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The Integration of Cleaner Production Innovation and Creativity for Supply Chain Sustainability of Bogor Batik SMEs

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***Abstract*—**Competitiveness and sustainability issues not only put pressure on big companies, but also small and medium enterprises (SMEs). SMEs Batik Bogor is one of the local culture-based creative industries in Bogor city which is also dealing with the issue of sustainability. The purpose of this research is to develop framework of sustainability at SMEs Batik Indonesia case of SMEs Batik Bogor by integrating innovation of cleaner production in its supply chain. The approach used is desk study, field survey, in-depth interviews, and benchmarking best practices of SMEs sustainability. In-depth interviews involve stakeholders to identify the needs and standards of sustainability of SMEs Batik. Data analysis was done by benchmarking method, Multi Dimension Scaling (MDS) method, and Strength, Weakness, Opportunity, Threat (SWOT) analysis. The results recommend the framework of sustainability for SMEs Batik in Indonesia. The sustainability status of SMEs Batik Bogor is classified as Moderate Sustainable. Factors that support the sustainability of SMEs Batik Bogor such is a strong commitment of top management in adopting cleaner production innovation and creativity approach. Successful cleaner production innovations are implemented primarily in the substitution of dye materials from toxic to non-toxic, reducing the intensity of non-renewable energy use, as well as the reuse and recycle of solid waste. "Mosaic Batik" is one of the innovations of solid waste utilization of batik waste produced by company R&D center that gives benefit to three pillars of sustainability, that is financial benefit, environmental benefit, and social benefit. The sustainability of SMEs Batik Bogor cannot be separated from the support of Bogor City Government which proactively facilitates the promotion of sustainable innovation produced by SMEs Batik Bogor.

***Keywords*—**Cleaner production innovation, creativity, SMEs Batik, sustainability supply chain.

I. Introduction

BATIK, as a product of Indonesian artwork, has high aesthetic values. Indonesian batik products have economic value that can penetrate both national and international markets. This can be seen from the export value of Indonesian batik and batik products until October of 2017, which reached the US $ 51.15 million with export growth rate reached 6.3% [1]. The main export market destinations of Indonesian batik are Japan, United States, and Europe.

Since the recognition of batik by UNESCO as Indonesia's cultural heritage, batik trend is increasing. Bogor City has the opportunity to become a new batik craft center because the city of Bogor has some styles and various kinds of batik produced by craftsmen. Batik craft industry in Bogor can develop better if it is synergized with tourism activities. By relying on domestic tourists, the average growth of tourists to the city of Bogor reaches 10% per year. In 2016 the number of tourist visits the city increased from 4,783,848 in 2015 to 5,262,233 [2]. By 2017, the number of tourists is projected to reach 5.7 million people. Bogor City Government targets the tourism sector to contribute 28% of the Original Regional Revenue target in 2017, which is IDR 712 billion [2].

Today, SMEs of Batik from Bogor City merely focus on the aspects of maintaining business and gaining profit for production continuity [3], [4]; those of sustainability has not yet received enough attention. The issue of competitiveness and sustainability is not only required by large firms, SMEs also need to pay attention to both issues in developing the business wheel. As markets for batik and batik products become more global, SMEs are increasingly integrated into global value chains [5]-[7].

One method of assessing industrial sustainability that is more focused on identifying improvements to improve industrial sustainability is PSS (Product-Service System). With PSS, it can be seen whether the system or product can be developed for a sustainable industry [8], [9]. The PSS approach is the development of a design for sustainability or D4S. PSS enables companies to seek new markets and profits, survive in rapidly changing markets, improve efficiency and reduce resource consumption, meet environmental and employment standards, win a market competition and reduce negative environmental and social impacts [10]. UNEP & Delf uses three dimensions to assess sustainability, i.e., environmental, socio cultural and economic dimensions.

The development of sustainability practices in industry cannot be separated from implementation of cleaner production approach compare to end-of pipe approach [11]-[14]. Hasibuan identifies that the successful of cleaner production implementation in the manufacturing industry are influenced by internal and external factors [13]. Utilization and handling of waste generated in batik small industries can be synergized with innovation and creativity approach.

The purpose of this research is to develop a supply chain sustainability performance of Small Medium Industry of Bogor Batik by incorporating cleaner production innovation and creativity. This research used five dimensions of sustainability by adding technology and policy dimensions.

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II. Method

The study was conducted in Bogor City in 2017. It applied explorative and qualitative methods and used both primary and secondary data. Primary data were obtained from observation, direct measurement in the field and opinion from the expert (immediate interview). The experts are chosen based on the consideration of their experience, reputation, and credibility.

Stages of research are literature study, site survey, data collection, and expert pre-survey. The main factors of the success of SME Batik Bogor are identified based on in-depth interviews and benchmarking results. The analysis of the sustainability status of SMEs of Bogor Batik since 2016 used criteria developed by UNEP et al. [10], which is modified by the MDS method. Assessment of each dimension on an ordinal scale is based on the sustainability criteria of each attribute. Sustainability assessment methods are designed in an objective, transparent and multidisciplinary basis. The sustainability index is categorized according to [15]-[17], which are:

(a) Index value 0 - 24.99 (unsustainable category)
(b) Index value 25-49.00 (less sustainable category)
(c) Index value 50-74.99 (fairly sustainable category)
(d) Index value 75 - 100 (continuous category)

SWOT analysis is used to identify the strengths, weaknesses, opportunities, and threats of SMEs sustainability. This analysis is directed at the identification of internal and external factors affecting the sustainable development of SMEs Bogor Batik. Sustainability policy recommendations for SMEs Bogor Batik refer to the results of identification of sustainable position of SMEs Bogor Batik [18].

III. Result and Discussion

A. Production System of Bogor Batik SMEs

Fig. 1 shows some patterns of Bogor Batik. The results of identification of batik production system in Bogor Batik SMEs are described in Table I. The parties involved in the supply chain system of Bogor Batik SMEs are suppliers of raw and supporting materials, batik production workshops, clothing and accessories, Bogor batik showroom of SMEs, regulators, distributors, and consumers of Bogor Batik.

Fig. 1 Various patterns of Bogor Batik

B. Sustainability Criteria for Batik SMEs

Sustainability criteria of SMEs of Bogor Batik were analyzed based on the approach in five dimensions, namely economic dimension, social dimension, environmental dimension, policy dimension, and technology dimension. In the economic dimension, the criteria which are considered important are market growth, market share, profitability, added-value for consumers, long-term business development, marketing partnerships, and macroeconomic effects. In the environmental dimension, the criteria considered important include the optimization of machine life, transportation/ distribution optimization, and so on, as summarized in Table II.

TABLE I
Production System of Bogor Batik SMEs

Input	Process	Output
The *mori* cloth	Cutting the cloth	Handmade Batik
	Duplicating the pattern	Printed Batik
Wax	Incising wax following the pattern	Combination Batik
Dye	Dyeing	Printed Batik
-Natural dye		Clothing
-Synthetic dye		Accessories
Water	Water heating	Liquid waste
Energy	Boiling (*melorod)*	Solid waste
	Natural drying	Energy emission
	Sewing	

TABLE II
Sustainability Criteria of Bogor Batik SMEs

Dimension	Criteria	Sustain ability	Dimensional Aggregate
Economy	Market growth (E1)	**L**	
	Market Share (E2)	**L**	
	Profitability (E3)	**M**	
	Added Value for Consumers (E4)	**H**	**Low to Medium**
	Long-Term Business Development (E5)	**M**	
	Partnership/marketing cooperation (E6)	**M**	
	Effect to Macro Economy (E7)	**L**	
Environment	Optimization of Self-Life (V1)	**M**	
	Optimization of Transportation/Distribution (V2)	**L**	
	Resource Savings (V3)	**M**	
	Waste Minimization (V4)	**M**	**Medium**
	Toxicity (V5)	**M**	
	Reuse (V6)	**M**	
	Recycle (V7)	**M**	
Socio-Culture	Social Concern (S1)	**H**	
	Occupational Health and Safety (S2)	**M**	
	Work environment conditions (S3)	**M**	
	Employment (S4)	**M**	**Medium**
	Justice/employment relationship (S5)	**M**	
	Preservation of local culture (S6)	**H**	
	Property right/ brand/patent (S7)	**H**	
Policy	Establish Bogor Batik Uniform (P1)	**M**	
	Promotional Event of Bogor Batik (P2)	**M**	
	Registration of Property Right/Brand/Patent of Bogor Batik (P3)	**H**	
	Capacity Building Improvement of batik human resources (P4)	**L**	**Low to Medium**
	R & D of Bogor Batik (P5)	**L**	
	Museum of Batik (P6)	**N**	
	Award on Small Industry of Bogor Batik (P7)	**M**	
Technology	Recycle Technology of Wax (T1)	**L**	
	Renewable Energy (T2)	**L**	
	Low Emission of Energy (T3)	**L**	
	Production Efficiency (T4)	**L**	**Low**
	Water Conservation (T5)	**L**	
	SOP of Production (T6)	**M**	
	Process Technology (T7)	**L**	

Among five dimensions of sustainability in Table II, it appears that the best sustainability status is indicated by medium category. The socio-cultural dimension belongs to this category. Meanwhile, the worst is shown by Low category; the Technology dimension belongs to this one. Meanwhile, the other three dimensions, namely Economy, Environment, and Policy are in Low to Medium conditions. The advantage of socio-cultural dimension is supported by the fact that most of (more than 45%) SMEs of Bogor Batik products have been registered for patents and trademarks. SMEs of Bogor Batik also have the social, economic and environmental awareness through a new entrepreneurial growth program conducted every six months in Bogor City. For the environmental dimension, SMEs of Bogor Batik make several breakthroughs, ranging from minimizing the use of toxic-containing dyes, recycling the use of the wax, reducing the use of conventional energy to more environmentally friendly gas, and applying the innovative concept of zero waste of solid waste cloth batik through Mosaic Batik program.

C. The Innovation of Cleaner Production through Mosaic Batik

Mosaic Batik is one of the innovations of clean production and creativity from the Institute of Course and Training (LKP) Bogor Batik which utilizes batik scrap waste, so there is no waste remaining (zero waste). Pieces of the batik patch then are used on the desired media, such as ceramics, plastics, pottery, cans, stainless, pillars of the house, and various other media by applying stick system. Fig. 2 shows variety of mosaic batik products that have been successfully produced and marketed by Batik Bogor SMEs.

Fig. 2 Product of Mosaic Batik

Mosaic Batik has many challenges to be able to match the remaining fabric available with various motifs, colors, and materials to look harmonious, and at the same time, to adjust to the characters of the target market. For example, for the European markets, soft colors are more attractive, while for African and Eastern Indonesian markets, bright and striking colors are more preferred.

Mosaic Batik is produced with a limited number that adds to the exclusivity value of the product, as well as because the rack used cannot be repeated. The selling price of this Mosaic product varies from IDR 50,000 up to IDR 6,500,000, depending on the media and difficulty level of process work.

Currently, Bogor Batik has made various products of Batik Mosaics, such as pots, jars, piggy bank, umbrella shelves, food jars, crackers cans, helmets, even cabinets. All the products of Mosaic Batik have been registered with the Director General of Intellectual Property Rights with two categories of products, furniture, and various jars. Mosaic Batik products have been used both for individuals and agencies in the city of Bogor and have penetrated into the Nusantara and even abroad.

Bogor Batik develops Mozaic Batik as a product innovation of cleaner and creative production, which has advantages in several aspects, including environmental, economical, social, technical, and educational aspect.

Environmental Aspect: The main raw material used in the production of Batik Mosaic is the patchwork of remnants of sewing batik cloth. The utilization of this material is one of the company's efforts in processing industrial waste to be creative products or high-value art that contribute to maintaining environment through the absence of waste or waste (zero waste).

Economical Aspect: As an innovation product development, making Mozaik Batik does not require exorbitant capital; something that is initially valueless can be transformed into a new product with a value-added art. Also, the application of Mozaik Batik to any media can cover any defective or damage on cloth that makes it look good again. For example, a slightly rusted cracker tin, after being overlaid with Mosaic Batik will become waterproof, look beautiful, and certainly can be reused.

Social Aspect: With the development of Mosaic Batik innovation, Bogor Batik has a new division, which creates a new job. Furthermore, Bogor Batik also provides training for the community around the workshop site in hopes to recruit both permanent and non-permanent workers in the field of Batik Mosaic.

Technical Aspect: Technically, the production process is not too complicated as it does not require any unique skills. The idea of Mosaic Batik is driven by the accuracy of combining existing pieces of motif and color with patience to produce high-quality Mosaic Batik products. Mozaic Batik can be done by anyone, anytime and anywhere. This causes some local people make Batik Mosaic as one source of additional income.

Education Aspects: In collaboration with the Institute of Course and Training (LKP), Bogor Batik, provides training programs for public and academic community on batik waste

utilization as one of 4R (reuse, reduce, recycle, replace) implementation activities, in addition to trainings on handmade batik and printed batik that have been done before.

Another clean production innovation conducted by Bogor Batik covers in the production process and emission management process. In the production process**,** SMEs of Bogor Batik substitute firewood on the boiling process with gas and using uses eco-friendly material dye which only takes once leaching process. Previously, it needs more water because it has at least two times washing process. In the boiling process (shed the wax attached to the cloth), the rest of the wax is filtered and processed into a new wax that can be used to slam back (Recycle and Reuse). Bogor Batik also modifies the dye it uses so that the fabric can be done by 1 person (old tub used 2 people).

Another successful cleaner production innovation is to improve the fabric dyeing process so that it can be done only by one worker (previously requiring two workers). The success of the improvement made by IKM Bogor batik has been recognized in awards quality control provincial and national levels.

D. SWOT Analysis of SMEs Sustainability

The next step is to conduct a SWOT analysis and then arrange the results in the diagram to identify the strengths and the weaknesses the company has in the present and the opportunities and threats the company face in the future. This SWOT diagram is drawn from the result of interviews with SMEs batik owner of Bogor city. The SWOT diagram of SMEs Batik of Bogor city in detail can be seen in Table III.

TABLE III
THE SWOT ANALYSIS OF SUSTAINABILITY OF SMES OF BATIK IN BOGOR CITY

SWOT	Current Status of Batik SMEs		The prediction of Future Status	
	Strength	**Weakness**	**Opportunities**	**Threats**
Environment	The length of equipment used is longer The use of nontoxic dyes is dominant Reuse and recycle	Distribution management is not yet optimal The use of synthetic dyes is more dominant than natural dyes	Innovation of zero waste in mosaic batik Natural dye waste for plant fertilizer	Production waste pollutes the environment
Socio-culture	Preservation of local culture in batik motif Growing new entrepreneurs property right, Brands, Patents	Human resources Batik is limited in Bogor High demand for labor Implementation of work health and safety program in the work environment	Open new job opportunities The number of Bogor batik increases Preserving Bogor culture	The knowledge about the motif / picture that fit the tastes of a fast-changing society is not yet mastered
Economy	The added value that customers get is quite high Full support from local government	Market position is lower than competitors There is no raw material supplier located in Bogor	Government training assistance Close to the market / capital Cooperation of marketing with Bogor tourism	The difficulties of marketing and opening up new market opportunities The scale of production is still small
Technology	The use of batik uniforms is widespread Already implementing GKM in production process Using low-emission energy	Production efficiency is still low Have not adopted energy management yet	Technology of digital batik production handmade Batik design technology and printed batik Dyeing techniques of handmade and printed batik.	Batik printing technology is cheaper The design of printed batik is more dynamic The color of printed batik is more durable
Policy	Facilitate registration of property right/brand/Patent Promotional event of Bogor Batik	Human resources capacity is still low	The use of batik uniforms is widespread Award to SMEs of Batik	There is no Batik Museum yet

The sustainability value of SMEs of batik is still low. The environmental and socio-cultural dimensions have better sustainability status than other dimensions. Technology dimension shows criteria of the low category, meaning that the criteria for the use of technology have not been applied in batik SME system yet. This shows that batik SMEs has to improve its sustainability level. Formulation of recommendations for improvement is needed. Economic Dimensions and Policy also still have criteria with Low sustainability status that require improvement recommendation.

Table IV shows that the alternative recommendations formulated at the top right are the distinctive customer (R2), zero waste of solid waste (R3), new batik entrepreneur (P6), harmonization with tourism (R9). Next is the establishment of senior vocassional school (SMK) Batik (R10), sharing knowledge (R11), conventional energy conservation (R13), and lean manufacturing (R14).

IV. CONCLUSION

The SMEs of Batik sustainability framework developed in this study uses five dimensions: Economic, environmental, social, policy, and technology. Each of the dimensions is broken down into several criteria. The results of the analysis concluded that the sustainability status of the SMEs of Bogor Batik is still low for technology dimension, low to medium for economic dimension and policy dimension, but high for socio-cultural dimension and environmental dimension.

The SMEs of Bogor Batik, together with the Bogor government, preserve the local culture through the variety of Bogor batik design that has been registered with the Director General of Intellectual Property Rights. There has been an initiation to encourage the emergence of new Batik entrepreneurs but the program that supports the effort is not yet well designed. The dominance of SMEs of Bogor Batik is on the environmental dimension, with various efforts of zero waste innovation, especially transferring solid waste batik

cloth into Batik Mosaic pots, jars, piggy bank, umbrella, jars, crackers, helmets, and cabinets. All the products of Mozaik Batik have also been registered with the Director General of Intellectual Property Rights with two categories of products, furniture and various jars. However, the market for and the marketing efforts by Bogor Batik are still limited.

TABLE IV
THE COMPARISON OF RECOMMENDATION ALTERNATIVES

Dimension		Criteria	Score		Recommendation
Economy	E1	Market growth	+	R1*	New market identification
	E2	Market share	++	R2°	Distinctive customers
Environment	L4	Waste minimization	++	R3°	Zero waste of solid waste
	L5	Toxicity	+	R4*	Nontoxic dye
	L6	Reuse	++	R3°	Zero waste of solid waste
	L7	Recycle	++	R5*	Recycle of new material
Socio-culture	S1	Social concern	++	R6°	New entrepreneurs
	S2	Working health and safety	+	R7*	The application of APD
	S3	Working environmental condition	+	R8*	The implementation of 5S
Policy	K2	Promotional event	++	R9°	Harmonization with tourism
	K4	Human resources capacity building	+	R10°	SMK (Vocational High School) of batik
	K5	R & D Bogor Batik	+	R11°	Sharing knowledge
Technology	T1	The technology of wax recycle	+	R12*	The Baseline of recycle performance
	T3	Low emission energy	+	R13°	Conventional energy conservation
	T4	Production efficiency	+	R14°	Application of lean manufacturing
	T5	Water conservation	+	R15*	Water conservation target

++ Very good; + good; *short term solution; °long term solution

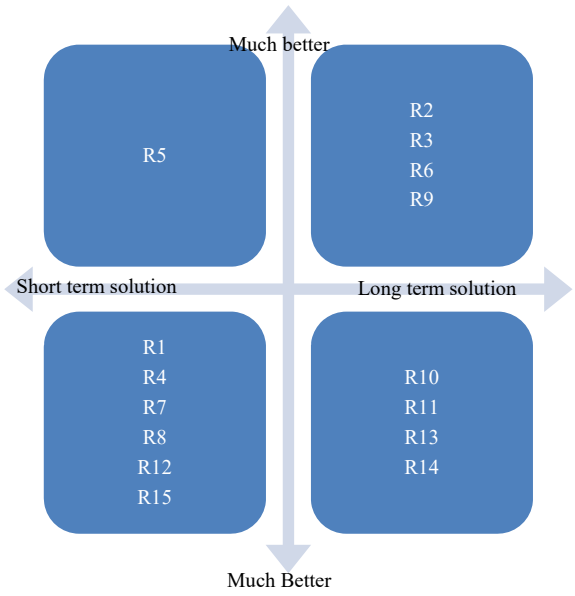

Fig. 3 The matrix of the feasible recommendation for the sustainability improvement Bogor Batik SMEs

Based on the results of the study, it is suggested to involve more diverse stakeholders in determining the sustainability criteria, as well as to see whether the importance of each dimension differs based on stakeholders' perception. It also needs to consider integrating the SMEs of Batik sustainability framework with other performance measurement models, such as balance scorecard or SCOR.

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