

INCORPORATION OF CIRCULAR ECONOMY CONCEPT TO THE APPAREL INDUSTRY: LITERATURE REVIEW

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Abstract

The apparel industry is one of the most foreign exchange earning industries for developing countries. However, it is one of the notable polluting industries in the world too. Additionally, there are numerous factors affecting the economy of the industry, for example COVID 19, and the industry needs to reinvent from those issues by forcing itself to live. Thus, Circular Economy (CE) can act as a potential solution to address the issues related to both environmental and economic factors of the apparel industry. CE is a business strategy to gain economic benefit, minimise environmental impacts and increase the efficiency of resource consumption. CE concept has been practised in various countries such as China, Bangladesh, Europe, Australia and Germany. However, it is still a novel concept in Sri Lanka even though Sri Lankan apparel industry has a solid reputation globally for their high-quality, reliability, lead time, and social accountability. Introducing the CE concept into Sri Lankan apparel industry will help to overcome the financial issues in a sustainable way. With the intention of introducing CE concept to Sri Lankan apparel industry, this paper intends to review the application of CE in global context and in the context of apparel industry, their benefits and challenges in order to further investigate the suitability of CE concept to SL apparel industry. This paper is therefore based on a comprehensive literature review. Hence, it highlights the literature findings on the applicability of CE in apparel industry, its benefits and challenges when adopting CE into apparel industry. This basic finding will aid to assess the possibility of incorporating CE concept within the Sri Lankan apparel industry. The key findings of the research, environmental gain, economic benefit, resource optimisation and collaboration among stakeholders are the key benefits of CE. The main challenges are expensive, advanced technology, measuring the benefits especially financially, lack of support, knowledge, awareness, commitment and leadership, systematic regulation, social and cultural acceptance.

Keywords: *Circular Economy, Apparel Industry, Challenges, Benefits*

1. Introduction

The ability to produce apparel at extremely low cost has allowed the apparel industry to grow into a trillion-dollar industry, now one of the largest globally (Allwood, et al., 2006). It has experienced extensive growth and success over the last two decades and also the most significant and dynamic contributor to the national economy of developing countries (EDB, 2020). This has led to an intense scrutiny over economic, environmental, and social impacts within the industry. The apparel industry has specific negative impacts on the environment through all stages of the apparel product life cycle, from fiber growth and manufacturing, dyeing and printing, transportation to stores and selling, to end of the garment life disposal (Allwood, et al., 2006; Shaw, et al., 2006; Gam & Banning, 2011; Fulton & Lee, 2010). The Earth cannot indefinitely support the current level of production and disposal of apparel due to depletion of natural resources and quickly filling landfills (Claudio, 2007; Walker, 2008; Winge, 2008). Along with that, the attention in sustainable and eco-friendly products has started to increase globally (Muthukumarana, et al., 2017).

CE is a fresh economic model in contrast to the linear economic model, adapted by China at first. CE initiatives happen in global level (Ghisellini et al., 2016). The ultimate aim of CE is to achieve the decoupling of economic growth from natural resource depletion and environmental degradation (Liu, 2009; Xue et al. 2010), to keep the maximum level utility and value of the products and materials, through design, maintenance, repair, reuse, remanufacturing, and recycling and decreasing waste (Merli, et al., 2018). CE is a regenerative structure in such a way that resource input waste, emission, and energy use are minimised by closed loops of material and energy (Geissdoerfer, et al., 2017). The conversion of CE from a linear economy requires organisations to redesign their supply chain. Thus, CE is effective to promote to the green supply chain from the traditional chain (Zhu, et al., 2010). Also, in CE, a need to propose a business strategy raised to gain economic benefit, minimise environmental impacts and increase the efficiency of resource consumption (Zhu & Sarkis, 2006; Lai, et al., 2011). It is CE that further strengthens the consciousness of resource conservation and environmental protection (Ying & Li-Jun, 2012). Moreover, CE highlights protecting the environment and conserving the resource, thus, it is important to go beyond green manufacturing to GSCM.

Meanwhile, the apparel industries have started to fight for its survival due to COVID-19 (Echelon Media, 2020). For example, in Sri Lanka roughly 1.5 billion American dollar loss is expected in export incomes in the quarter of April-June 2020, while bracing for a 50% drop in demand for the next one to one and a half years (Sukumaran, 2020). Therefore, the industry should be in a position to reinvent by forcing itself to live (Echelon Media, 2020). Thus, CE could be a sustainable way to overcome this phenomenon. Accordingly, this is the best time to introduce the Circular Economy concept into apparel industry to overcome the economic issues in a sustainable way. The next section presents the methodology adopted for this paper followed by introduction, need and application of CE in the context of apparel industry. Further it discusses the benefits and challenges of adopting CE concept within apparel industry. The conclusions and way forward are finally presented.

2. Research method

This research paper was developed based on a comprehensive literature review and synthesis on the CE concept, its significance and the reported evidences on the incorporation of CE within apparel industry. It further reviewed the benefits and challenges associated with the adoption of CE concept. Conducting literature review is facilitating to initiate the research process when carrying out a research work. In a research, literature synthesis is a significant portion and according to Wilding, et al., (2012), a literature review is a systematic, explicit, and reproducible design for identifying, evaluating and interpreting the existing body of recorded documents” and further literature review is defined as primarily qualitative synthesis of results (Fink, 2005). Hence this paper adopts the literature review as the main methodology to present the research findings.

The literature search operation was facilitated by using a combination of keywords such as ‘Circular Economy’, ‘Circular economy & Apparel industry’, “Circular economy” & “Textile industry”, and ‘Benefits and challenges of CE’. The key journal articles published within last 10 years were mainly searched using main databases such as Google scholar, Emerald, Science Direct, Springer, etc. A total of 69 articles was selected after the first round of filtration, which involved scanning article titles for relevancy. The second round filtration was done to further refine the set of articles by reading the abstracts and conclusions, which resulted in 57 papers. While reviewing the full papers, 5 of the papers were found as not appropriate. Hence, 52 papers were finally identified to develop this literature review based paper.

3. Literature Synthesis

This section discusses the key literature findings of the study in four sub sections such as introduction to CE, need for CE in apparel industry, application of CE in apparel industry and benefits and challenges of adopting CE.

3.1. INTRODUCTION TO CIRCULAR ECONOMY

CE has both linguistic and descriptive meaning. The linguistic meaning of CE is an antonym of a linear economy (Murray, et al., 2017). Linear economy is a straight-line process; ‘take-make-dispose’ approach (open loop) with energy flow model whereas the CE is a cyclical approach (closed loop) with alternative flow model where wastes become resources (Gregson, et al., 2015; Braungart & McDonough, 2002). Even though, Linear economy is expected to have unlimited resources and energy for usage and also bulk environment to absorb the discharged waste and pollution, CE is idealised for reduction in the amount of energy and raw material usage with less waste generation (Cooper, 1999). Primarily, linear economy is an unsustainable economic system and it has dominated the overall development causing serious environmental harm, but on the other hand, CE is a sustainable economic system (Ellen Macarthur Foundation, 2014). Moreover, CE is based on natural laws which following natural cycle (Twigger, 2016), and four principles such as natural resource preservation, resource optimisation, risk reduction and renewable flow of resources and products (Gullingsrud & Perkkins, 2015). Figure 1 visualizes the linear and circular supply chain.

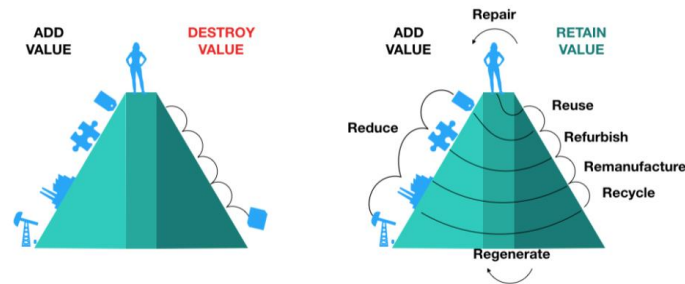


Figure 1: Visualization of linear and circular supply chain.
Source: (Achterberg, et al., 2016)

The descriptive meaning of CE is related to the theory of the cycle, which contains two cycles, biogeochemical cycles and the idea of products recycling (Murray, et al., 2017). CE concept is basically balancing the development of economy with protection of environment and resource (UNEP, 2006). Further, Ellen MacArthur Foundation (2017) defined “A CE aims to redefine growth, focusing on positive society-wide benefits, it gradually decoupling economic activity from the consumption of finite resources, and designing waste out of the system (Rattalino, 2017). Likewise, there are a number of definitions and multiple principles of CE exist in the literature (Prieto-Sandoval, et al., 2017; Pompon & Moncaster, 2016). The following four components are recognised as essential to establish the CE concept through a research analysing more number of CE definitions which are 1) the recirculation of resources and energy, the minimisation of resources demand, and the recovery of value from waste, 2) a multi-level approach, 3) its importance as a path to achieve sustainable development, and 4) its close relationship with the way society innovates (Prieto-Sandoval, et al., 2017).

Moreover, a conceptualised definition for CE was derived from Kirchherr, et al. (2017) who have defined CE, after analysing 114 definitions, as an economic system that replaced the ‘end-of-life’ model through reduction, alternative reuse, recycling and recovering materials in production, distribution and consumption processes. Moreover, authors stated that the aim of the CE concept is to achieve sustainable development which simultaneously generates viable natural environmental, economic prosperity and nurturing community (Wu, 2005; Shen, 2007). Further, it is an industrial system concentrated on closing the loop for material and energy flows and contributing to long lasting sustainability (Genovesea, et al., 2017). Additionally, CE integrates strategies and policies for optimise energy efficient, materials, and water consumption, whereas waste discharging to the environment is minimal (Geng, et al., 2013). Furthermore, the closed loop economy and design to redesign thinking are the two concepts that are the causes for the uniqueness of CE and also it contains low energy consumption, less pollutants emission and high efficiency (Murray, et al., 2017). To conclude, CE highlights the repair, reuse, refurbishment, remanufacturing, cascading and upgrading of materials, products and components, in addition renewable and waste-derived energy consumption all through the value chain of the product and cradle-to-cradle life cycle (Mihelcic, et al., 2003; Braungart, et al., 2007).

3.2 NEED FOR CIRCULAR ECONOMY IN APPAREL INDUSTRY

The apparel industry is having a resource-intensive supply chain which pollutes water, soil and air; as a result it is one of the notable polluting industries in the world (Leonas, 2017). Considerable amount of CO₂ is emitted during the production of petrochemicals, from which more than 60% of textile fibres are derived and balance are ruled by cotton which lead to toxic pollution, by rigorous pesticides usages (Sandin & Peters, 2018). Most elements of apparel supply chain have negative impacts on the environment as samples dyeing, finishing, printing are emitting toxic substances, and spinning weaving, knitting are relying on fossil energy (Roos, et al., 2015). In addition, greenhouse gas emissions, usage of water, discharge of toxic substances and huge waste generation are the leading environmental issues for the apparel industry (Allwood, et al., 2006). Thus, to overcome the

mentioned challenges, the need for CE concept is raised. The implementation of CE could reduce the virgin fibre production and which lead to avoid engineering processes further downstream in the textile product life cycle, and thus reduce environmental impact as well (European Commission (EC), 2008).

Conventional approaches to solve the matters relating to waste, sustainability, and resource depletion have not addressed a complete image to attain sustainability (Martin, 2013). Moreover, to support communities in achieving a sustainable growth, the need for a CE has been widely acknowledged (Ghisellini, et al., 2016). Thus, CE has the potential to solve the gap resulting from natural resource scarcity and global growing population or consumption, especially when the relationship between resource use and waste residuals is considered (Andersen, 2007). Other than the environmental factors, CE can act as a potential answer for economic loss of the apparel industry and it provides economic efficiency to the organisations (Geissdoerfer et al. 2017; Haas et al. 2015; Park et al. 2010) which covers a technique of economic value making. Figure 2 shows an example about how CE effecting on material demand, it would reduce the amount of material consumed to a lower set point.

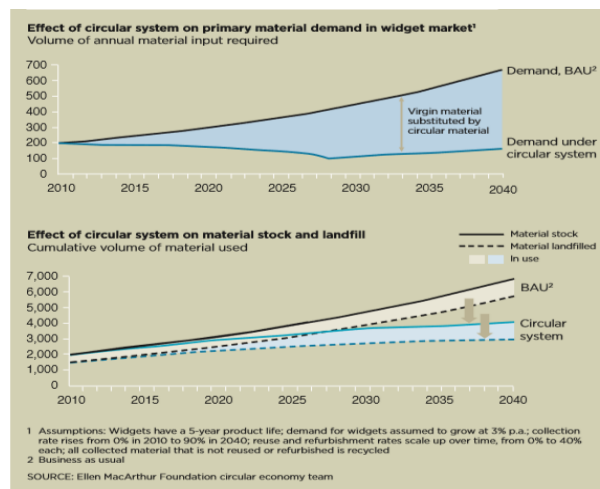


Figure 2: Effects of CE on material demand

The above graph clearly highlights the generous savings result through circular arrangement by showing the variances among the businesses as usual (BAU) and the circular scenarios of both fresh virgin materials required and the build-up of stock.

3.3 APPLICATION OF CIRCULAR ECONOMY IN APPAREL INDUSTRY

Several countries have adopted the CE model to attain environmental and economic sustainability; some of those are China (Korhonen, et al., 2018) Europe (Gregson, et al., 2015), Bangladesh (Moktadir, et al., 2017), Australia (Giurco, et al., 2014), Dutch (Fischer & Pascucci, 2017), Denmark (Tajuddin, 2019), Brazil (Amaral, et al., 2018) and Romania (Staicu & Pop, 2018). CE is applicable for all the industries and among those it is widely used in apparel industry. Certain leading apparel manufacturing organisations in the multinationals viewpoint such as H&M, Inditex and Bestseller have adopted CE models already for the environmental and economic benefits. Likewise, PUMA has established a new track for shoes and clothing named as INCYCLE™, which consists in biodegradable or recyclable products where all certified Cradle-to-Cradle™ (Ellen MacArthur Foundation, 2013). The Figure 3 summarises some of the classification of textile reuse and recycling route. Textile recycling is mostly discussing as the reprocessing of pre or post-consumer waste of textiles which is used either in new textile or non-textile products. Generally, it is classified as mechanical, chemical and thermal; however, it is unclear and debatable. Thus, this summarization was based on the disassembly level of the recovered material.

Fabric recycling used when the fabric is recovered and reused in new products, Fibre recycling is used when the fabric is disassembled, but preserved with original fibres, Polymer/Oligomer recycling is referring as the fibres are disassembled, but preserved with the polymers/oligomers and Monomer recycling is referred as the polymers/oligomers are disassembled, but preserved with the monomers. Additionally, closed loop and open loop recycling were considered here. Closed-loop and open-loop recycling are referring to when the material of a product is recycled and used in an identical product, in another product respectively. Whereas Figure 4 provides an overview of the fibre content of the materials being reused or recycled, and the type of recycling routes is employed. Here, numbers correspond to the number of cases examining reuse, or a specific recycling route, for a certain material.

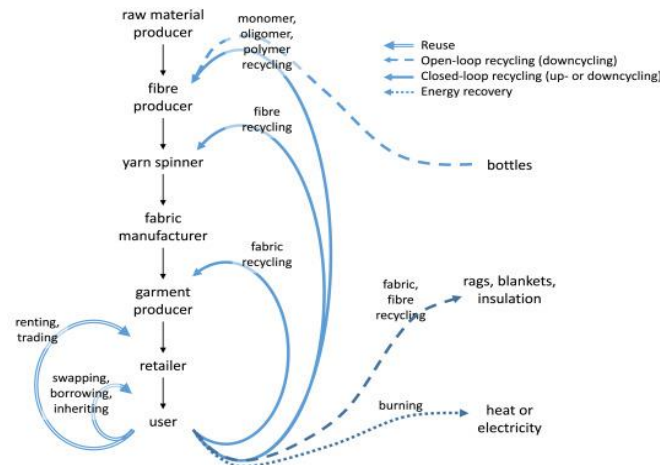


Figure 3: A classification of various forms of reuse and recycling. Source: (Sandin & Peters, 2018)

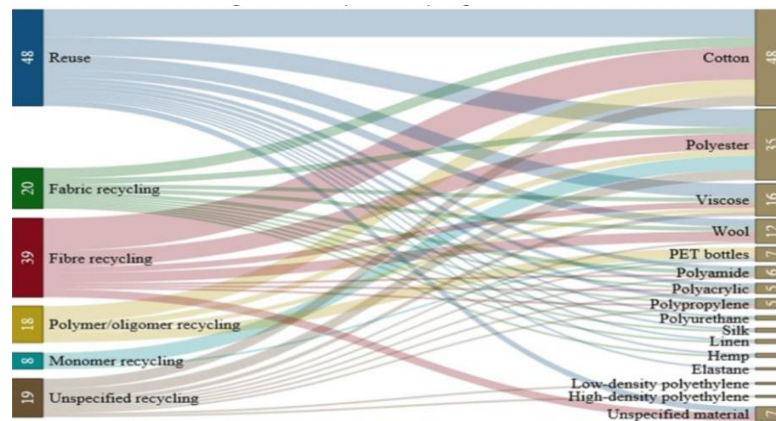


Figure 4: An overview of the fibres content of the materials being reused or recycled, and the type of recycling routes being employed Source: (Sandin & Peters, 2018)

Above figure 4 was developed based on a literature analysis on environmental assessments of textile reuse and recycling using 41 publications. 57%, 37%, 23% and 14% are the percentages of studies carried out on fibre recycling, polymer/oligomer recycling, monomer recycling and fabric recycling. The high prevalence of fibre recycling is probably due to the fact that it is a relatively common recycling route, widely applied in commercial scale both in terms of open loop and textile-to-textile recycling.

3.4 BENEFITS AND CHALLENGES OF ADOPTING CIRCULAR ECONOMY

3.4.1 Benefits of adopting Circular Economy

The adoption of CE provides multiple benefits that are listed in Table 1.

Table 1: Benefits come through adoption of Circular Economy

Code	Benefits	Sources						Count
		1	2	3	4	5	6	
B1	Environmental gain	*	*	*	*	*	*	5
B2	Economic benefit	*	*	*	*			4
B3	Resource optimisation		*	*	*		*	4
B4	Collaboration among stakeholders	*	*					2
B5	Extended producer responsibilities					*		1
B6	Eco friendly labeling					*		1
B7	Respond quickly to market demand					*		1
B8	Promote industrial upgrading					*		1
B9	Improve the energy efficiency					*		1
B10	Sustainability			*				1
B11	Connectivity of material streams – cluster collaborations		*					1
B12	Design for end-of-life		*					1
B13	Enhance job growth				*			1
[1- (Jia, et al., 2020), 2 - (Boiten, et al., 2020), 3-(Gardettia, 2019), 4-(Snoek , 2017), 5-(Lofgren & Enocson, 2014), 6- (Du, et al., 2010)]								

Environmental gain has been identified as the significant benefit come through adopting CE which means mainly the reduction of environmental pollution. Then, economic benefit and resource optimisation have been mentioned in four sources. The cost savings presented by more widespread recovery and reuse. Also, the Resource optimisation comprised of resource productivity, optimise research usage, allow the necessary time and space for natural resource regeneration and avoid natural resource depletion. Moreover, Collaboration among stakeholders includes both collaboration among organisational and environmental collaboration with customer and suppliers. In addition, *Eco friendly labelling*, The European commission (2012) introduced eco labelling. This is a label, which gives promise to the consumer that the product is sustainable and produces little waste. This labelling is not yet common for textiles but is seen as an opportunity for the future to gain legitimacy.

3.4.2 Challenges to adopt circular economy

Adoption of the CE at the organisational level is a challenging job given the linear economy mind-set dominant in most organisations (Ellen MacArthur Foundation, 2013). The speed and scale of the circular transition will depend on knowledge, awareness and engagement of all market participants (Koszewska, 2018). Table 2 presents the challenges of adopting CE.

Table 2: Challenges faced during the adopting circular economy.

Code	Challenges	Sources								Count
		1	2	3	4	5	6	7	8	
C1	Expensive	*	*	*	*	*	*	*	*	6
C2	Advanced Technology	*	*		*	*	*		*	6
C3	Measuring the (financial) benefits	*				*	*			4
C4	Lack of knowledge and awareness	*		*				*		3
C5	Lack of support, commitment and leadership	*			*				*	3
C6	Lack of systematic regulation	*	*				*			3
C7	Lack of social and cultural acceptance		*		*		*			3
C8	Lack of risk taking attitude	*				*				2
C9	Integration between functions					*				1
C10	Missing exchange of information					*				1

C11	Value chain structures					*				1
C12	Low quality materials				*					1
C13	Lack of infrastructure						*			1
C14	Time consuming						*			1
C15	Complexity				*					1
C16	Thermodynamic				*					1
[1- (Jia, et al., 2020), 2-(Boiten, et al., 2020),3-(Gardettia, 2019), 4-(Korhonen, et al., 2018), 5- (Ritzena & Sandstroma, 2017), 6- (Snoek , 2017), 7- (Lofgren & Enocson, 2014), 8- (Geng & Doberstein, 2008)]										

Expensive and *Advanced technology* have been identified as the most noteworthy challenges when adopting CE. The code expensive, Swedish apparel industry as an example, Plam (2011) mentioned that, “there are clear economic barriers in the Swedish apparel market, which hinder the implementation of a CE. That makes it relatively cheaper to produce new garments than recycled or reused old ones, which in turn makes the price of second hand garments not competitive enough compared to new ones”. In case of advanced technology, there is a need for major changes in both the products and the production/take-back systems and they were hesitant about how that would work and what it would cost. Additionally, about the quality issue as well (Geng & Doberstein, 2008). Further, the still largely inadequate technological capability to provide high value recycling of textile fibres was a recurring concern by stakeholders across the case study locations. Next to that, *Measuring the (financial) benefits has been cited in four sources*. There is an uncertainty about how revenues would be generated through CE adoption and about what values an increased sustainability of their deliverables would give. These changes also take time, investments and the logic in the financial system are focused on rapid returns on investments and cost saving, making it difficult to convince owners of a long-term system change.

Even though, only two out of eight have been mentioned the *Lack of risk taking attitude*, it is one of the most prominent barrier, Ritzen and Sandstrom, (2017) stated that “it was the overall large risk aversion and the business logic of taking small safe steps in the development of the organization”. *Lack of knowledge and awareness, there is unfamiliarity* with the CE concept and having a shallow understanding of its meaning, which prohibits an evolutionary change towards CE. *Lack of systematic regulation* is definitely a challenge to have a dramatic change like introduction of CE into organisations. Likewise, The European commission (2012) mentioned that tax incentives, increase tax either on specific waste streams and extended producer responsibility, tax in relation to the final amount of waste that is thrown away must be included into regulation as sustainable opportunities in future. If the producer has to pay for how much that is thrown away in the end, it would make them produce more sustainable and recycled products. Moreover, *Integration between function* is mentioned by only one source, but that is a key challenge to establish CE into organisations as CE is far too complex to be handled by a single department, still it is unclear how the responsibility for CE would be managed within the organisation.

4. Conclusions and way forward

The study evaluated the CE concept and its importance in the apparel industry. CE was well established in China, Bangladesh, Europe, Australia and Germany, though it is a novel concept in Sri Lanka. Based on the literature findings, it has been evident that CE concept has been incorporated successfully within the apparel industry across several countries, providing environmental and economic benefits. However, the paper also presented the key benefits and challenges of adopting CE concept. The main benefits are environmental gain, economic benefit, resource optimisation and collaboration among stakeholders and the main challenges are expensive, advanced technology, measuring the benefits especially financially, lack of support, knowledge, awareness, commitment and leadership, systematic regulation, social and cultural acceptance. Moreover, this paper lays the

platform to carry out the research to analyse the applicability of CE in Sri Lankan apparel industry, which is the way forward of this study.

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