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STRATEGIC DIRECTION OF INFORMATION TECHNOLOGY ON SUSTAINABLE SUPPLY CHAIN PRACTICES: EXPLORATORY CASE STUDY ON FASHION INDUSTRY IN MALAYSIA

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ABSTRACT

A growing body of research emphasises sustainable supply chain management (SSCM) in contrary with limited studies exploring role of information technology (IT) in sustainable supply chain activities. Moreover, little is known on SSCM implementation in niche industries like fashion/textile-apparel industry. As most studies concentrated on investigating IT impact on business performance and profitability in supply chain, integrating sustainable practice with IT is still scarce. The aim of this study is to identify current SSCM practices with the focus on IT role in supporting SSCM in fashion industry. For that purpose, this study applies the sustainable key practices framework discussed in the literature of SSCM and adopted previous study framework that differentiates four IT roles for sustainability. Using the proposed frameworks, interviews were conducted with five fashion practitioners that are currently engaged with SSCM practices. The findings from this study highlight the existence of SSCM practices in fashion industry. Finally, this finding enhances the current understanding of how IT can support SSCM practices and helps future research in exploring the IT implementation, challenges and benefit towards SSCM.

Keywords: Sustainable Supply Chain Management, Information Technology Resources, Sustainable Fashion, Triple Bottom Line.

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1. INTRODUCTION

The topic on sustainability particularly in fashion industry has attracted a lot of media hype due to ethical and social concerns on human rights and negative environmental impact (James &

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Montgomery, 2017). It was reported that fashion industry is one of the world's leading polluting industries with global textile consumption estimated at more than 102 million tonnes per year by 2030, resulting in serious environment and social impacts in the supply chain (Niinimäki et al., 2020). In Malaysia, it was reported that two million kilograms of textile waste produced every day which constituted about four percent of total solid waste in 2013 and the number continues to grow (Nadiah, 2018). Brand retailers adopting fast fashion business model encourages consumers to throw away a good condition garments and purchase a new and latest fashion trends in market (Niinimäki et al., 2020). Such business approach is unsustainable since it has short product life-cycle whilst leading to negative sustainable issues.

A piece of clothing undergoes a long, complex and geographically complicated supply chain which leads to cost- and time-consuming process factors (Bozic, 2017; O'Rourke, 2014). It involves various supply chain activities of raw material acquisition, production, processing, manufacturing, shipping, selling and, clothing use and disposal. These activities often affects the environment and social issues such as the use of chemical products, pesticides, high water consumption, textile waste, exploitation of human rights which involves unequal payment, unsafety working conditions, low education and training support to the workers (Moretto et al., 2018; Shen, 2014). Thus, fashion industry players are urged to change their production, distribution and marketing practices and strategies towards greater sustainable practices. Shen et al. (2017) argue that it remains a challenge to put into practice the sustainability in fashion supply chain.

Sustainable Supply Chain Management (SSCM) refers to "the management of material, information and capital flows as well as cooperation among companies along the supply chain, taking into account economic, environmental, and social dimensions based on customer and stakeholder requirements" (Kurnia et al., 2012; Seuring & Muller, 2008). The definition adopts three aspects of economic, environment and social, known as triple bottom line (TBL) by Elkington (1999). Whilst the concept is noble, lack of innovation and technological adoption within TBL dimensions of sustainability poses challenges concerning data availability, consistency, traceability, and efficiency in production and logistics operations in supply chain activities (Ejsmont et al., 2020; Sánchez-Flores et al., 2020). Over the years, information technology/information system (IT/IS) have immersed in business operations to improve the organizational product information flows and inventory processing. IT helps in avoiding loss of sales and maximizing profits which were otherwise a time-consuming process (Ageron et al., 2020; Aftab et al., 2018). For example, fashion retailers like ZARA use radio-frequency identification (RFID) technology for inventory management in order to identify and locate stocks quickly and accurately. Besides, to bring sustainable advantages to supply chain management (SCM), designers and consumers could innovate to integrate technologies like 3D computer system and artificial intelligence (AI) during the production process (Lee, 2021). Albeit adoption of technologies related with Industry 4.0 transforms businesses into smart factories, such advances could also harness the benefits from sustainable business development practices (Luthra et al., 2020). Businesses could acquire, operate, process, manipulate and share information through the development of new system or applications like blockchain technology, to exploit sustainable practice to environment and society (Agrawal et al., 2021). Blockchain-based smart contract provide transparent and traceable supply chain process enabling trustworthy and visibility of information sharing among supply chain stakeholders.

Consequently, SSCM is able to be a strong driver of value and success to the fashion industry players in supporting sustainability (Strahle & Muller, 2017) considering the challenges that the industry faces with regard to environment and social issues. Even though growing body of research focuses on SSCM practices, there are limited number of studies investigating IT adoption and diffusion in supporting sustainability initiatives (Dao et al., 2011; Kurnia et al., 2012; Luthra et al, 2020; Rivera & Kurnia, 2015). Furthermore, in an emerging economy like Malaysia that embraces Industry 4.0 and digital transformation, little is known on sustainable practices in supply chain activity and IT integration. Past studies in Malaysia focus on SSCM in manufacturing industry at general (Abdul-Rashid et al, 2017; Eltayeb et al., 2011; Zailani et al., 2012), but empirical evidence is needed on SSCM covering diverse industry sectors. Adopting and implementing the concept and practices of sustainability and its dimensions must be tailored to specific industry-based needs and operational capabilities rather than 'one-size-fits-all' (Amni Husna et al., 2020). Moreover, extant research focused mainly on supporting the business operations and economic aspects by ensuring good return of investment (ROI) and healthy cash flow while lacks consideration of environmental and social responsibilities (Eitiveni et al., 2017; Kurnia et al., 2012; Thoni & Tjoa, 2017).

Therefore in our context of study we are motivated to explore the current state of sustainable practices and initiatives in Malaysian fashion industry, and how the existence (if any) of IT could drive sustainability in supply chain management. Therefore, the research aim is to address the question of *how IT drives organisations towards sustainable fashion supply chain activities?* This study identifies current SSCM practices and IT roles to support the fashion industry grounded by key practices adopted from two leading studies within sustainability framework, Kurnia et al. (2012) and Dao et al. (2011). This study contributes to the information and communication technology literature by providing evidence of how IT can be adopted and use to support sustainable practices and enhance the current understanding and awareness of fashion sustainability area for both academics and practitioners. This study provides insights to policy- and decision-makers on how triple bottom line as a holistic sustainability framework in SCM. As an evidence-based study of how IT supports sustainable practices in a niche domain of textile/fashion industry, we believe that the strategic IT direction can be replicated to other industries seeking framework for sustainable supply chain activities.

2. LITERATURE REVIEW

2.1. Sustainable Supply Chain Management – An Overview

The word sustainable in SSCM addresses a balanced focus on environment and social factors rather than on economic factor alone as in a typical supply chain. The term of sustainability first entered the public consciousness with the definition by Brutland Commission on 1987 where; "Sustainable development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). The shift from traditional SCM to a growing dedication to SSCM is progressively taking place in the last two decades. SCM involves upstream processes as storage and movement of raw materials, manufacturing activities, inventory process and distribution of finished goods from production to consumption, and interconnected business network that aims to provide products and services to downstream channel (Eitiveni et al., 2017).

SCM is driven by economic concerns and concentrates on enhancing profitability, cash flow, productivity and increasing competitive advantage. Thus, the rapid growth of business organization has therefore contributed to environmental and social implications (Rivera & Kurnia, 2015). The challenges of sustainable development come from unsustainable consumption and production practices that have grown over the years. For example, transportation and distribution activities, contributes to pollution of increasing carbon emission caused by transport and road congestion (Eitiveni et al., 2017). Therefore, successful implementation of SSCM practices would need to address economic, environment and social dimensions or Triple Bottom Line (TBL) of sustainability (Kurnia et al., 2012). Elkington (1999) refers TBL as 3Ps of profit (economic), planet (environment) and people (social). Closs et al. (2011) argued that sustainability development must address four dimensions of economic, environmental, ethical and education. However, most of the past researches articulates TBL based SSCM theory, as ethical and educational aspects basically represent the social dimension (Carter & Easton, 2011; Kurnia et al., 2012; Rivera & Kurnia, 2015; Seuring & Muller, 2008; Shen, 2014).

TBL proposes that organizations need to engage environment and social concerns together with economic performance when addressing sustainability. The economic dimension mainly addressed in organizations which measures the cost, profit and loss in the business (Eitiveni et al., 2017; Ratan et al., 2010). This relates to the ability of an organization to create a unique identity which not easily imitated by the competitors thus, achieving customer satisfaction.

The environmental dimension or sometimes known as green supply chain management refers to the consumption of resources impacting the ecosystem (Sarkis et al., 2011). Moreover, practice that concerns on optimizing the use of resources during distribution of products from production to consumption is called green logistics/distribution, i.e. water and energy consumption, recycling and reuse sources and proper disposal of waste (Ninlawan et al., 2010; Rahim et al., 2013; Strahle & Muller, 2017).

And finally, the social dimension focuses on management of social resources consisting of ethical and education considerations among stakeholders inside and outside organization (Rivera & Kurnia, 2015). Ethical consideration covers the integrity of different business management practices and issues related to employee relationships such as human rights and workers' welfare (Closs et al., 2011; Ratan et al., 2010; Sroufe & Drake, 2010). Meanwhile, education consideration addresses the nature of employment relationship, training and talent development (Closs et al., 2011).

2.2. Sustainable Supply Chain in Textile/Fashion Industry

The development of sustainable supply chain in fashion industry aims at promoting sustainable behaviour within upstream and downstream value network. Fashion supply chain involves raw materials, production, distribution, retail, consumer and after-use (Agbonkhese, 2010; O'Rourke 2014). Each activity in fashion supply line reflects differing sustainability concerns which in turn influence the environment and social aspect (Strahle & Muller, 2017). Moreover, fashion supply chain is relatively long and complex due to involvement of large number of suppliers and geographical factor (Bozic, 2017; Koksal et al., 2017; Shen et al., 2017). Consequently the pressure to lower the cost and shorter production time have negatively impact the environment

and social concerns (Koksal et al., 2017; Moretto et al., 2018). Environmental issue caused by intense use of water, energy, pesticides and toxic chemicals at the manufacturing activities generates waste and pollution to the air, water and land field. The social concerns in fashion industry relates with unacceptable working condition, such as child labour, underpaid workers, safety issues, animal mistreatment and the use of harmful chemicals (Choi & Shen, 2016; Koksal et al., 2017; Moretto et al., 2018).

From the demand side, awareness about sustainable fashion remains low in Malaysia (Tan, 2018). The challenge is to inform and advocate consumers that purchasing sustainable fashion as means of choosing an environmentally conscious lifestyle as opposed to fashion conscious purchasing i.e. fast fashion. Given the above background and support from studies by Kurnia et al. (2012) and Rahim et al. (2013), SSCM cannot be achieved without adequate IT management assistance and contribution. Notably, social media plays an important role to create awareness of sustainable fashion (TCBL News, 2018). Fashion Revolution (2018), a non-profit movement, was created by ethical fashion designers demanding great ethical concern in the fashion supply chain. Knowledge and awareness among consumer on sustainable fashion will shape the society towards practices of responsible consumption.

2.3. Information Technology and Sustainability

There is no doubt that implementation of IT in organisations has provided both strategic and operational benefits. Most organizations are presently engaged with variety activities of supporting economic dimension such as information flows of product, development of applications to execute supply chain transaction and manage the stakeholder relationship (Kurnia et al., 2012). Several researches have acknowledged the importance of IT innovation, particularly technologies related with Industry 4.0, as driver or enabler for sustainability practices. Using systematic literature review approach, Bag et al. (2021) identified 13 key enablers for Industry 4.0 that influence sustainability of supply chain acitivities. The enablers are government support; support of research institutes and universities; law and policy regarding employment; improved IT security and standards; management commitment; focus on human capital; change management; horizontal integration; vertical integration; standardization and reference architecture; and corporate governance and third-party audits. Luthra et al. (2020) explored key drivers of Industry 4.0 related technologies to achieve economic, environment and social dimensions in sustainable supply chain. The study reports that government supportive policies and, collaboration and transparency among supply chain members, are the most significant drivers for technology diffusion. According to Thoni and Tjoa (2017), IT can be used as to improve transportation and coordination between the supply chain activities. Melville (2010) recognizes the ability of IT to improve environmental sustainability by helping to decrease energy use through dematerialization. Likewise, IT is an enabler of implementing green sustainability practices in organization (Seidel et al., 2010; Srivastava, 2007). Meanwhile, Rivera and Kurnia (2015) explored Internet-of-Things (IoT) implementation as a support for sustainability initiatives.

Apart from supply chain, technologies such as green computing and cloud computing have particularly improved process efficiency and resource optimization via affordable and sustainable technological solution known as bring-your-own-device (BYOD) and virtualization. Jusoh et al. (2017) provided a framework to implement BYOD practices in public sector based on end-user

profiling and green computing concepts. Wan Mohd Isa et al. (2019) modelled a cloud computing reference framework deliberating on factors and challenges for adoption.

Recognising the potential use of IT in enabling sustainability practices, Dao et al. (2011) proposed a framework for sustainability that integrates aspects of human, supply chain and IT resources to help business develop sustainable capabilities within thier organisations. In thier study, they explored four notable roles of IT resources in sustainable practices; automate, informate, transform and infrastructure. These different types of IT roles could enable strategic business objectives which will help the organization to develop sustainable competences. Automate is when IT resources are used to help the organization automate business process by reducing or eliminating the manual role served by human resource so that work processes and tasks could be performed quicker, more effectively and precisely. Informate is associated with communication, coordination and decision-making tools of information from various data captured by different IT platforms (Kurnia et al., 2012). In transform, IT helps the organization to restructure or rebuild the business strategy, practices, processes and relationship within their stakeholder in order to develop new products or services and reposition themselves to the better position in the marketplace (Dao et al., 2011). Meanwhile, infrastructure typically covers hardware, software and network components to support business process (Rivera & Kurnia, 2015).

Later, Rahim et al. (2013) proposed taxonomy of IT use within SSCM which includes determining, recording, informing, bench-marking, educating, evaluating and addressing SSCM practices. They derived the definition of IT for SSCM practices "organization wide initiatives involving IT and IS products, infrastructure and services to support the implementation and subsequent operations of SSCM practices and policies which are authorized by senior management in organization" (Rahim et al., 2013).

Given this backdrop and guided by the key practices of SSCM, we further explore the current state of sustainable supply chain practices and how IT plays a role in the context of fashion/textile industry, particularly in an emerging economy like Malaysia.

3. METHODOLOGY

3.1. Case Selection Strategy and Description

This study adopted qualitative approach to gain better understanding into the current practices of sustainable supply chain in Malaysian fashion industry, and how IT is used in supporting sustainable practices. Therefore, qualitative research is a best approach to generate novel insights into phenomena that are difficult to quantify (Berg & Lune, 2012). The sample was selected via purposive sampling method using the following selection criteria guided from previous work done by Kurnia et al. (2014) and Moretto et al. (2018);

a) Experience regarding sustainable fashion and currently active promoting sustainable fashion practices.
b) Knowledge or involvement in fashion supply chain or life cycle.

An initial search using Google search engine yields seven sustainable fashion local brands in Malaysia. We then further searched for suitable organizations (of local brands) by visiting their website and social media presence to verify their active engagement in sustainable practices that fits with our selection criteria. The potential organizations were contacted either by phone or email. From the initial organizations that were identified as potential participants, only five acknowledged and agreed to participate. Two practitioners are academic staff from a local higher learning institution with experience in sustainable fashion study. Three other practitioners are from different fashion organizations mainly advocate sustainability strategy in their business process. Table 1 provides a brief profile description of the study participants.

Table 1: Profile of Study Participants

Practitioner	Industry	Position	Experience (years)	Sustainable Fashion (SF) Mission
P1	Education	Program Coordinator	25	Promoting SF in fashion education
P2	Education	Senior Lecturer	19	Promoting SF in fashion education
P3	Fashion Retailer	Founder	6	Social ethics of fashion sustainable development
P4	Fashion Retailer	Co-founder / Head of Ethical Fashion	7	Waste management for unwanted fashion products.
P5	Fashion Retailer	Founder	6	Eco-Fashion / Slow fashion

Practitioner 1 (P1) and Practitioner 2 (P2) are lecturers in fashion study and actively promote sustainable fashion through education. Their team had organised multiple events such as fashion competitions using plastic waste, talks and recycle campaigns. They also collaborate with non-profit organisations to increase awareness on sustainable fashion to their faculty students. Practitioner 3 (P3) is a founder of a fashion organisation with social enterprise certification/accreditation, focuses on preserving *batik* heritage via ethical practice and transparent working conditions, as well as fair-pay of *batik* artisans and workers. Practitioner 4 (P4) is a co-founder and head of ethical fashion at a retail organisation since 2012. The organisation champions in urban waste problem by producing products from waste materials. Lastly, Practitioner 5 (P5) is a founder of fashion business that promotes ethically sourced fabrics and fibre that use to produce outfits and textile such as towels. She actively works on fashion sustainability since 2013. Their business model is based on slow fashion where products are not mass-produced, but based on demand based production.

3.2. Data Collection and Analysis

The case studies were conducted in 2019 through face-to-face interviews. The interview sessions were carried out at the participants' location mainly in the Klang Valley region. Moreover, researcher's accessibility to these locations was deemed necessary as the targeted participants were only willing and ready to participate when researcher is at their business premise. This way, the sessions were run in participant's natural interactive setting where richer information and understanding can be obtained during the data collection process.

The data was collected via semi-structured interview approach using open-ended questions designed in four parts ; (1) describing sustainable fashion and mission, vision, goals towards fashion sustainability ; (2) current/ 'as-is' sustainable practices, initiatives and activities in fashion supply chain, (3) current/'as-is' IT usage within their sustainable supply chain, and (4) future/'to-be' perspective of how IT could be use to achieve the sustainable supply chain practice in fashion industry. During the interview process, exploratory questions were asked to present better clarity to the phenomenon. For example, "can you explain more on this? Explain your experience about this concept?". The interview lasted between 45 minutes to an hour. All interviews were audio recorded and subsequently transcribed. Data saturation was attained through data triangulation (Fusch & Ness, 2015) by comparing information gathered from industry practitioners with information from academic expert, thus further verifying and confirming credibility of data collected.

The interview transcripts were transferred into a spreadsheet based on the four parts of the interview. Data analysis was done using thematic analysis. Key themes were identified and coded into individual words for identifying current fashion sustainable practices and related IT applications.

4. RESULTS AND DISCUSSION

4.1. Sustainable Supply Chain Management Practices

This section presents SSCM practices in fashion industry as highlighted by practitioners and thereafter a synthesis of current SSCM initiatives is produced.

4.1.1 Current SSCM Practices in Fashion Industry

Eco-design of Products

One important practice involved in ensuring sustainability in the supply chain is how the products were designed and produced. Design and development of products should minimize the harmful effect to the environment throughout the supply chain (raw materials to manufacture, distribution, retail, use, disposal and waste management). However, the use of natural fibre and natural dye in eco-design of products which related to raw materials making in the supply chain as justification below;

"When you are going to the store that focuses in fashion's sustainable, the store sure sells only cotton shirts or cotton linen. It's natural fibre. Satin, polyester is not from natural fibre. Cotton is sustainable because it is from the nature. Cotton from cotton plant and silk from worms." (P1)

"From my supply chain, the cotton farms that we purchase from, in terms of the actual fibre before they loom into a full fabric, they are coming from farms that don't have pesticides in them". (P5)

Moreover, natural fibre is not only from cotton plant. It can be other sources of natural environment such as;

“Fabric can be obtained from natural fibre. Yarns from banana stems, pineapple skin. The pineapple skin is used and processed into fibres and been woven into a cloth.” (P1)

“We work with non-GMO cotton, bamboo and handcrafted fabrics for our ready-to-wear and home items collection.” (P5)

“There is a Malaysian brand, the material that he used natural fibre. I think that's what they currently practice is more to the environment sustainable.” (P2)

“The beauty of batik is when you wear natural fibre fabric...which means there is no micro-plastic problem because it is pure natural fibre.” (P3)

Besides natural fibre, the use of natural dye for colouring fabric was also emphasized in raw material processes. Natural dyes are dyes derived vegetable material without any chemical treatment.

"Dyeing process needs to use natural dye... The use of chemicals will harm the human and environment." (P2)

“We also work with vegetable dye. Most recently, I start sourcing fabrics that utilises vegetable dye.” (P5)

The extraction of natural dye and its application in fabrics industries has been practice at few places;

“If it's a natural dye practice, I think it's a lot. They are big batik players. They use this natural dye. One near Langkawi, one near Sungai Buloh. They are big batik players. Big factories. They have been doing natural dye for years.” (P3)

I've seen in Central Market, the sustainable store did sell their clothes which been made from fruit dye colours… Fruits that are spoiled so cannot eat and sell, so they make dye from it.” (P1)

Besides the use of natural raw materials, eco-design products enable the use of material waste to be processed or upcycled into a new product. In this way, the supply chain activities skip the use of raw material process, and proceed for production of another product i.e. circular economy.

“For us, we don’t produce material. We use material that has already been produced. When you need to make a product, either you have to get it from somewhere, all the processes and everything. We skip that. We don’t want to create the material. We use existing material. That is how for us is sustainable… For example, advertising banners. People have used these banners for their advertising purposes and then they will remove them. So, here's where we take it and we make it a new product. Just like a bag, all these are seat belts. It's a waste from the factory.” (P4)

Even packaging process should reduce the environmental impact and create packages from waste as strategy for improving sustainability.

"Our packaging is also 100% upcycled as well…. For example, hotel bed sheets, they have a small stain, but they cannot use the whole sheet anymore. So, we take, we make it into packaging bag. It is actually very cute." (P4)

Clean and Lean Production

Clean and lean production is an approach to manufacturing processes in optimizing resources and energy usage. The purpose is to eliminate waste issue in the operations and subsequently minimising negative impacts on the environment.

"Indian cotton price is double compare to normal cotton because they are certified organic cotton… The process is expensive; they use less water and all that." (P3)

In supporting clean and lean production, the upstream channel such as suppliers are social enterprise certified. Furthermore the production applies zero-waste design approach.

"Fabric is typically made from factories; they have large processes and machines that would create yarn fabrics. However, with a looming machine, it is small. It takes up less energy and less water in the process." (P5)

"In production, we move towards zero waste… We use all the fabrics." (P3)

"In terms of designing. For example, a lot of our wear, we try to follow a zero-waste design approach." (P5)

"Production involves the factory. So, the factory has to figure out how to minimize the operation resources... For example, from the raw material it was already sustain and then sent to the factory, the factory had to lessen the use of the fabric." (P1)

Green Purchasing

This practice refers to purchase activity from supplier whilst considering the environmental and social impact such as purchasing from supplier that compliant with the environmental standards.

"Our cotton supplier, they are a certified supplier of organic cotton. For production, us, we have Social Enterprise United Kingdom (SEUK) certification… So, from India certified, organic cotton, then we, certified social enterprise, then send to Philippines certified, ethical factory. US, the retailer, ethical brand, so, on the go, all transparent. " (P3)

"… then actual supplies, where are they source, how are they source. Is the process of sourcing it and the process to end product of it environmentally friendly, does it contribute to carbon emission or does it reduce toxics? … We're working towards with organic certified organic cotton but at the moment, we are working with non-GMO. And that really means that the cotton fibre that we're sourcing from in Turkey, it comes from a farm that doesn't allow pesticides in their farm." (P5)

To some extent businesses conduct self-monitoring and assurance mechanisms on supplier and product statuses.

“We are doing our personal audit. If they meet our sustainable report criteria. Then, we will source from them."(P3)

"I used to work with Metrojaya, when they were focusing on sustainable fashion collection particular on the selection of natural colour… They wanted natural dye… So, they would look for certified suppliers to supply the material." (P1)

Reverse Logistics (Waste management)
Reverse logistics represent the process of moving products from consumers or aftermarket back to production stage for the purpose of recapturing value i.e. recycling and upcycling.

“Recycle or upcycle the waste that still in good conditions ... either to make a shirt or to make another product. For example, I've seen a string, cut and then woven into a tablecloth or mat." (P1)

“The methods and procedures that allow waste or remnants to be reused for another product... It does not necessary shirt, it can be other product such as art, decorations…” (P2)
"Repair, re-design and upcycle is a process where the disposal item will be cut and check what are the materials from… It’s depends on the design and the waste itself, there are direct disposals can be upcycled, there are also disposal that need repair, re-cut or wash back." (P2)

“Then it also could be innovation, upcycling to me is sustainable. So, if there is ample wastage of materials whether it is non eco-friendly or eco-friendly. I have heard of recycled plastics turn into shirts. I know a factory in Malacca that does that." (P5)

Moreover, implementing reverse logistics in business operations helps a lot in removing waste into the landfills.

"We use our scraps to create new wears out of it. We reduce 33 kg of excess wastage scrap from our previous collection to create this collection and reduce it up to like 3 kg." (P5)

“We don’t produce new product. We use ‘sampah’ but it is good wastes… For example, unwanted seatbelt we bought from factories, banners are from the donation, left over kimono, we do collaboration with another brand. There are different types of give and take. So, whatever purpose of exchange, we try not to create new product. We use existing product that has already been produced. That is how sustainable practice in our organization.” (P4)

“In the future, the plan is to accept return, give discount. The return can be upcycled to something else.” (P3)

Additionally, clothes that are not worn anymore could also be recycled and upcycled. In Malaysia, collectors of clothes (that have reached its end-of-life, or disposed due to fast fashion phenomena) is known as bundle business. These clothes are either sold as second-hand value, donated or sent to third-world (poorer) countries or nations.

“Like bundle, is it sustainable… He sells something still good and not new. One is a re-cycle…”(P2)

"Bundle business are sustainable fashion practices, but the public do not know that." (P3)

Work Safety

A good business was not only measured on the basis of the profit but also to make sure that the workplace is safe and healthy, workers feel comfortable and the organizations do not tolerate unsafe conditions as mechanism for social sustainable practice.

"*Working place condition must be taken seriously in terms of safety." (P2)*

"I start sustainable from batik manufacturing, I do ensure on my workers safety. Avoid any negative impact on workers like how they handle the chemical; make sure it is safer for them." (P3)

"….who are your labour?… are they sustaining of a healthy income and working under fair wages and in good condition?... On the workers, we also only work with small number of seamstresses… It is done in someone home by one person. So, we are not looking at setting up a large factory where the amount of water, toxics and carbon emission are huge." (P5)

The practitioners dedicated in providing safe working conditions across the supply chain who involves the factory workers, seamstresses, retailers, sourcing recycled raw materials and up-cycling post-production and consumers' wastes.

Employee Well-being

Besides work safety, another ethical aspect in sustainable practice is about the commitment to the employee in improving their satisfaction. A fair payment matter is one issue that has been raised.

"With us, our objectives we preserve the heritage and then make sure the batik makers can earn a sustainable income. Our workers earning more than the minimum wage. So, social aspect we are solving that." (P3)

"In terms of people, I think directly we work with the production. We make sure that they are paid fairly. In Malaysia, we are the first World Fair Trade Organisation (WFTO) member. We are the first one in Malaysia. " (P4)

"… who is your labour? are they paid well? are they sustaining of a healthy income and working under fair wages?... We also work with refugees from TANLA Organisation, they are from Myanmar. So, we do pay them equivalent to market rate." (P5)

Fashion industry has received a lot of criticism over this past few years because of exploitation of underpaid workers.

"If it is supposed to get high paid but the workers received low payment, the worker has to complain to the legal authority body." (P2)

Community Relation

This refers to the organization's planned activities to ensure that both the organization and community get benefit from continuing community participants in enhancing sustainable environment. Such community relation is established by organizing events and activities to promote environmental campaigns and hands-on workshops.

"It is retailer roles to promote and market on environmental conservation campaign and spreading the concept of sustainability." (P1)

"Through fashion revolution. We organized events to create awareness, but it is still at urban level... To consumer level is education. Now like I am always transparent who are the makers. Transparency from the maker, the fabric we use and dye we use." (P3)

"They can come back if their bag got ripped, we will fix it… The aim is for them to use as long as they can. Do not throw it… For customer, we sometimes do workshop. For example, they can bring their old clothes and turn them into a pouch." (P4)

"We are also constantly doing talks. Monthly, we are doing events. We are looking to kind of further go beyond just selling but I think later on we would want to come up more experiences for our customers to go behind the scenes and actually experience the lifestyle of the makers." (P5)

Thus, sustainable fashion businesses in Malaysia have been actively promoting the concept of sustainability to the public. They want to change consumer's perception on fast fashion and cultivate the culture of valuing clothes and the makers.

Enhancing Sales

One way to increase the demand and attention about sustainable business and its products is through marketing initiatives. Such initiatives support sustainable brands by opening marketing space via omnichannel merely for sustainable brands to promote their products.

"We saw that missing in the market is a viable and commercial space for a new and upcoming sustainable brand who are already exhausting a lot of their cost into production and research development. So, when it comes to the commercial side where we need to market and get it out into the market, we saw a huge gap in that and hence, we create a conscious select store where we carefully curate conscious brands from around the world that provide everyday needs but they are also very design based. So, we decided to park ourselves here as it was, we need more spaces to focus on this. Even if you can see, all of the brands that are brought into this space they are curated based on matrix where each of them falls at least under 2 of our matrices." (P5)

The market for sustainable brands in Malaysia is still relatively small and struggle to promote their products. Thus, avenues such as commercial platforms for marketing and promoting sustainable brands would help to gain more exposure from potential consumers.

Education Support

Sustainability initiatives also include providing education assistance to the workers. Education sustainable practices seek to ensure that managerial talent and workers are properly trained to run the sustainable business.

"*It is one of the SDG, when it is comes to education it is also has to be sustainable. If you want to make it sustainable, they need to have knowledge. If you don't have knowledge, you cannot be sustainable. If you don't know how to use tools, if you don't know how to use VR, how you want to be sustainable? This is a textile lab, you can be sustainable… making products when you know how to stitch. Knowledge is a part of SDG which is also a sustainability element." (P4)*

Education support such as training programs can enhance working experience, develop technical skills among the workers and provide better understanding about sustainable fashion.

4.1.2 Triple Bottom Line and Fashion Supply Chain Practices

In terms of economic dimension, the practitioners pay close attention in enhancing sales of their products through marketing initiatives even though P3, P4 and P5 adopts slow fashion business strategy whereby productions are run in a small quantity and on-demand basis. Such control mechanism is an effective way to avoid inventory waste which otherwise would be costly to run business process and lead to resource wastage. As an ethical lifestyle brand in Malaysia, P5 well aware the struggles of sustainable brand in Malaysia to market their products. Therefore, to enhance the sales and help other brands, P5 launched a "conscious select store" as a platform for other brands to commercial their products.

From the environmental dimension, eco-design products and reverse logistics or waste management are well-known current practices that pointed by these practitioners to reduce the harmful impact to the environment. In eco-design product, P1, P2, P3 and P5 have acknowledged that the raw materials must be eco-friendly. The fabrics are made from natural fibre such as organic cotton, bamboo, banana stems and pineapple skins, together with vegetable dyeing process in production in order. Whereas, the practice of reverse logistics (or waste management) involves reuse, recycle and upcycle activities of unwanted fashion products, eventually avoiding more fashion wastes that ends up in the landfills. P1 and P2 suggested that the waste or remnants that is still in good conditions can be cut and turn into a new product. Likewise this practice is carried out by P4 and P5. In particular, P4 uses recycled fabrics from various products such as banner, seatbelt, etc. and transformed them into fashion products whilst P5 uses scraps from their collections to create new outwear design.

On another note, lean production and green purchasing were also mentioned by the practitioners. Their production facilities are certified and places high responsibility in managing resources to avoid waste and negative impacts to the environment, such as the use of energy, water and fabrics. Besides that selection of certified suppliers that are compliant with environmental standards are too being practiced by P3 and P5. These practices are highly encouraged for moving towards zero-waste approach as all fabrics are utilised in production phase. As a matter of fact P1 has mentioned that the production line must figure out how to minimize operational resources especially in the cutting process.

And finally the social dimension includes various initiatives particularly in work safety, employee well-being and community relations. P3, P4 and P5 are dedicated in providing safe working conditions and equivalent pay to their workers, especially P4 who is a pioneer member of World Fair Trade Organisation (WFTO) from Malaysia. All practitioners actively provide education to members of community via talks, campaigns, workshops and competitions, to

improve awareness about sustainable fashion. P2 emphasises the need for workers to report to relevant authority if they were under-paid. Table 2 illustrates sustainable practices presently exist in fashion industry supply chain.

Table 2: SSCM Practices in Fashion Industry Supply Chain

Dimension	Sustainable Practice	Supply Chain Activity					
		Raw Materials	Production	Distribution	Retail	Consumer	After-use
Economic	Analysing ROI and profit margin	x	x	x	x		
	Enhancing Sales				x		
Environment	Eco-design of products	x	x		x		x
	Clean/Lean Production	x	x				
	Green purchasing	x	x		x		
	Reverse Logistic/Waste Management		x		x	x	x
Social	Community Relations				x	x	
	Employee well-being	x	x	x	x	x	x
	Work safety	x	x	x	x	x	x
	Education support	x	x	x	x	x	x

The interview findings revealed several economic dimension practices that are sustainable such that of the upstream supply chain manages activities to avoid waste that otherwise could incur cost and possible risks to business finances and resources. Besides that, retailers play a major role to increase demand by injecting knowledge and awareness about sustainable business through marketing initiatives so as to enhance and sustain sales. Whilst for environmental dimension, eco-design product involves practices of utilizing raw material from natural fibre, and reuse fabric waste to create a new eco-design product. Furthermore, manufacturing approach like clean and lean productions are widely known processes for optimization of resources and energy use. It is important for the production and manufacturing team to place high responsibility in handling waste issues such as energy, water and fabric remnants. Fashion industry should purchase raw materials or other resources from suppliers that are compliant with environmental standards. Another sustainable practice essential in after-use process is the reverse logistics that basically move products from consumer or aftermarket back to production stage for the purpose of recapturing value or proper disposals.

And finally, the social dimension practices are seen present at every level of fashion supply chain. A good business is not only measured on the basis of profit but also to make sure that the workplace is safe and healthy, workers feel comfortable and that the organisations do not tolerate unsafe conditions. Besides work safety, another ethical aspect in sustainable practice is about the commitment to the employee in improving their satisfaction such as fair payment. Moreover education assistance on fashion sustainability to workers ensures that managerial talent and workers are properly trained to run sustainable business. Sustainable fashion practice also describes the interaction between the organization and community, as mutual benefit through engagement in planned activities.

4.2. Information Technology Use in SSCM Practices in Fashion Industry

The current state of IT use as according to the practitioners vastly attributed in increasing awareness among consumers. Thus, current challenge in sustainable fashion is addressing the lack of consumers' awareness towards environmental and social issues. IT is an expensive investment, if current demand on sustainable product is low and businesses does not meet their break even, eventually leads to major pitfall for the organisation. Thus,

"Can plan from the marketing side, so how IT can improve… more on awareness, if there is awareness, we can create demand, when there is demand, we can make bigger production and grow." (P3)

"IT can promote awareness through media, education or campaign." (P1)

However, P3 and P4 claims that they are on the path of using communication technology such as social media platform;

"Currently we use social media platforms to create the market and sales, because everything is still start-up…." (P3)

"Follow us on Facebook, Instagram… we usually posted there." (P4)

This is supported by statements from practitioners with regard to IT use for brand awareness via social media and company website;

"In my opinion, the most important sustainable practice is awareness .... and now, the brand has website and social media, so that information will be available to consumers more quickly." (P2)

"*The usual marketing today is like… they are using social media channels, via the internet." (P1)*

The market for sustainable brand or products in Malaysia is still relatively small. Sustainable brand in Malaysia is still struggling to promote their products. According to P5;
"So, what is the point of creating apps for styling if the users are not going to use it. And currently, just talking about e-commerce phase, Malaysia's market, in terms of lifestyle products, they are not there yet. They are still purchasing online where they are only looking for deals." (P5)

Social media is mentioned as one of the best way to deliver message and information. Most respondents are already engaged with IT platform such as social media as an effort to connect with consumers in the aim to increase awareness about sustainable fashion and market their products. Thus, IT demonstrates the *informate* and *infrastructure* roles by conveying information to consumers about the importance to choose sustainable fashion and educate them that buying sustainable fashion is an eco-conscious lifestyle and value-added to the products.

Besides examining the current state of IT use, we investigated on future IT roles from practitioners' perspective. Table 3 denotes our findings on the "as-is" state and future roadmap for the sustainable fashion industry and proliferation of IT role for each strategy direction.

Table 3: IT roles and Sustainable Practices: Current and Future State

Strategy	Strategy Themes	Dimensions: Sustainable Practices	Automate	Transform	Infra-structure	Informate
Current State "As-is"	Promotes sustainable fashion and creates demand	Economic: Enhancing sales			x	x
		Social Community relation			x	x
	Enables product innovation	Environmental: Eco-design of products	x		x	x
		Reverse logistics (Waste management)	x		x	x
	Enable process innovation (Enhance efficiency)	Economic: Quality initiatives			x	x
		Environmental: Clean and lean production	x	x	x	x
Future State "To-be"		Social: Employee well-being	x		x	x
	Foster dissemination of information and knowledge	Economic: ROI and profit margin			x	x
		Enhancing sales			x	x
		Environmental: Reverse logistics (Waste management)			x	x
		Social:			x	x
		Community relations			x	x
		Product safety Education support			x	x

"To-be" Perspective: Enabling Product Innovation

Eco-design products are a proclaimed practice in SSCM as they are designed and manufactured to minimize the environmental impact of the entire supply chain. Thus, the use of IT could facilitate towards the creation of new products in attempt to achieve sustainable development through improved quality and product functionality whilst reducing operational cost.

"IT can figure out how the waste materials can be recycled or turn into other products… IT can create a new designer concept to create the product. " (P1)

"IT like machines or systems can innovate waste to something interesting... We can manipulate the material that we have by using the machine to produce a sustainable product." (P2)

IT enables product innovation under two sustainable practices; eco-design of products and reverse logistics where IT can support by providing infrastructure such as machines and technological devices, facilitating information across the supply chain and transform business processes to minimize the negative environmental impacts.

"To-be" Perspective: Enabling Process Innovation

Most practitioners from the interview session agreed that IT can enhance efficiency fashion of SSCM practices by process innovation. IT has significant potential for improving production processes and manage resources efficiently and effectively.

"IT can be applied in the way how the designer could formation the pattern... For example, IT can create a system which pattern use the least amount of fabric?" (P1)

"Let say, we have certain amount of fabrics… IT can suggest how to optimize the fabric without any leftover or waste." (P2)

"We have 3D machine (Research and Development), if we have that kind of machine for fashion, it can just cut based on the pattern and exactly no waste." (P4)

Besides, IT could also assist as a guide in natural dye process;

"IT can help to natural dye… There's a system that control the fruit colour… For example, what fruits are suitable? how much amount fruit needed for dark colour." (P1)

Furthermore, IT can enable process innovation to the whole supply chain by measuring the environmental impact i.e. measuring carbon footprint when sustainable processes is adopted.

"I think it is in the end, we want to be able to see which processes is considered sustainable in which we try to measure in terms of its output, its positive outputs and reduction of negative outputs as well as positive and negative inputs into the processes.. If they can help to measure reduction of waste and what can be done, it will be good but again it will be going to measuring impact." (P5)

Consistently, there has been emphasis on the use of automation to ease the laborious work especially in printing.

"The current batik making process is hard labour, using hand block… I am actually going to be collaborating with engineer who has worked with the car brand to semi-manual the production line. " (P3)

One strategy to enhance efficiency is by integrate IT in the business processes. Findings clearly acknowledges the impact of Industry 4.0 on sustainable practices. Technologies such as big data, Internet-of-Things, machine learning, 3D printing and cloud computing capabilities could be optimised for lean and additive manufacturing.

"To-be" Perspective: Foster Dissemination of Information and Knowledge

IT could also provide a vital support for both organisation and consumers to get information directly from the original provider without intermediaries. IT which includes hardware, software, network and communication enables players of supply chain to share data and information collaboratively.

"It is still lacking the players mainly the supply chain, one thing you can do is map the supply chain. It so small, it so hard to find people. IT can help in mapping all the players and display in one place." (P3)

Alternatively, website platforms could inform consumers on "where" and "how-to" dispose thier unwanted clothes.

"If you have a website, they know where to send the unwanted cloth. Some people want to send clothes but do not know where to send them." (P3)

"... people use IT to actually record what they have…, they can list it (waste products) in their website..." (P4)

"IT can go with a platform… Even the factory itself, if they have unwanted or left-over fabric. It's more on the supplier level… IT can help, like Carousel…" (P4)

"There are people, they have many unwanted clothes, but they do not how to handle it. So, there's a need of a mechanism to provide information to these people" (P1)

Apart from handling unwanted fashion products, the need and demand for timely and accurate information pertaining to sustainable fashion is deemed important.

"Consumers want to receive information quickly, let's say they want to buy a shirt and look at the label ... at that time they need to make the decision ... They might use QR code to find information about the shirt." (P2)

"But if you can have a scanning platform like a QR code ... If there's scanning, we're at least legit. The trust is there when consumers buy ... This is an added value. " (P3)
" .... having QR code where consumers can zoom and read the details." (P5)

"There is ton of apps, online space, e-commerce platforms. So, I think the standard support on the marketing aspect is good as well. We still need all that support still for the sustainable space." (P5)

4.3. Discussion

The findings from this study indicate that SSCM practices in Malaysian fashion industry are still at the infancy stage. Several local brands and academic circles are challenged towards trying to create the demand for sustainable fashion by educating consumers on buying fashion products that are sustainable, and on the other hand sustaining ethically-abiding supply chain activities across suppliers and buyers (upstream and downstream channels). Demand for SSCM practices can be created when there's market pressure via globalisation and establishing collaborative value network among suppliers and buyers. Such strategies are consistent with findings from Prasad et al. (2020) on critical success factors for SSCM practices. This study too confirms that environment (eco-design, reverse logistics) and social (work safety) sustainability practices have been the focus and important for the fashion SSCM. This finding is consistent with the other studies where previously traditional SCM practice was aimed at profitability consideration but in

recent years, environmental and social factors have entered the public consciousness under the concept of SSCM (Kurnia et al., 2014; Oelze, 2017; Seuring & Muller, 2008).

Drawing on the study findings, the economic dimension currently follows two sustainable practices as fashion business is based on slow fashion and not mass-produced. Thus these home-grown retailers are challenged to promote their product as they are small producer and the brands are new in market. As for the environmental dimension, four sustainable practices were identified; eco-design, clean and lean production, green purchasing and reverse logistics. Reverse logistics or waste management via recycling activities are commonly practiced in Malaysian fashion environment. Fashion designers are urged to move towards zero-waste fashion design approach. In relation with social dimension, four sustainable practices that include work safety, employee well-being, community relation and education support were identified. The workplace must be safe and healthy, besides to make sure the workers get equivalent pay. In addition, there is a need for education support so that workers trained to run sustainable business. Additionally, community relation practice broadens consumer awareness about sustainable fashion.

This study also indicates possible solutions of using IT roles to support the fashion industry in addressing sustainable practices. The awareness on sustainable fashion among the fashion organization and consumers are relatively low. Thus, IT plays a major role to increase awareness via social media platform to deliver message to promote and create demand. As such roles like informate and infrastructure supports communication within the sustainable fashion brands and consumers. Presently, the production phase in fashion supply chain, the activities and processes are still manual. Practitioners have not decided to move forward with advance technology in this area soon because consumers demand on sustainable brand/product is yet too low. However, Dao's et al. (2011) four roles of IT (automate, transform, infrastructure and informate) could support the future direction of IT strategy for product innovation and improving process efficiency in SSCM for fashion industry.

Each of the four roles of IT plays significant role in enabling companies to create opportunities for sustainability development as concurred by Luthra et al. (2020) and Rivera and Kurnia (2015). This study indicates that informate and infrastructure likely to foster dissemination of information and knowledge so as to cultivate the sustainability culture, and enhance learning for workers as means for education support. As mentioned by Shen (2014) that internet is useful for promoting eco-fashion brands, likewise, fashion retailers in this study use social media platform to promote awareness sentiment on valuing fashion in terms of environment aspects and social ethics. Rapid growth on demand for sustainable fashion eventually will push the fashion supply chain to use IT for automation (automate) and re-engineering (transform) business processes with the intention to improve business efficiency and/or product innovation. In the mean time, without demand from consumer, sustainable fashion businesses in Malaysia are not ready to move to advance technology, particularly in production area.

5. CONCLUSION

Sustainable practices in fashion supply chain management in Malaysia is challenged by multiple factors namely, manual operations, lack of certified suppliers and distributors, and lack of

demand due to low awareness level among consumers. IT could play a part as informate role in the dissemination of information and knowledge in promoting sustainable fashion to the public. Therefore, collaboration among product manufacturer, supplier, distributors (value network) and, encouraging consumer behaviour towards sustainable products are among the mechanisms that can support SSCM practices and further enhanced through IT assimilation. Furthermore, any sustainability initiative at a country level requires government support; hence policy makers could assist industry players in facilitating collaboration within the value system of the supply chain. This would allow for a more accessibility for consumers to see more sustainable fashion products. In exchange, this will encourage the recognition of relevant IT roles that needed across the supply chain for better SSCM practices.

This study contributes to the information and communication technology literature by providing evidence of how IT can be adopted and use to support sustainable practices and enhance the current understanding and awareness of fashion sustainability area for both academics and practitioners. However, this study has some limitations; the number retailers used in sampling were small quantity and represent home-grown/local businesses. We had difficulty identifying sustainable fashion brands and getting them to participate to this study.

It is highly recommended that future studies to explore competitive advantage from the use of IT in fashion supply chain. In-depth exploration will be required on the extent of and how IT capabilities could support sustainable supply chain practices in Malaysia. Additionally, it is worth investigating the downstream fashion supply chain to examine consumer behavioural factors towards sustainable fashion and fashion-waste management using cross-sectional survey method.

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