

Utilization of Digital Technology in Managing Fabric Waste into Garments

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Abstract. The textile industry is a significant contributor to foreign exchange. This can be seen from the contribution of this industry which is 10.52% of total exports national (Ministry of Industry, 2019). As much as 2% of total waste in Indonesia comes from cloth. The fabric waste can be processed into products of economic value. Various kinds of fabric waste products, including bags, blankets, sandals, table mats, and doormats, can compete with products from major industries. The study wants to address fabric waste as a commercialized garment. This research aims to support the 2020 Waste Free Indonesia program, especially fabric waste, in this case used clothes, by building waste management applications from a small scale to a national scale. The research was conducted by interviews, focus group discussions, and field observations of related parties, both in the central, regional, and civil society governments and industries related to the issue of waste in Indonesia. Field studies carried out in the locations of the waste level, which is the highest compared to other big cities on the island of Java. The results show mobile application for fabric waste management. The study results are expected to be a medium for the community and waste management parties, both government and private, to manage waste in the surrounding environment. Thus, this research is an innovation that provides solutions to reduce fabric waste and increase the profit of fabric waste managers.

Keywords: Waste of fabrics, green consumer, non-woven, digital content, mobile application.

1 Introduction

The textile and textile product industry is one of the mainstay sectors for Indonesia because this industry makes a large contribution to the national economy. The textile industry is a significant contributor to foreign exchange. This can be seen from the contribution of this industry which is 10.52% of the total national exports. According to Indonesian Ministry of Industry, the textile and clothing industry achieved the highest growth during 2019 at 18.98 percent [1].

Based on the Roadmap for Making Indonesia 4.0, the textile industry is one of five manufacturing sectors with priority development in preparation for the industrial era 4.0. The big aspiration that Indonesia will realize is to make textile and apparel producers from the national scope into the top five in the world by 2030. Currently, the domestic industry needs support for raw material supply, investment, and development of market access.

In the textile industry, the garment manufacturing sector has a major concern with fabric waste. This problem requires a solution to overcome the obstacles faced by the textile industry. The main goal that will be achieved in the future is that every factory in Indonesia can reach a stage where the disposal of fabric waste is below one percent. According to Law Number 18 of 2008 concerning Waste Management, waste has become a national problem. The Indonesian government has also created a road map for a Clean Trash Indonesia 2025. Thus, waste needs to be managed comprehensively and integrated from upstream to downstream.

Waste management also needs to be supported by adequate facilities and infrastructure [2]. Waste that still has value should be treated and must be used as raw material or other valuable materials. Processing waste and using waste as secondary raw materials in the production process saves raw materials, energy and can reduce environmental pollution [3].

From the background above, the problem formulations to be examined are: (a) what is the community's need for proper fabric waste management? (b) how is an appropriate information system for fabric waste management able to provide economic value for society? (c) how to develop mobile-based applications and garment products from textile materials recycling non-woven for society?

The urgency of this study is developing a mobile-based application for fabric waste management and supporting the Life Environment of Ministry program "Clean-from-Waste Indonesia 2025".

2 Literature Review

Studies on textile recycling can be categorized as fabric waste divided into two categories, namely pre-consumption and post-consumption waste [4]. Research related to fabric waste management in Indonesia has been conducted into an economical and commercialized product [5], [6].

Various methods of fabric waste reduction conducted by the fashion industry, including Zero-Waste [7]. In addition, various other studies have been conducted related to the management of fabric waste involving consumers [8] as the main subject [9].

A recent study of the textile industry's most recent waste management model has been developed by Rapsikevičienė, Gurauskienė & Jučienė [10]. The focus of the waste management model for the textile industry is oriented towards preventive solutions. Other researchers also continued to study the risks and management of textile waste at a number of multinational companies [11].

The implementation of waste management system has been widely done in various countries in the world. Implementation of the internet of things (IoT) based waste management system in Malaysia improves city management and provides public services through smart city applications [12]. The study developed a "Core Smart City" app called Device Agnostic Solution [12].

Other research has also used IoT in developing intelligent waste management systems in India [13]. The study Lee & Wu [14] showed that the study develops an approach by combining RFID technology and mobile applications for waste management and can raise public awareness about the importance of sorting waste for recycling and minimizing waste. The study proposes

to develop a mobile app to motivate users to record waste disposal frequency and provide incentives for users to reduce waste and sort out recycled materials [14].

The development of cloud computing also offers automation capabilities through "cyberphysical" systems that make new changes in the waste management process [15]. The previous research [15] has developed a solution called "cloud-based smart waste management (Cloud SWAM)". It discussed solutions with special containers for each type of waste (organic, plastic, bottle, and metal) equipped with sensors. It constantly monitors and updates their status to the cloud, where stakeholders connect to receive information relevant to their interests. The system acted not only in waste management but also in the best collection routes, tracing the more economical lines within the metropol. The solution uses information collected by language-related waste management systems that use genetic algorithms that assist in the selection of suitable land for landfill construction [15].

There are 3 types of waste: organic waste, recyclable waste, and industrial waste [15]. Research and implementation of intelligent waste management systems has been conducted in various developing countries, including Malaysia [12], Hongkong [14], Sri Langka [16], and Nigeria [17].

Mobile communication technology includes various types of technologies such as GSM, GPRS, wireless LAN, satellite communication, and other devices, such as smartphones, Global Positioning System (GPS), Bluetooth, and so on [18]. Some system design approaches that can be developed [18] are Dustcard Tracking/Fleet Management, Cellular Tracking System, RFID Tracking System, GPS Tracking System, Route Designing, Communication, Staff Checking, Bin Tracking, and Weight Calculation, Real Time Central/Control Office.

3. Methodology and Data Analysis

In collecting data, researchers conducted interviews, surveys, and Forum Group Discussion (FGD). Interviews were conducted with the management of a well-known textile company in Indonesia. This activity is carried out to gather information about the current process of fabric waste management. The FGD conducted with company managers and collectors as the parties receiving and collecting fabric waste.

The system is equipped with a special software development method for the Software Development Life Cycle (SDLC) in the development process. It is modified with the Agile (Scrum) model. The states in SDLC are shown on Fig. 1.

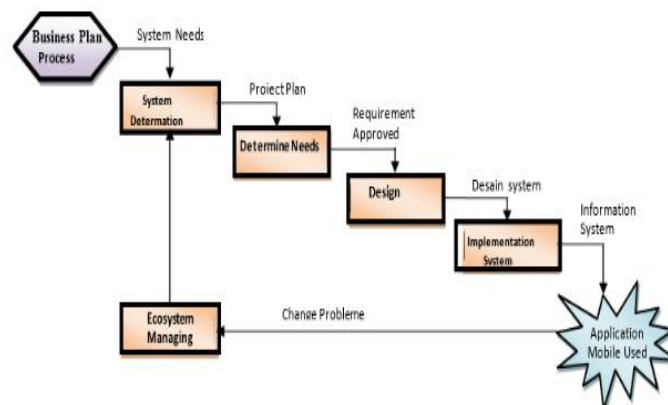


Fig. 1. Software Development Life Cycle [19]

The development research method design used follows the stages and paths adopted from the Scrum Development Model adopted from Kroenke and Boyle (2017) shown in Fig. 2.

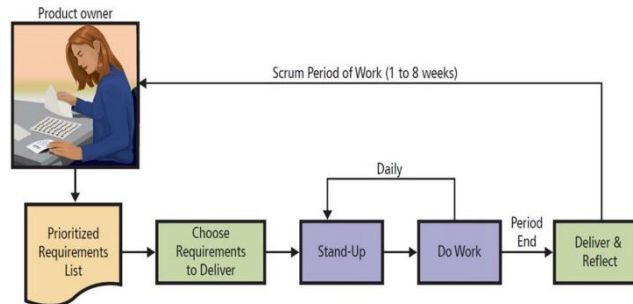


Fig. 2. SCRUM Development [19]

The questionnaire was designed to explore the perceptions of consumers and fabric collectors as well as research partners, the textile company. The data that analyzed is regarding to design the model for managing fabric waste into green products or garment products that are economically valuable on a mobile basis. The observations and surveys conducted on the waste collectors and consumers who use a mobile-based digital content marketing system application after the initial implementation stage.

The final output targeted in this study is to produce a smart mobile-based application in the fabric waste management system. The target to be achieved in this research is a green product in the form of a garment product made from recycled non-woven textiles and digital content in the form of digital marketing content in the form of marketing applications for online shopping activities, online marketing, and education to the public online about green products. The implementation of this research activity will focus on the Greater Jakarta and Bandung areas, where the level of consumption of clothing products is quite high in these regions.

This research is expected to contribute to the field of environmental management science and the concept of appropriate fabric waste management based on technology. Thus, this research is a new innovation that reduces fabric waste and increases profit for clothing manufacturers.

4. Research Result and Discussion

This research is a prototype experimental research that focuses on designing, creating, and testing mobile-based digital media content marketing at the textile company. The application to be developed contained information on managing waste into green products, which the knowledge center will use for the general public. The application is a mobile-based digital content marketing system that will be used by the textile company, fabric collectors, and consumers who are part of the fabric waste management ecosystem.

The research and development of this system is carried out at a modest spinning factory on the outskirts located in Indonesia, West Java. The company is expanding its business scope to become premium non-woven products. The textile industry, which has grown rapidly for decades, has left textile waste piles in local landfills and landfills. In addition, this study also collaborates with some fabric waste collectors in West Java.

The products produced in this study are green products in the form of garment products ready to be commercialized from non-woven recycled textile materials. The following production process of the green product can be seen in Fig. 3.

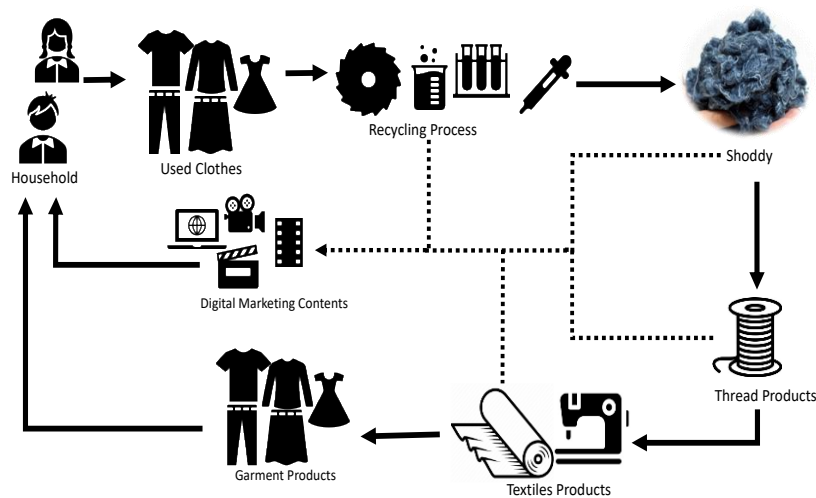


Fig. 3. Production Business Process

Household is a community that donates wearable clothing to fabric garbage collectors. Where this wearable clothing will be recycled into new clothes with the concept of green products ready to be commercialized again so that people can buy new clothes. Garment company is a company that has experience producing textile materials from non-woven materials. The production process of the green product will be conducted in a garment factory in collaboration with experts and researchers in clinical trials of the product's feasibility and commercialization test.

The final product of this production process and garment products ready to be commercialized will be produced digital content in the form of digital marketing content in the form of marketing applications for online shopping activities, online marketing, and education to the public online this green product.

This recycled garment product has consumers with segmentation as follows:

Geographic: Consumer segmentation of non-woven garment products is based on geography can reach industrial areas outside the area that garment companies have not reached so far and consumer types other than the garment industry and household consumers.

Demographics: Segmentation of consumers by demographic is consumers with upper middle income where a portion of the income is used to buy fashion products.

Psychographic and Consumer Purchasing Behaviour: Consumer segmentation based on psychographics and purchasing behaviour is a consumer of society who has a lifestyle in selecting fashion products and fashion product purchasing behaviour is greater than the need so that there is an increase in waste of unused clothing.

Consumers do not yet have awareness about the concept of green consumerism behaviour where this is a behaviour that applies the concept of environmentally friendly in consumer

consumption activities [20]. So that by using digital media developed, consumers can more easily get information to behave green consumerism.

The selection of target consumers for a company aims to choose 1 (one) or more consumer segmentation characteristics that the company can serve according to the company's resources [21]. The consumers' segmentation of non-woven garment products is geographically based are consumers in the greater Jakarta and Bandung area, which does not yet have green consumerism behavior in purchasing fashion products to become the target of consumer education and the target of selling the company's green product.

The consumers of these products are the buyers of recycled non-woven products consisting of household consumers and business consumers. Business consumers who are small and medium enterprises and household consumers buy non-woven products. The target consumer of the product is shown in Fig. 4.

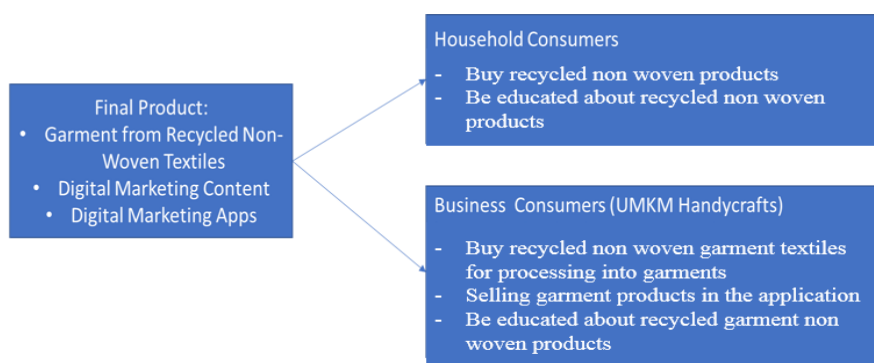


Fig. 4. Consumer of the Product

5. Implication and Suggestion for Future Research

A study of the business-to-business phenomenon conducted by Holliman & Rowley (2014) reflects the role of digital content in marketing [22]. As part of disseminating waste management information, the technology that can be used is to create a digital content marketing system. This activity can help the industry to market products produced from fabric waste. In addition, this digital content is considered to increase consumer brand awareness of garment products that are economical and environmentally friendly.

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