were aware of the SNI requirements for batik products. However, none of them had pursued product certification, and as a result, they all lacked the SNI certificate. The primary reason for this is the significant cost involved in obtaining certification or conducting laboratory testing.

Table 1
Material use in the batik industry.

Aspect	Criteria	% Compliance with GIS
Material use	Product-to-raw-material-ratio (fabric)	36 %
	Use of batik wax	Batik tulis: 96 % Stamped batik: 83 %
	Waste wax recycling	64 %
	Use of dyes	–
	Use of fixator	–

Table 2
Data on fuel usage.

Fuel Type	Number of craftsmen	
	Waxing the designed fabric	Releasing the wax
Kerosene	15	1
LPG	7	10
Firewood	0	14
Electricity	3	0

Moreover, there is a prevailing belief among the craftsmen that obtaining SNI certification would not significantly impact their product sales, so they opt not to pursue it.

The GIS also plays a role in regulating the packaging used for batik products. According to the regulations, plastics are only allowed to be used as secondary packaging. Fig. 2 illustrates the materials used for primary packaging. The findings reveal that only 24 % of craftsmen adhere to these guidelines by not using plastic as their primary packaging.

Unfortunately, the majority of craftsmen still rely on plastic as the primary packaging for their products, often adding paper bags as secondary packaging to protect the items from damage and dirt during consumer purchase. However, this practice results in a significant increase in waste generation, particularly if consumers fail to reuse the packaging they receive. Plastic packaging is more desirable from the industry's point of view, as it is more cost-efficient, lightweight, durable, flexible, resistant, and impermeable than alternative packaging materials like metal and glass. Nevertheless, it presents a significant threat to the natural environment: it can degrade into microplastics which are harmful to the environment, disrupting food chains as well as human and environmental health [45,46].

3.1.5. Waste

In the GIS, waste from the batik industry falls into several categories: liquid waste, exhaust gas and air emissions, hazardous waste, solid waste, and greenhouse gas emissions. Specifically, in the batik industry, liquid waste is generated during the coloring, colour fixation, rinsing, and wax release stages of the production process. Table 3 presents the methods used for disposal of liquid waste during the coloring and colour fixation stages in the batik industry. Surprisingly, the majority of craftsmen still opt to directly dump this waste into rivers, citing the small quantity of waste involved and the belief that river water will dilute it, rendering it harmless to the environment. However, it is important to note that the chemicals in wastewater solutions do not easily dissolve in water [42]. Consequently, discharging such untreated wastewater into rivers leads to discolour water with a foul smell. This practice can also result in the siltation and narrowing of rivers, with significant damage to both the surrounding soil and the river's ecosystem over time [47].

During the rinsing stage, liquid waste is discharged directly into waterways or soil, as it is believed to be free from hazardous compounds because it is primarily used for rinsing purposes. In the wax removal stage, the resulting liquid waste still contains wax from the fabric. However, craftsmen employ a simple filtering process to remove the wax, after which the liquid waste is released into the environment since it is no longer considered harmful.

The batik industry's liquid waste must adhere to the wastewater quality standards outlined in Regional Regulation of DIY No. 7 of 2016. This aligns with the requirements of the GIS that mandate that liquid waste should meet the prescribed quality standards. However, it is worth noting that not all craftsmen can ensure compliance as no laboratory test has been conducted on the liquid waste. This includes waste that is stored, managed through a WWTP, or directly discharged into the environment.

The regulations pertaining to exhaust gas emissions impose requirements on the batik industry, necessitating the presence of management facilities and compliance with specific quality standards. However, the craftsmen in this study stated that they did not perceive their production processes as generating significant exhaust or air emissions. This is mainly attributed to the relatively small amount of energy used, primarily only in a stove. Consequently, the exhaust and atmospheric emission limits specified in the GIS

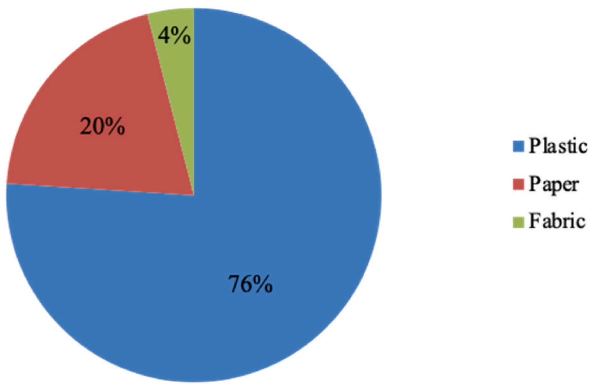

Fig. 2. Types of primary packaging used.

Table 3
Liquid waste disposal media.

Disposal media	Number of craftsmen
Communal WWTP[a]	2
Simple WWTP[a]	4
Reservoir	4
Septic tank	1
Soil	4
River	10

[a] WWTP = Wastewater Treatment Plant.

cannot be directly applied to these craftsmen based on their production practices.

Government Regulation No. 22 Year 2021 concerning the Implementation of Environmental Protection and Management states that batik businesses that utilize hand-written, stamping, or combined wax processes are a significant source of hazardous waste. This waste includes dyes containing heavy metals and dangerous chemicals, along with sludge from wastewater treatment plants (WWTPs). Surprisingly, after conducting interviews with all the craftsmen, it was revealed that they were unaware of the hazardous nature of the synthetic dyes and fixatives they were using. Consequently, they handled and disposed of these materials carelessly, exacerbating the environmental impact. Furthermore, WWTP sludge was haphazardly dumped in the vicinity of their homes.

The solid waste generated during the batik-making process mainly consists of cloth scraps, scattered wax, and wax released from the cloth during the wax removal process. Although the cloth scraps are usually discarded due to their low quantity, it is possible to collect and reprocess the wax waste from the batik and wax removal stages. Some craftsmen who are unable to process the waste wax sell it to third-party candle producers. This way, the solid waste from the batik-making process can be effectively managed. The greenhouse gas (GHG) emission limits laid out in the GIS are based solely on energy consumption, following the Intergovernmental Panel on Climate Change (IPCC) *Guidelines for National Greenhouse Gas Inventories* (2006). The findings indicate that 86 % of crafters operate within the GHG emission limits specified in the GIS (Fig. 3). Since the batik industry uses a relatively small amount of energy, the resulting GHG emissions are also comparatively low.

3.2. Readiness to apply the green industry standards

The readiness analysis applied in this study employs the Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES), which assesses an individual's readiness or motivation to address existing problems. This instrument is specifically designed for the study of individuals facing challenges: it can be used to evaluate their awareness of the problem and their willingness to initiate changes. Fig. 4 illustrates the concerning state of batik artisans' awareness and readiness for change. The data reveal that the majority of artisans score "low" and "very low" on the "recognition", "ambivalence", and "taking steps" categories. This suggests that they are not fully aware of the existing issues in the production process and tend to believe that there is no need for corrective action. Consequently, their readiness to embrace change remains low. Interviews with the craftsmen further highlighted the primitiveness of their waste management practices, wherein waste is disposed of directly in natural environments such as rivers and soil. The craftsmen perceive this method as natural and harmless to the environment. These findings demonstrate that the craftsmen's understanding and awareness of environmental management remains inadequate. Urgent measures are necessary to improve their practices and ensure a more sustainable approach to batik production.

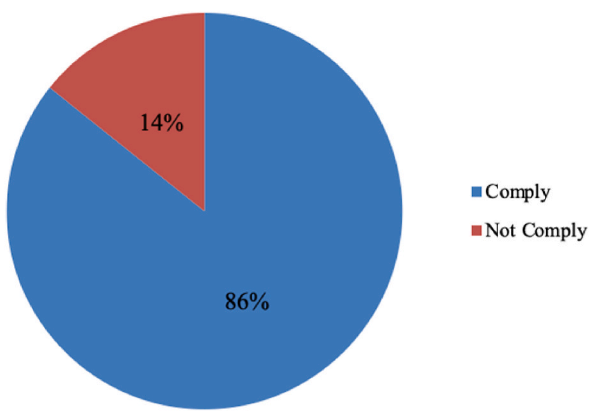

Fig. 3. Fulfillment of GIS criteria for GHG emissions.

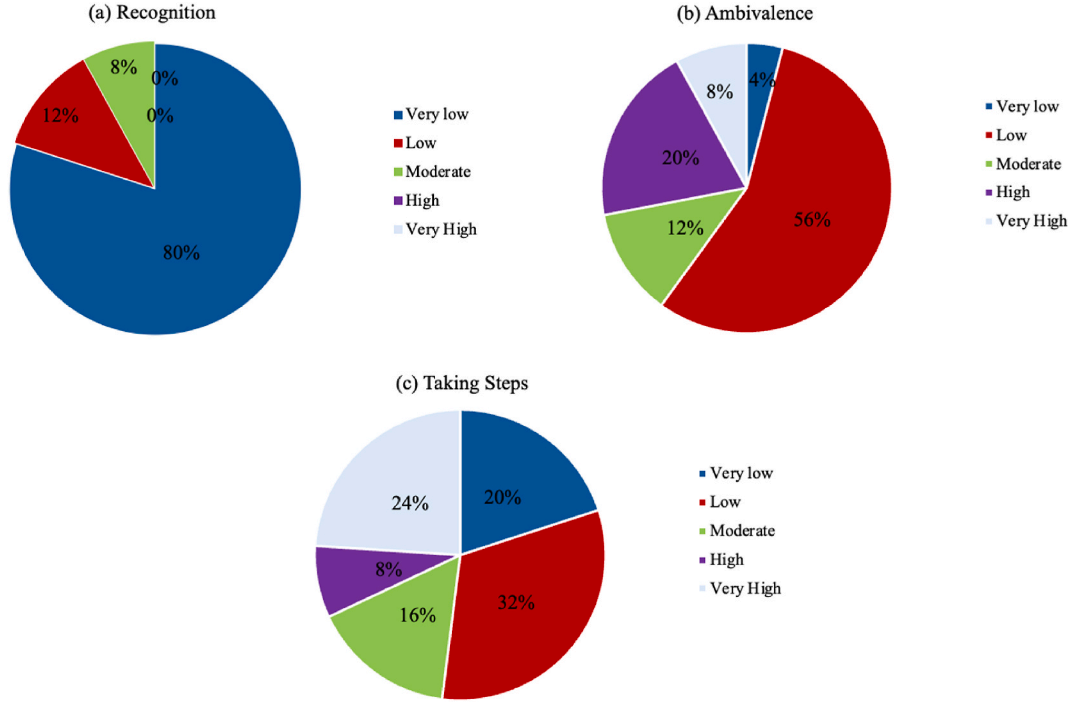

Fig. 4. Results of interpretation of SOCRATES values: (a) recognition; (b) ambivalence; (c) taking steps.

3.3. *Optimizing strategy for GIS implementation*

The process of developing an optimization strategy involved utilization of threats, opportunities, weaknesses and strengths (TOWS) matrix analysis. This began with the identification of external factors. Subsequently, the opportunities and threats confronting the batik industry were assessed, followed by an evaluation of the industry's strengths and weaknesses. These factors were gathered

Table 4
TOWS results for the batik industry.

External Factors	Internal factors	
	Strengths (S) 1. Cultural heritage that must be preserved (S1) 2. Characteristic motif for each region (S2) 3. Creative industries that free craftsmen to be creative (S3) 4. Absorb a lot of manpower and empower women (S4)	***Weaknesses (W)*** 1. Understanding and awareness of the concept of the green industry is still low (W1) 2. Low regeneration (W2) 3. Awareness of product quality recognition (W3) 4. Low working capital (W4)
Opportunities (O) 1. Abundant natural resources as material substitution (O1) 2. Cooperation or assistance from government and non-government institutions (O2) 3. Overseas market development (O3) 4. Research related to the batik industry (O4)	**SO Strategy** 1. Policies on the use of environmentally friendly batik with local motifs in government institutions (S1-4, O1, O2) 2. Participation of the batik industry in foreign exhibitions with funding from government or non-government institutions (S1, S2, O2, O3) 3. Utilizing modern technology to increase productivity (S3, O2, O4)	**WO Strategy** 1. Business coaching and development program (W1, W2, W4, O1-4) 2. Certification assistance for product quality recognition (W3, O2) 3. Involving the batik industry in foreign exhibitions to increase the interest of the younger generation (W2, W3, O2, O3)
Threats (T) 1. Textiles with batik motifs (batik printing) at low prices (T1) 2. Dependence on imported materials (T2) 3. Decreasing environmental quality (T3) 4. Decreasing number of exhibitions (T4)	**ST strategy** 1. Patents for local motifs (S1-3, T1) 2. Making batik for several market segments, including eco-friendly batik (S1, S3, S4, T2, T3) 3. Collaborating with suppliers (S3, S4, T2) 4. Using technology or the digital market to promote the industry (S1-4, T1, T4)	**WT Strategy** 1. Employee training and coaching program (W1-3, T2-4) 2. Utilizing loan facilities for business development (W4, T1) 3. Government policy regarding the use of batik printing other than for clothing (W3-4, T1)

through interviews with experts and insights gathered from craftsmen.

Based on the TOWS analysis, four alternative strategies can be formulated to help stakeholders encourage the achievement of a green batik industry (see Table 4). The S–O strategy maximizes existing internal strengths and existing opportunities, while the W–O strategy minimizes internal weaknesses while maximizing existing opportunities. The third strategy, S-T, maximizes internal strength and minimizes existing threats. Finally, the W-T strategy minimizes internal weaknesses and existing threats.

Based on the industry's readiness to implement the GIS and the results of the TOWS analysis, the recommended optimization strategy involves implementing a 'turn-around' approach (the W–O strategy). The primary focus is on addressing internal challenges within the batik industry so that favorable market opportunities can be capitalized on [48,49]. This aligns with the findings of the readiness analysis, which indicate that the dominant factor affecting the batik industry is a weakness in awareness and understanding of the production process and its environmental impact. The awareness and understanding of business actors play a significant role in determining their level of involvement in adopting green industry practices and supporting the GIS policy. Community participation in these initiatives is influenced by both internal and external factors. Internally, it relies on the willingness and capability of the actors, while externally it depends on the opportunities available [50].

4. Discussion

Evaluation of the status of the batik industry in terms of adherence to the Green Industry Standards determined that the industry is not yet adopting numerous eco-friendly practices in the production process with regard to materials, energy, water, product packaging, and waste. Administration and data management, including recording data on the use of resources such as material, energy, and water during their production process, are central issues in the batik industry. This has significant implications for the industry's resource consumption and environmental impact. The primary reason for this problem is the continued use of traditional technologies, which hampers effective resource tracking. This issue has a wide-ranging impact on the entire batik production process. For instance, it often leads to product failures due to color mismatches. The craftsmen do not precisely measure out the dye they use, resulting in inconsistent outcomes.

To address data management problems and boost productivity, a study by Rahmadyanti et al. (2017) [51] suggests implementing clean production practices which have already been applied in various textile and non-textile industries [52–54]. This involves meticulous planning and accurate record-keeping, calculating color composition, maintaining precise weighing procedures, and organizing storage areas for materials. By focusing on proper planning and recording in every aspect of resource usage (materials, energy, and water), the batik industry could potentially increase productivity by more than 100 %.

Simultaneously, maintaining accurate resource tracking can help prevent waste generation during the initial stage of the production process (the 'cradle'). This approach aligns with the waste management pyramid concept, emphasizing waste reduction as the primary goal. If waste production is minimized there is less need for extensive treatment facilities, resulting in lower environmental management costs. A study conducted by Soesanti and Syahputra (2016) proposes a method to enhance batik industry productivity by achieving a 4.8 % reduction in raw material usage and reducing production time by 10 % [44]. Nevertheless, the success of this method relies on the batik industry's ability to maintain accurate records of resources. Only with precise data can the industry perform proper calculations and plan effectively to achieve these savings.

Some criteria of the GIS seem less relevant to the batik industry, especially the criterion concerning water usage per unit of product. Notably, the limits set for batik made with synthetic dyes differ significantly from those for batik made with natural dyes. Consequently, compliance with these limits appears unequal: 73 % of craftsmen using synthetic dyes meet the requirements, while none of those using natural dyes can fulfill them. Interestingly, research by Handayani et al. (2021) supports the observation that natural dye usage requires less water than synthetic dye [55]. The study identifies several factors influencing water usage, including the type of dye used, the scale of production, the habits of the craftspeople, and the type of waste treatment technology used. The data show that producers employing natural dyes consume less water than those using synthetic dyes. However, if the focus is on meeting the standards, the use of natural dyes seems less efficient than the use synthetic dyes. One reason for this inefficiency is that the limit values set for synthetic dyes are too lenient, while those for natural dyes are overly stringent. Consequently, producers utilizing natural dyes face challenges in meeting these strict requirements.

Analysis of the readiness of batik SMEs to implement the GIS shows that the studied producers were not ready yet to enforce the standards. The batik industry lacks understanding of the application of standards in their production process, and the products they produce are neither recognized nor certified. The reluctance of the batik industry to pursue certification is primarily due to the convoluted process and costs involved in applying for it. The suggested strategy for optimization, based on the results of TOWS analysis, focuses on overcoming internal challenges within the batik industry to take advantage of favorable market prospects. The batik industry, which primarily consists of micro and small enterprises, does not yet prioritize environmental awareness [43]. This is mainly due to the challenges these businesses face in competing with others to survive. The batik industry also still lacks awareness of the importance of adopting clean production practices, resulting in the use of non-environmentally friendly materials and energy [56]. This is also supported by data gathered from informants, who revealed that the batik industry continues to face challenges relating to environmental management during manufacturing. Some of the obstacles encountered include a lack of understanding regarding their environmental responsibilities and the associated costs. Interestingly, however, business owners and managers do not perceive any problems with the production process. To address these challenges and bring about positive change, it is crucial to begin by shifting the mindset of business owners and managers toward embracing environmental improvements. There is a need to increase the environmental awareness of the batik industry by explaining that implementing green standards can bring several benefits to batik producers, such as decreasing the number of defective items produced, increasing market penetration, expanding market reach, and reducing customer complaints. Furthermore, applying the standards could increase productivity, improve raw material efficiency, and promote consumer confidence by ensuring that industry's products meet the specified requirements [57].

When involving various actors in implementing GIS, the government, particularly the Ministry of Industry as the policymaker, will help boost implementation by supporting the green industry initiative through policies and incentives. Arnstein (1969) emphasizes that the level of opportunity for participation depends on external parties, such as organizers or policy makers [58]. Coaching and guidance can also be provided to help the batik industry understand and adopt green industry principles. Nevertheless, the willingness of batik SMEs to participate will be determined by psychological factors, such as their expectations about the benefits of engaging with the program and their motivation to involve themselves in it [50]. To encourage active participation in the green industry program, stakeholders must effectively communicate the benefits of implementation and adherence to green industry standards [59]. Moreover, education, including to increase environmental awareness and industrial hygiene [60] and promote sustainable development [61] will also play a crucial role. Given that most craftsmen in the batik industry are high school graduates (Appendix 1), it should not be difficult to implement green industry practices if information is conveyed clearly. The market also plays a vital role in sustainable industries [62,63]. Cultivating a consumer mindset that values sustainable and stylish batik clothing will create demand for green batik industry products. Therefore, fostering positive consumer attitudes toward sustainability in the textile industry, particularly with regard to batik, is essential [64,65].

4.1. Theoretical and managerial implications

The research findings suggest sustainable practices must be embraced in the SME manufacturing sector. Theoretical, and managerial implications of the study are given below.

4.1.1. Theoretical implications

This study has broadened the application of SOCRATES's tools to validate the theory of readiness for change across various fields. The SOCRATES instrument is predominantly used in the health sector, for instance, to analyze the readiness for change in alcohol or drug abusers. This paper extends the application of this instrument to support the theory of how individuals (owner or manager) and industries respond to changes. Furthermore, it contributes to the discourse on sustainability transitions, particularly regarding the role of actors as agents of change. In SMEs, owners and managers act as agents of change, highlighting that while sustainability is a 'common problem' requiring 'collective action,' the transition must be supported and optimized starting from the individual level, especially the decision-makers at every level.

4.1.2. Managerial implications

By implementing the GIS, SMEs in the batik industries can reduce their environmental impact, conserve resources, and become more cost-effective by integrating all energy-efficient technologies into their daily operations. As a result, there will be greater consumer demand for environmentally friendly textile products, resulting in a competitive advantage and greater reputation.

5. Conclusion

The introduction of the GIS necessitates an examination of whether the batik industry, especially SMEs, is ready to implement environmental sustainability programs. Assessing SMEs' readiness to adopt these standards is vital to identify and address any obstacles that may hinder the industry from meeting environmental requirements.

This study concludes that Indonesia's batik SMEs are still not ready to implement the GIS. Assessment of the batik SMEs in Bantul Regency concerning aspects of the GIS (i.e. materials, energy usage, water management, product and packaging, and waste management) showed that they had not yet integrated various environmentally friendly methods into their production processes. Application of the SOCRATES instrument in this research also revealed a relatively low level of readiness to fulfill the GIS. Many craftsmen still believe that their production processes are not problematic, leading them to overlook the need for corrective action. The challenges faced in this area include a lack of understanding of their environmental management obligations, and the costs associated with environmental management.

According to the findings of the TOWS analysis, the primary strategy for optimizing the implementation of the GIS should focus on the creation of programs that raise industry owners' awareness of the need to apply green industry principles. One potentially effective approach would be to conduct green industry training and coaching sessions, covering production processes, environmental management, and business development, for batik craftsmen. External stakeholders, particularly the government as policymakers, can play a significant role in achieving the implementation of the green industry by providing opportunities for businesses to engage and explaining the benefits of the initiative, sparking individual willingness to participate. Once this willingness emerges, individuals' capabilities can be optimized by providing education and guidance help them adopt green industry practices.

This study has several limitations. The criteria used to evaluate the batik industry's conformance to the GIS examined in this study did not include all the criteria included in the GIS; for instance, noise pollution, corporate policies towards the GIS, and environmental social responsibility are not examined as factors in this study. Future research would be more comprehensive if it also considered these additional parameters. Furthermore, the study's findings may not be generalizable to other batik-producing nations and regions. It is possible to testing the same model in various other market segments and locations. Further research using TOWS analysis could also interview other stakeholders, including academics and several national and international NGOs, to produce a more thorough analysis.

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Data availability statement

Data associated with the study has not been deposited into a publicly available repository and data will be made available on request.

Ethics statement

This study was approved by the Ethics Committee of the Center for Environment and Sustainability Science, Universitas Padjadjaran, with ethics approval reference No. 029a/UN6.Q.EP/2021. Informed consent was obtained from all participants for this study.

Credit authorship contribution statement

Sylvia Diah Ayu Kusumawardani: Writing – original draft, Methodology, Data curation, Conceptualization. **Tubagus Benito Achmad Kurnani:** Validation, Supervision. **Annisa Joviani Astari:** Writing – review & editing. **Sunardi Sunardi:** Supervision, Resources, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e36045.

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