Moving towards circular economy in the fashion industry: a systematic review of New Product Development and Supply Chain Management practices

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Abstract: Today's current focus on mass production and consumption resulted in extreme human influence on natural processes. Circular economy (CE) emerges to be an alternative and promising paradigm, focusing on disruptive innovation, greener industrial capacities and policy interventions. However, inefficiencies in supply management, globally dispersed production networks and high utilization rate of finite resources impede such systemic changes to transform today's linear industrial settings. Personal goods, such as apparel, leather goods and consumer electronics, are pivotal to explore the extent to which environmental as well as social footprint could be mitigated through CE adoption. Putting CE into practice, developing new products while adopting CE principles requires a unique orchestration of supply chain stages. That is, the combination of the New Product Development (NPD) and the Supply Chain Management (SCM) perspective on CE is fundamental for a successful creation of regenerative flows. Focusing on one of the most-polluting and natural resource dependent industries, this study explores the fashion industry by responding to existing knowledge gaps. The paper aims to answer two research questions: i) what practices are adopted to support designers and supply chain actors to develop new products and manage the flows for CE?; ii) what capabilities in the NPD and SCM processes are needed to accelerate this transition?. Adopting a systematic review of peer-reviewed papers on Scopus database, we analyzed 37 publications to investigate the extent to which CE is adopted in the fashion industry. This allows to close the circle between NPD and SCM processes and to provide scientific and practical contributions to inspire linear industrial settings to move towards CE.

Keywords: Circular Economy, Supply chain management, New product development, Sustainability, Fashion industry

1. Introduction

Climate change has become one of the greatest challenges of the 21st century as a consequence of growing human influence on natural processes and fossil fuel based industrial societies. As such, carbon dioxide (CO_2) emissions, as the most significant greenhouse gas affected by the human activity, have increased by 50% since 1990 (United Nations, 2015b). Water, on the other hand, emerges to be another resource that is being vitally jeopardized. That is, by 2030, the available water supply is expected to reach a global shortage by 40% (Carbon Disclosure Project, 2017). That is to say, considering that the world population is estimated to account for 9.6 billion by 2050, three planets will have been needed to sustain our lives that are dependent upon natural resource utilisation (United Nations, 2015a).

Therefore, there is an urgent need to transform traditional industrial settings into regenerative systems to tackle climate change. Circular economy (CE), in this vein, emerges as an alternative economic paradigm focusing on innovative technologies, green industrial capacities and environmental policy interventions. In accordance with the definition by the Ellen MacArthur Foundation (2013), CEs are restorative and regenerative industrial systems by design. The European Commission estimated that CE based transitions could create 600 billion euros annual gains for the European manufacturing sector (Korhonen, Honkasalo and Seppälä, 2018).

Existing economies can be redesigned only when waste generated either at upstream or at downstream levels is adequately reintroduced to the system. That is to say, the supply chain perspective is pivotal for CEs since upstream actors (i.e. manufacturers) as well as downstream actors (i.e. retailers) are fundamental to generate input for these regenerative flows (Masi et al., 2017). Research hitherto conducted has successfully justified that investigating sustainability across product, process and supply chain stages by pursuing a simultaneously three-dimensional approach leads to substantial practical as well as academic implications (Ellram, Tate and Carter, 2007; Caniato *et al.*, 2012; Karaosman et al., 2017). Therefore, it is important to analyse how industries, that are dependent upon natural as well as social resources, could cope with the CE by linking new product development (NPD) with supply chain management (SCM). However, while there are attempts to create competitive advantage through CE, little is known on the types of actions needed to engage design and supply chain teams to develop and produce for CE and on the technical capabilities needed to accelerate this transition.

There is a challenge in terms of intra-organisational and intra-sectoral management of inter-organisational and inter-sectoral physical material flows (Korhonen et al.,

2018) and the adoption of some (supply chain sustainability) practices may be restricted by various contingent and decision variables (Karaosman *et al.*, 2018). It is therefore suggested to explore industry specific situations to better address inter-sectoral material, knowledge and financial flows. In this vein, the global clothing and textile industry emerge as an interesting candidate to investigate the phenomenon for multiple reasons. Firstly, fashion products entail significant levels of carbon, water and waste footprints. Clothing production has more than doubled since 2000; however 40% of the clothes purchased are rarely or never worn (Fashion Revolution, 2017). Existing research shows that on average consumer purchases 60% more items of clothing while keeping them for half in comparison to 15 years ago (Greenpeace, 2016). Yet, the clothing and textiles industry is dependent upon mostly non-renewable resources (Ellen MacArthur Foundation, 2017) and synthetic chemicals (Aiama et al., 2016). Furthermore, the global fashion industry generates 92 million tons of solid waste every year, that accounts for 4% of the global solid waste dumped yearly (Global Fashion Agenda and Boston Consulting Group, 2017). To this end, the majority of the textiles waste actually happens at the supply chain level, for example, in 2016, fashion supply chain waste reached over 800.000 tons (WRAP, 2017).

Hence, while interrogating the status quo, this study aims at uncovering those practices at the intersection of NPD and SCM to address the transition of the industry towards CE while, simultaneously, highlighting drivers, enablers and barriers that have moderating effect on this transition. The rest of the paper is structured as follows. The next section introduces the theoretical background while the methodology adopted throughout the study is showcased in Section 2 followed by the paper's overall findings, reported in the Section 3. Lastly, discussion, conclusion and limitations are delivered in the final section.

1.1 Theoretical background

The increasing relevance of the CE phenomenon is witnessed by a plethora of literature reviews that have been published in recent years, tackling the issue from multiple perspectives. Review works have been developed around the existing definitions of CE (Kirchherr et al., 2017; Masi et al., 2017) as well as on the prevailing business models to translate the CE paradigm into a description of the set of resources and activities that are required to define, create and capture sustainable value (e.g., Ghisellini et al., 2016; Lüdeke-Freund, 2019). As a whole, the prevailing focus on the CE literature identifies as the main unit of analysis a "system" considered at the macro-level (i.e. city, province, region), meso-level (i.e. industrial parks), or micro-level (i.e. the single company) (Kirchherr et al., 2017). Notably, Masi and colleagues (2017) developed a screening on the extant CE literature by deepening the different types of supply chain configurations for CE, thus extending the "meso-level" perspective to include supply chain configurations. Moreover, other reviews have reported on specific circular SCM issues, such as the bullwhip effect (Braz et al., 2018); as well as the challenges connected with the implementation of circular supply chains in specific contexts, such as the developing countries (Mangla et al., 2018). Moreover, the alignment between product design, supply chains and business models is pivotal to ensure the transition towards CE (Lüdeke-Freund, 2019). Deciding the proper product characteristics (e.g. product complexity, product range, speed of change, product customisations, etc.) to fit new supply chains and material flows, appears to be not entirely explored (Bressanelli et al., 2018). Put differently, while for a supply chain that manages linear flows of goods and information, the importance of coupling SCM processes with NPD features to reach higher effectiveness and efficiency is a consolidated concept (Pero et al., 2010), the theoretical and practical applicability of this framework to circular flows is yet to be explored. Finally, despite the previously discussed relevance of the fashion industry, there are no extant studies systematizing the knowledge developed around CE in the context of the fashion industry, adopting a framework that considers simultaneously product and supply chain related aspects.

1.2 Research questions

Given the practical relevance and the theoretical gap identified, we aim to investigate how the alignment of SCM and NPD would facilitate CE. We set our theoretical inquiry in the fashion industry, as one of the most impactful sectors on sustainability (Karaosman *et al.*, 2018). In particular, we focus on two detailed research questions (RQs): RQ1: what are the NPD- and SCM-related *practices* that facilitate the transition of fashion industry towards CE? And RQ2: what are the *drivers, enablers and barriers* that have a potential moderating effect on this transition?

1.3 Research model

The boundary of our analysis concerning SCM practices is represented by the key SCM processes in the SCOR framework, namely: source, make, deliver and return. Similar to Pero et al. (2010), NPD practices refer to set of activities, including the decisions of certain product features (e.g., modularity, variety), ranging from the product idea generation until the product launch in the market. Alignment is reached when the supply chain receives support from NPD or the other way around (Pero et al., 2010). Hence, alignment (ALM) practices refer to matches between NPD and SCM decisions. For the present study, the focus is on SCM, NPD and ALM practices that aim at operationalizing CE. In line with Masi et al. (2017), we focus not only on a prescriptive set of practices, but we also concentrate on the investigation of those factors that can create the proper conditions to implement the practices (i.e., enablers), push towards or hinder the implementation of practices (i.e., drivers and barriers).

2. Methodology

To address the research questions, we adopted the systematic literature review methodology to collect evidence from the extant knowledge based on academic publications, and to identify research gaps from the existing intellectual territory (Tranfield et al. 2003). In particular, our review is guided by a theoretical framework aiming to develop knowledge in a structured and unbiased manner. The following chapter explains the process of material collection and selection. The process adopted in our review

is similar to the one followed by the previous reviews on related topics (e.g. Karaosman et al., 2017; Ciccullo et al., 2018).

2.1 Material collection

The entire process starts with planning the review (Tranfield et al. 2003). The rules of material collection and the list searching keywords were carefully chosen in line with our research questions. The applied query was mainly guided by the combination of three subsets of keywords: 1) NPD- and SCM-related activities, 2) CE and sustainability perspective, and keywords pertaining to the 3) fashion industry. With reference to a previous study (Karaosman et al., 2017), the NPD- and SCM-related keywords include *product, process* and *supply chain*. Keywords on CE and sustainability perspective derives from a break-down of CE concept (i.e. *reus*, return, recycl*, remanufactur*, repair** and *circular)* in conjunction with the triple-bottom-line concept for sustainability *(environment*, econom*, social** and *sustainab*)*. Then, in seek of contributions with particular focus on the fashion industry, we combined keywords *fashion, apparel, leather* and *textile* to the search string. Finally, keywords within the same subset were joint with the (OR) operator the, while the subsets were connected by (AND) operator. For the search of relevant papers, we included only peer-reviewed articles and reviews from journals on the Scopus database. This decision is made since peer-reviewed journals is considered as the main outlet for high-quality research, and Scopus is the major source of knowledge for systematic literature reviews (Karaosman et al., 2017). Being the year the marks the first definition of "sustainability" by the World Commission on Environment and Development report, we restricted the search starting from the year 1987. The searching process was conducted in September 2018 and resulted in a total list of 807 papers. We retrieved the demographic information and abstracts for further selection.

2.2 Material selection

The material selection process was conducted in two sequential steps. The first step checked the article eligibility based on title and keywords to reduce the papers that were out of scope or without managerial implication (Ciccullo et al. 2018). We excluded articles of out-of-scope disciplines (e.g. chemical and material engineering: influence of the degree of polymerization on fibre mechanical properties), and those focusing only on the advancement of technologies and material properties (e.g. technology to regenerated cellulose fibre from cotton waste; production technologies to achieve certain fibre mechanical or chemical properties). The output of this step resulted in a list of 143 papers that went through further examination.The second step of selection was performed on the article abstract, and we specifically focused on the managerial contribution of these publications by checking the presence of the elements in our research questions. Papers were kept if they tackle specific NPD- and SCM-related *practices* addressing the fashion industry transformation towards CE, or *enablers, drivers* and *barriers* which are expected to have a moderating effect to this paradigmatic shift. We discounted conceptual papers with broad discussions on sustainability and green economy (e.g. how green is the future?) and papers approaching technical issues related to the production process without managerial implication (e.g. water recycling system installations in a textile plant). The search and filtering process finally yielded 73 papers passing the eligibility criteria. However, after eliminating the documents that are not accessible online, we obtained only 37 full texts, which forms the basis of the following coding and analysis. Most of the non-accessible documents are papers either published in regional and low ranked journals, or published a long time ago. Therefore, since the remaining sample encompasses the most recent and high-quality papers, we believe that we can still provide a comprehensive picture of the field. We constructed a database by extracting the practices, enablers, drivers and barriers from the resulted 37 papers. Figure 1 sketches out the steps in the material collection and selection, and the full list of selected papers and their corresponding category are shown in Table 3.

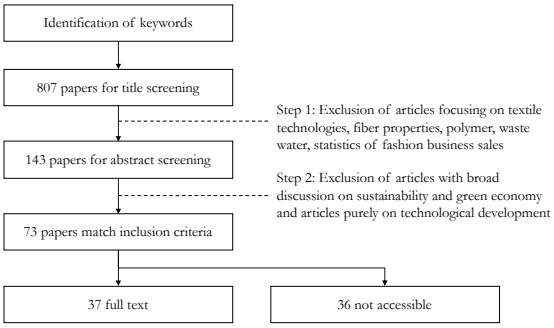

Figure 1 Steps in the literature review

2.3 Descriptive analysis

Our review found out that the first relevant paper was published in 2004 – long time after the definition of "sustainability" proposed by the World Commission on Environment and Development in 1987. We observed a positive trend on the papers published on this topic, and especially from the year 2014, it starts to show a steady growth (Figure 3). To classify the contributions according to the geographical region of focus, we merged the publications in terms of the continent due to the fact that several papers involve cross-country studies, while none of them has crossed the continent. Europe witnesses most of the studies in our database (with 15 contributions), then followed by North America and Asia (10 papers each) highest which also exhibit a number of relevant contributions. Figure 2 plots the paper distribution with respect to the research outlet. It shows that *Sustainability* and *Journal of cleaner production* have dominated the list while the rest of the contributions are relatively even-distributed in other academic journals.

Finally, we noted that our database is mainly constituted by papers adopting case study methodology, owing to our specific focus in seek practices that are mostly empirical grounded. Modelling, survey, review and mix method, i.e. combination of case study and survey, made up the rest of the population (Table 3).

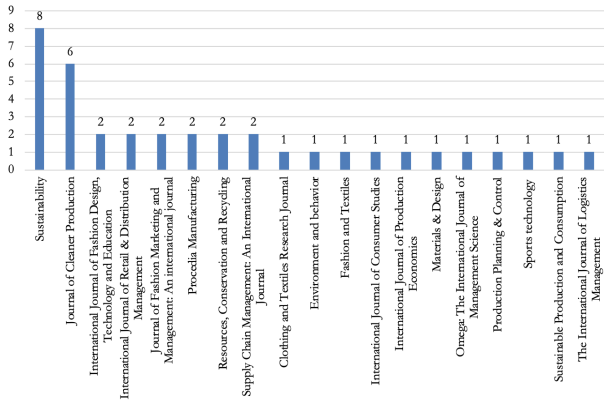

Figure 2 Article distribution by journal

3. Findings

3.1. RQ1 - Practices

Thanks to the knowledge disclosed by our investigation, we are able to summarize the main evidences regarding NPD, SCM and ALM practices in Table 1. Relatively few practices have been retrieved for what concerns NPD process. To illustrate, paper 21 suggests that modular product design could effectively and efficiently support the easy repair and change of components for recycling. Collaborations with multiple stakeholders are also an important practice for NPD. Paper 17 identifies co-evolution with customers and suppliers as a key product stewardship practice for closed-loop supply chain. Paper 15 envisages NGOs to be important mediators, for the fashion companies, to establish collaborations with local producers, thus reducing the waste connected to transportation and storage. As it appears clearly from Table 1, most of the detected SCM practices regard the "return" process. Notably, the return-related practices refer to *segmentation activities* aimed at distinguishing different types of return flows. As suggested by paper 6, return flows can be distinguished on the base of the quality level of the used products that need to be reprocessed. According to this contribution, products with different quality levels can be associated with different incentives. Another form of segmentation is presented for example by papers 1 and 9 in which different options are presented for return flows: reuse (i.e. customer to customer product exchange to minimize quick disposal), redistribution (i.e. directing the return flows to charity organizations) and refurbishing. Paper 1 suggests performing testing and sorting activities for the identification of the best option. Paper 11 suggests adopting distinct processes for the linear flows and the reverse ones (either managing both of them internally or by outsourcing the management of the reverse flows). Another set of papers (e.g. paper 1, 2, 3, 9) focused on the return process studied how to identify the optimal pricing policy in primary and secondary markets for used product to maximise profit (mostly leveraging on mathematical modelling and optimization). Similarly, other contributions consider the window for returning products sold through e-commerce (paper 3) or the amount of information provided to customers (e.g., on product fit) before purchasing the apparel product in order to minimize the return flows (paper 1). Just one SCM practice among the detected ones refers to the *make* process. Paper 4 reports about technological innovation in product operations to recycle and recovery tannery waste. SCM practices related to the *source* process emerge instead mostly as alignment type of practice.

Table 1 Practices

Practice	Practice short description	Paper ID
NPD	Modular design	21
NPD	Collaborate with stakeholder to co-create sustainable value	15,17
NPD	Assess design solutions on financial, social and ecological aspects	23
NPD	Design for life extension, Design for energy recovery; Design for hazardous substance reduction	21
SCM	Optimizing profit of return clothes by deciding the optimal price (in secondary and primary market)	2; 3; 9
SCM	Setting the optimal window for returning products sold through e-commerce	3
SCM	Reducing apparel waste by off-pricing through retailer	13
SCM	Empowering the customers (e.g. increase the information richness of garments that are bought online to minimize the probability of returning the item)	1
SCM	Product reuse, redistribution and refurbishing	1; 9; 8; 18
SCM	Technology driven recycling and recovering practices for tannery waste	4
SCM	Decoupling linear and reverse flow through internal separation or outsourcing	11
ALM	Computer aided pattern making and grading	25
ALM	Selection of materials to be re-processed on the basis of easiness to disassemble and clean the post consumption products	25
ALM	Labelling with garments' reconstruction history	24; 25
ALM	Collaborative technologies to redesign second hand clothes components and to collect, track, and manage data on waste.	5
ALM	Eco-design approach for material selection	21;24
ALM	Eco-design approach: cradle to cradle fashion design; design product out of pre-production waste (leftovers from past collections)	24; 34; 19
ALM	Design for disassembly, Design for recycling, Design for re-usability	20,22, 21, 26; 33
ALM	Standardize the second-hand clothes deconstruction (garment disassembly) to provide guidelines for a permanent production facility	5

As for the practices on alignment (ALM), the eco-design practice indeed embeds explicit connection with material selection and collaboration with supply chain actors within the fashion supply chain (paper 24). Notably paper 24 explains how Eco-design can guide material selection (e.g., non-toxic and recyclable materials) to reduce the harmful consequences along the supply chain. Most of the analysed papers refer to design for disassembling, design for recycling and design for reusability (e.g. paper 20, 22, 26 and 34). These types of practices are related to the dominant logic of the NPD process subjected to the constraints affecting SCM processes. Paper 26 for example

suggests reducing product component complexity to facilitate reuse and redesign. Interestingly, paper 25 provides a different perspective: the selection of materials to be re-processed and recycled is guided by the easiness to disassemble and clean the products that are collected from the market after use. Similarly, in paper 5 it is also suggested that creating a guiding document on how to disassembly a garment could be of interest for a manufacturer to deal with their unsold items.

3.2. RQ2 - Drivers, enablers and barriers

The implementation of the different SCM, NPD and ALM practices is not straightforward and literature points out a set of enablers and driver to facilitate the transition towards CE. The full list of enablers, drivers and barriers are reported in Table 2. Paper 11 for example discusses the role of regulative, normative and cognitive processes as key drivers. As a whole the role of policy makers appears to be of pivotal importance to facilitate the implementation of CE practices, both in the form of regulations (e.g. paper7) and of government sponsorships (paper 2 and 9) to encourage remanufacturing. Another interesting set of drivers consider socio-demographic factors as the main determinants of customers' attitude to participate in circular schemes (e.g. with donations or in buying the recycled/remanufactured items). Paper 27 identify younger customers as the less inclined. Paper 9 discusses the role of age and gender, which, positively impact on the propensity to donate used clothes to charity organizations. Finally, paper 36 adds education level in the list of factors positively influencing the adherence to fashion circular schemes. Other factors act in the opposite direction and inhibit the adoption of certain practices. These barriers refer for example to demand features (paper 7 and 20), i.e., variability in the volumes to be reprocessed and structural constraints, i.e. the lack of production capacity and ad-hoc facilities for the re-processing (e.g. paper 9).

Table 2 Drivers, enablers and barriers

Element	Short description	Paper ID
Enabler	Environmental legislation to increase awareness on recycling	30,21,7,14,23
Enabler	Funding for R&D to facilitate recycling system innovation	7
Enabler	Government financial sponsorship to encourage remanufacturing	2,9
Enabler	Establish collaboration with buyer and suppliers	20,26
Enabler	Specific marketing investments for recycled products	2,8,35
Driver	Raising social awareness on slow fashion culture	19
Driver	Environmental legislation on sustainable product design	23
Driver	Raising social acceptance of remanufactured fashion	20,22,25
Driver	Raising customer awareness regarding recycling fashion / environmental consciousness	21,25,26,32, 33, 35,36
Driver	Socio-demographic factors	9, 27, 28,30,33, 36.
Driver	Institutional pressures (normative, coercive, mimetic pressures)	11
Barrier	High cost associated to sustainability implementation	15,18,14
Barrier	Lack of management commitment toward sustainability	14,18,36
Barrier	Low and variable volume of clothing waste	7,20
Barrier	Lack of facility capacity for collecting garment waste	9,31,12

4. Discussion and conclusions

One of the fundamental problems of this multi-million-dollar worth industry, which significantly generates both pre- and post-consumer waste, is that product development and supply chain processes are detached due to operational inefficiencies. The industry is seriously addressed and critically questioned to embed CE principles into operational strategies. Findings revealed two main paths around which NPD and SCM could come in full circle: (i) Align NPD with SCM in order to reduce waste, and (ii) Align NPD with SCM to utilise waste.

Align NPD with SCM in order to reduce waste

Findings generated based on earlier contributions unveil that new products developed with eco-consciousness pursue some design parameters by considering supply chain constraints. The most prevailing practices emerge in terms of technology driven design, consumer engagement to extend the life cycle of clothing and design for modularity. Findings are aligned with earlier contributions that support the idea of reusing textiles in the design phase (Hu *et al.*, 2014) and of pursuing cradle to cradle design principles (Resta *et al.*, 2014) to better integrate sustainability at the design stage. Orchestrating supply chain activities is pivotal to facilitate this transformation. Accordingly, the alignment between NPD and SCM could eliminate waste generation only when design teams create their product developments to reduce waste by considering sourcing and manufacturing constraints (i.e. "design for" rules). To this end, design stage should utilise limited materials and apply modular design techniques, take actions to enhance disassembly, facilitate reuse and repurpose and apply technological cut and sew operations to eliminate what manually operated cutting & sewing practices generate.

Align NPD with SCM in order to utilise waste

While the aforementioned suggestions could reduce waste footprint, this part highlights those practices that would utilise supply chain waste by adding additional value through NPD. That is to say, upcycling and using not only post-consumer but also pre-consumer waste, creating a constant waste flow within the system and design principles based on wasted materials appear to be predominant solutions. Furthermore, alternative ways to enhance waste collection schemes are suggested to better integrate waste into the material flows. Though, material compositions and processing stages are very important to understand how to allocate and reutilise waste; hence, some innovative suggestions are required to create eco- patterns. For example, some innovative alternatives consist of providing design teams with the materials' and/or products' recycling history so that designers could prioritise the materials to be used based on their quality, applicability and functionality. In addition to an open life-cycle history, labelling garments could display illustrative steps to improve the performance of product deconstruction. For example, it is revealed that products created out of waste could be provided with a

unique reconstruction history to give information about the origin of the material in terms of the waste's composition, its life cycle stage and required quality parameters to better decide how to repurpose it. While promoting the alignment between NPD and SCM, this study also uncovers some factors whose existence are pivotal to move the needle further. Despite our study reports age as positively related to the inclination towards the adoption of CE practices and behaviors, the truth is that consumers, even young ones, are becoming more and more aware of ethical and environmental footprint of the global fashion operations, and therefore they growingly inquire actions and demand transparency. Additionally, governments, especially in Europe, are gradually passing legislations to better tackle waste as well as traceability related problems of the fashion industry. Recently, the United Nations have launched a specific charter to reach net zero emissions by 2050 and there are ongoing projects to help the textiles industry move toward circularity. That is to say, market dynamics appear to be the biggest driver pushing companies to take actions. Not only to become compliant but also to gain market advantage by being part of the change, a large number of fashion companies are committing themselves to serious charters to help the industry clean its dirt. Yet, the fact of clothing supply chains being ultimately dispersed and being somewhat disconnected do not support or facilitate this inclusion. Agents, a high number of small manufacturers and home workers, which jointly showcase how opaque fashion supply chains really are, actually jeopardize the performance of circular fashion. Relatedly, high investment costs and lack of technology that would enable all supply chain actors to approach NPD-SCM with a circular mindset and that would deal with highly mixed material compositions appear to be the most critical impeders of circularity across fashion supply chains. Nevertheless, given that the change is coming and the demand is growing, the fashion industry attempts to learn how to do things in right manners for which financial incentives, legislations and cross-industrial collaborations emerge as the biggest antecedents to exchange material, resources and knowledge that would eventually enable circular fashion management. While providing some interesting implications that could be utilised by both academia and practice, the study, in its current form, has some limitations. First of all, we have discarded the "non-accessible" documents. Therefore, despite the discussed results are still valid, while based on a smaller sample, further refinement could also aim to include those papers in providing a complete overview of the topic. Secondly, even though systematic literature review is favored to capture and document existing body of knowledge in a methodologically approved scientific as well as systemic way, the profundity of the topic requires interpretation through data acquired from real-life situations in which social and natural resources intersect. Hence, this study must be advanced by exploring how and to what extent this initial classification framework can be applied in real life. Thirdly, CE requires a radical change at the system level: therefore, this study calls for future contributions to investigate the phenomenon by exploring the dynamics between and across all value chain actors, including the legislative bodies, NGOs, consumers and service providers to accurately address how NPD and SCM could be truly aligned and accelerated.

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Appendix A. - Search string

(TITLE-ABS-KEY (fashion OR apparel OR leather OR textile) AND TITLE-ABS-KEY ("supply chain" OR process OR product) AND TITLE-ABS-KEY (reus* OR return OR recycl* OR circular OR remanufactur* OR repair*) AND TITLE-ABS-KEY (sustainab* OR evironment* OR econom* OR social*)) AND DOCTYPE (ar OR re) AND PUBYEAR > 1986

Appendix B. - Article distribution by year

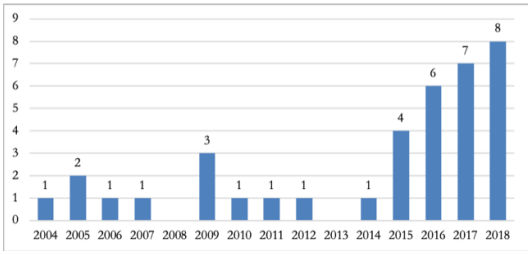

Figure 3 Article distribution by year

Appendix B. Full list of articles reviewed

Table 3 Full list of paper resulted from selection process

Paper ID	Author	Year	Journal	Ariticle type
01	Bertram R.F., Chi T.	2018	International Journal of Fashion Design, Technology and Education	T: Review
02	Choi T.-M.	2017	Journal of Cleaner Production	E: Modeling
03	Difrancesco R.M., Huchzermeier A., Schröder D.	2018	Omega: The International Journal of Management Science	E: Modeling
04	Hu J., Xiao Z., Zhou R., Deng W., Wang M., Ma S.	2010	Journal of Cleaner Production	T: Review
05	Lewis T.L., Park H., Netravali A.N., Trejo H.X.	2016	International Journal of Fashion Design, Technology and Education	E: Case study
06	Masoudipour E., Amirian H., Sahraeian R.	2017	Journal of Cleaner Production	E: Case study
07	Mo H., Wen Z., Chen J.	2009	Resources, Conservation and Recycling	E: Case study
08	Morana R., Seuring S.	2011	Sustainability	E: Case study
09	Paras M.K., Ekwall D., Pal R., Curteza A., Chen Y., Wang L.	2018	Sustainability	E: Case study
10	Shen B., Li Q.	2015	Sustainability	E: Modeling
11	Stâl H.I., Corvellec H.	2018	Journal of Cleaner Production	E: Case study
12	O'Reilly S., Kumar A.	2015	International Journal of Logistics Management	E: Case study
13	Beh L.-S., Ghobadian A., He Q., Gallear D., O'Regan N.	2016	Supply Chain Management: An International Journal	E: Case study
14	Abdulrahman M.D., Gunasekaran A., Subramanian N.	2012	International Journal of Production Economics	E: Case study
15	Yang Y., Han H., Lee P.K.C.	2017	Sustainability	E: Case study
16	Wang F., Zhuo X., Niu B.	2016	Sustainability	E: Modeling
17	Miemczyk J., Howard M., Johnsen T.E.	2016	International Journal of Supply Chain Management	E: Case study
18	Macchion L., Da Giau A., Caniato F., Caridi M., Danese P., Rinaldi R., Vinelli A.	2018	Production Planning & Control	E: Case study
19	Cimatti B., Campana G., Carluccio L.	2016	Procedia Manufacturing	E: Case study
20	Dissanayake G., Sinha P.	2015	Resources, Conservation and Recycling	E: Case study
21	Ljungberg L.Y.	2005	Materials & Design	T: Review
22	Subic A., Mouritz A., Troynikov O.	2009	Sports technology	E: Case study
23	Sissel A. Waage	2006	Journal of Cleaner Production	E: Case study
24	Wang L., Shen B.	2017	Sustainability	E: Case study
25	Young C., Jirousek C., Ashdown S.	2004	Clothing and Textiles Research Journal	E: Case study
26	Franco M.A.	2017	Journal of Cleaner Production	E: Case study
27	Birtwistle G., Moore C.M.	2007	International Journal of Retail & Distribution Management	E: Case study
28	Ha S., Kwon S.Y.	2016	Fashion and Textiles	E: Survey
29	Joung H.-M.	2014	International Journal of Retail & Distribution Management	Mixed method
30	Meneses G.D., Palacio A.B.	2005	Environment and behavior	E: Survey
31	Morgan L.R., Birtwistle G.	2009	International Journal of Consumer Studies	E: Case study
32	Norum P.S.	2017	Sustainability	E: Case study
33	Pessôa C., Araújo K., Arruda A.	2015	Procedia Manufacturing	E: Case study
34	Vehmas K., Raudaskoski A., Heikkilä P., Harlin A., Mensonen A.	2018	Journal of Fashion Marketing and Management: An international journ	E: Case study
35	Yang L., Dong S.	2017	sustainability	E: Modeling
36	Lang C., Armstrong C.M.J.	2018	Journal of Fashion Marketing and Management: An international journ	E: Modeling
37	Lang C., Joyner Armstrong C.M.	2018	Sustainable Production and Consumption	E: Case study