Towards the circular supply chain: a literature review of challenges

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Abstract: The notion of Circular Economy (CE) has been arisen as a promising approach to promote sustainability without compromising economic growth. However, companies who are going to redesign their supply chain to adopt the CE paradigm face several challenges. Despite their relevance in such an early stage of CE practices adoption by companies, literature still lacks a systemic and holistic identification of this set of challenges. In fact, previous research either focused on a particular industrial sector, on a geographical context, on a specific firm category or by limiting the analysis to only some CE aspect. Therefore, this paper carries out a literature review to identify the main challenges that companies have to face when they want to redesign their supply chain according to CE principles, i.e. to implement a circular supply chain. As much as 24 challenges have been identified and classified in accordance with the life cycle phase(s) affected and the CE lever(s) touched as recognized in literature, i.e. product redesign, servitised business models, reverse logistics and system enablers (e.g. legislation or digital 4.0 technologies). Findings highlight the multidisciplinary character of CE, and show that the challenges are quite distributed among the different life cycle phases, implying that companies who desire to implement a circular supply chain should be prepared to face challenges related to both the direct and the reverse flows of materials, despite the common thinking that CE is only related to reverse logistics. Moreover, findings show that a non-negligible number of challenges arises within each CE lever, thus confirming the need for a systemic and holistic approach. Managers may use the set of challenges to prevent likely barriers that arise in the transition towards CE.

Keywords: Circular Economy; Sustainability; Closed-loop supply chain; Green supply chain

1. Introduction

Circular Economy (CE) has gained attention from academia, companies and policy-makers as a promising approach to jointly promote sustainability and competitiveness (Elia et al., 2017). Among others, China, Japan, US and the European Union have issued policies to support the adoption of CE (Ghisellini et al., 2016). However, besides this top-down approach (Lieder and Rashid, 2016), increased bottom-up efforts from companies are needed (Masi et al., 2017).

Companies who decide to redesign their supply chain for CE may obtain environmental, social and economic benefits (Cucchiella et al., 2015; Ongondo et al., 2013). However, they also have to deal with several obstacles, which may prevent the achievement of these expected benefits (Linder and Williander, 2017; Rizos et al., 2016). Despite their relevance in such an early stage of CE practices adoption by companies, the literature still lacks a systematic analysis of the challenges that may arise in redesigning supply chain accordingly to CE principles, i.e. in implementing a circular supply chain. To fill this gap, this paper carries out a systematic literature review about the challenges that companies face when supply chain are redesigned for CE. More specifically, 24 challenges are pointed out from the literature and grouped into seven categories, namely: Economic and financial viability, Market and competition, Product characteristics, Standards and regulation, Supply chain management, Technology, Users' behaviour.

Therefore, the remainder of the paper is organised as follows. Section 2 describes the background of the study, introducing the CE concept and its implication to supply chains. Section 3 provides the research design, introducing the research gap, the research question and the methodology applied, while Section 4 provides the main findings of the systematic literature review. Finally, Section 5 discusses the findings, and provides concluding remarks, limitations and avenues for future research.

2. Background: Circular Economy and circular supply chains

CE is not a brand new concept (Lieder and Rashid, 2016), even though a detailed definition of CE is still missing in the literature (Tecchio et al., 2017). Indeed, several authors refer to the Ellen MacArthur Foundation (2012), which describes CE as a 'system restorative and regenerative by design' (Franco, 2017; Lieder and Rashid, 2016). More specifically, CE aims at maintaining products, resources and materials at their highest utility and value at all time by enabling several closed-loop cycles of reuse, remanufacturing and recycling (Ellen MacArthur Foundation, 2012), for both technical and biological materials (Braungart et al., 2007). The implementation of the CE paradigm may take place at three different levels, with different scales and unit of analysis (Geng and Doberstein, 2008; Murray et al., 2017). At the micro level, the focus of the study is on the single company efforts towards CE (Franco, 2017), and sometimes extended in order to encompass its entire supply chain (Masi et al., 2017). At the meso level, the focus shifts on the inter-firms collaboration, as a result of the establishment of eco-industrial parks that promote the trading of industrial by-products through industrial symbiosis (Ghisellini et al., 2016). Lastly, at the macro level, the adoption of the CE paradigm is analysed at a national or regional scale (Geng and Doberstein, 2008).

According to the Ellen MacArthur Foundation (2012), companies may invest on four main levers to accelerate the transition towards CE (Bressanelli et al., 2017; Elia et al., 2017). First, companies should rethink the design of products offered. Indeed, in order to keep products, components and materials at their highest utility and value at all time, several design policies may be pursued, such as product life extension (Bakker et al., 2014), eco-design (Mont, 2008), modularisation and material selection (Bakker et al., 2014), and Design-for-X techniques (Kane et al., 2018). Second, companies should adopt a servitised Business Model (BM), i.e. a BM based on the provision of the function instead of the physical product ownership. Indeed, servitised BMs encourage take-back systems and circular product redesign (Mont, 2008), since manufacturers retain products ownership (Tukker, 2015). Leasing, sharing, pay-per-use and pay-per-result represent viable examples of servitised BMs (Tukker, 2015). Third, companies should implement a reverse logistics. In fact, CE entails returning products from users to producers, involving 'renovation' activities such as reuse, refurbishment, repair, remanufacturing and recycling (Parajuly and Wenzel, 2017; Singh and Ordoñez, 2016). When feasible, a hierarchy among these activities should be followed: reuse is preferable to recycling, since much of the value remains intact (Kane et al., 2018). Finally, companies should invest on several enabling factors, i.e. system conditions that may support a CE transition, such as collaboration (Elia et al., 2017), digital 4.0 technologies such as Internet of Things (Bressanelli et al., 2018) or 3D Printing (Despeisse et al., 2017), regulation, financing and education (Saidani et al., 2018), as well as the creation of a market for 'renovated' products and secondary raw materials.

To redesign supply chains for CE, i.e. to implement a circular supply chain, the supply chain architecture and configuration must shift from linear to circular (Ellen MacArthur Foundation, 2012). In this regard, literature suggests that such a transformation requires actions belonging to each CE lever (Elia et al., 2017).

3. Research design and methodology

Even though a redesign of the supply chain towards CE poses several challenges, this aspect has been quite overlooked by the literature to date. Indeed, previous research on CE challenges either focused on a particular industrial sector (Densley Tingley et al., 2017; Franco, 2017); or on a geographical context (Geng and Doberstein, 2008; Shahbazi et al., 2016; Whalen et al., 2018); or on a specific firm category such as social or small and medium enterprises (Ongondo et al., 2013; Rizos et al., 2016); or by limiting the analysis to only some CE aspects such as reverse logistics, green- or closed-loop supply chain (Bouzon et al., 2018; Linder and Williander, 2017; Singh and Ordoñez, 2016). Overall, a systemic and holistic categorisation of the challenges for supply chain redesign for CE has not been proposed yet. To fill this gap, this paper addresses the following research question: 'Which challenges do companies face, at the micro-level, when they decide to incorporate the CE paradigm into their supply chain?'.

Following the formulation of the research question, hereafter this paper will only refer to the implementation of a circular supply chain at the micro level (Ghisellini et al., 2016) that focuses on material technical cycles, i.e. cycling flows of materials that can potentially remain in a closed-loop system through many product life-cycles (Braungart et al., 2007).

To address the research question, the scientific literature was scrutinised in a systematic way (Tranfield et al., 2003). The literature review, conducted between November and December 2017, was performed on the Scopus database, while the selection procedure was designed following the guidelines drafted by Seuring and Gold (2012). A structured search was carried out (see Table 1) and the list of papers obtained from the searches was refined following the process depicted in Figure 1.

Table 1. Keyword search

Search string	N° Papers
Circular Economy AND Barrier	69
Circular Economy AND Obstacle	24
Circular Economy AND Challenge	239
Closed loop supply chain AND Barrier	10
Closed loop supply chain AND Obstacle	9
Closed loop supply chain AND Challenge	93
Green supply chain AND Barrier	124
Green supply chain AND Obstacle	20
Green supply chain AND Challenge	308
Total	**896**

The keyword search led to an initial set of 896 entries, corresponding to 733 unique documents originally written in English. To ensure the quality and relevance of the analysed studies, only papers that appeared in journals with Impact Factor, according to Thomson Reuters Journal Citation Report, have been selected from this set. Although this choice has the limitation to exclude conference papers or book chapters that may be relevant to this study, using Impact Factor is a quite common way to ensure the quality and the relevance of papers.

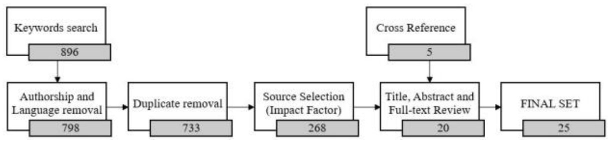

Figure 1. Systematic literature review process

Thus, 268 papers were scrutinised by initially reading the title and the abstract. When title and abstract evaluations were unclear, the full paper contents were scrutinised. The following inclusion criteria were defined: (i.) the paper must address and discuss the challenges to the adoption of CE paradigm into supply chains, AND (ii.) the paper must discuss the micro level AND (iii.) the paper must deal with technological cycles of industrial materials. Consequently, a large number of papers (starting from the

268 selected) were discarded, since they focused on CE but without addressing challenges to its introduction into supply chain, they addressed only the meso or the macro levels, or they dealt with biological cycles of materials.
Lastly, in order to overcome possible limitations of database search, the set of papers has been complemented by cross-referencing (Seuring and Gold, 2012). This step led to the inclusion of 5 additional manuscripts to the 20 papers resulting from the previous phase. Consequently, 25 papers have been judged relevant, according to the inclusion criteria presented above.

4. Literature review: a systematisation of challenges

The 25 identified articles have been analysed regarding publication year (Figure 2), journal (Figure 3) and keywords (Table 2).

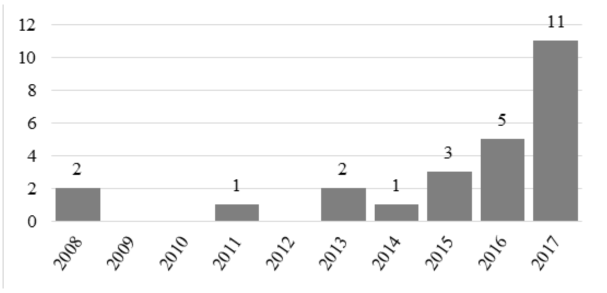

Figure 2. Distribution of publications per year

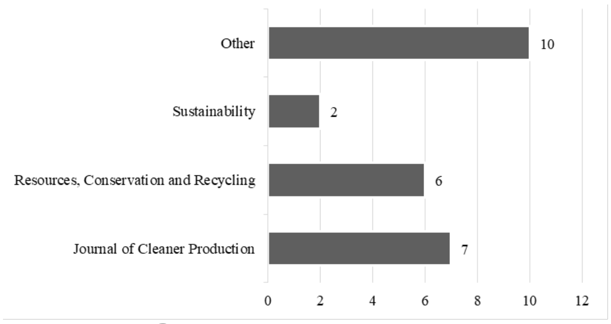

Figure 3. Distribution of publications per journal

Moreover, a content-based analysis allowed the identification of 24 challenges about the implementation of circular supply chains. The challenges were classified into seven categories (see the next sub-sections). A complete overview of each challenge and the classification applied is provided in Appendix A. Table 3, instead, shows the distribution of the 24 challenges according to the life cycle phase(s) affected and the CE lever(s) touched. In the following, each challenge category is presented, and each challenge is referenced through a number after the symbol '#'.

Table 2. Keyword analysis

Keyword	N° Papers	% Papers
Circular Economy	16	64 %
Sustainability	6	24 %
WEEE	4	16 %
Reuse	4	16 %
Implementation	3	12 %
Eco-design	3	12 %
Reverse Logistics	2	8 %

4.1. Economic and financial viability

Three specific challenges have been identified and grouped in this category. First, when companies adopt servitised BMs, they must take into account a time mismatch between revenue and cost streams (#1). In fact, providers who convert their offering from product's ownership to functions have to finance in advance the capital costs of the offered solution (Tukker, 2015), while revenue streams are postponed over time (Rizos et al., 2016). In turn, this results in longer payback time, thus questioning the economic and financial viability of CE implementation. Moreover, when products are offered through servitised BMs, financial (#2) and operational (#3) risks are transferred from users to providers (Krikke, 2011; Mont, 2008). Indeed, providers are financially exposed to the risks of early suspensions of the contract by customers, even though they have financed in advance the entire solution (Linder and Williander, 2017). Moreover, providers of several type of offering are responsible for the operational costs of the solution offered, such as maintenance and repair costs.

4.2. Market and competition

In general, companies may avoid to provide 'circular' products (remanufactured or designed to last ones) because they fear that this offering may lead to a reduction of primary sales (Parajuly and Wenzel, 2017), thus affecting the company revenue streams from traditional products. This phenomenon is also called market cannibalisation (#4) (Linder and Williander, 2017). When third parties are involved, supply chain issues related to know-how access and intellectual property arise (#5), and may prevent the execution of maintenance or renovation activities (Rauer and Kaufmann, 2015). Original Equipment Manufacturers (OEMs) may limit the possibility for third parties to execute these activities through proprietary technology or by preventing the access to technical manuals, spare parts and specific tools (Saidani et al., 2018). Finally, renovation activities performed by third parties may also affect the OEM brand and reputation (#6) if not performed correctly, especially when OEMs exert little or no control over their execution (Whalen et al., 2018).

4.3. Product characteristics

'Circular' products are designed to last, rather than for 'use-and-throw-away'. Thus, they might be unable to respond to fashion changes (#7), resulting unattractive for a part of the customer base (Franco, 2017). Moreover, as products or product ranges complexity increases (#8), renovation activities might become more difficult (Despeisse et al., 2017). This relation is quite evident in e.g. the plastics industry, where the number of polymers proliferated in the past decades (Huysman et al., 2017). Products customisation (#9) has a similar impact, since it reduces the attractiveness of CE renovation activities (Kane et al., 2018). Mass customisation, often enabled by technologies like 3D printing (Despeisse et al., 2017), pushes towards even more personalised products, thus increasing the difficulties in renovation processes and narrowing down the market for products issued from such activities (Singh and Ordoñez, 2016).

Table 3. Distribution of the challenges among life cycle phase(s) affected and CE lever(s) touched

			Life cycle phase					**CE lever**			
Category	**ID**	**Challenge**	**Raw materials supply**	**Manu-facturing**	**Sales and Distribu-tion**	**Utilisa-tion**	**Reno-vation**	**Circular product redesign**	**Servitised Business Model**	**Reverse Logistics**	**Enablers**
Economic and financial viability	1	Time mismatch between revenue and cost streams		X	X	X			X		
	2	Financial risk			X	X			X		
	3	Operational risk			X	X		X	X		
Market and competition	4	Cannibalisation			X			X	X	X	
	5	Intellectual property and know-how access					X			X	X
	6	Brand Image					X			X	X
Product characteristics	7	Fashion change				X		X			
	8	Product complexity		X			X	X			
	9	Product (mass) customisation		X			X	X			
Standards and Regulation	10	Taxation and incentives misalignment	X	X	X		X	X		X	X
	11	Measures, metrics, indicators	X	X	X	X	X				X
	12	Lack of standards		X			X	X			X
Supply chain Management	13	Return flows uncertainty		X			X			X	
	14	Transportation and infrastructure					X			X	
	15	Availability of suitable supply chain partners		X	X		X				X
	16	Coordination and information sharing	X	X	X	X	X			X	X
	17	Product traceability	X	X	X	X	X			X	X
	18	Cultural issues		X							X
Technology	19	Eco-efficiency of technological processes					X			X	
	20	Product technology improvement	X	X		X		X			X
	21	Data security				X	X			X	
Users' behaviour	22	Ownership value			X	X			X		
	23	Careless behaviour in product usage				X			X		
	24	Users' willingness to pay			X	X	X	X	X		
Total			**5**	**12**	**11**	**12**	**15**	**9**	**7**	**10**	**10**

4.4. Standards and Regulation

Taxation and policy instruments misalignment (#10) is one of the most common challenges that hinders the implementation of CE at the micro level (Geng and Doberstein, 2008). For instance, to promote CE, non-renewable resources like carbon-based fuels should have taxation levels higher than renewable ones such as labour, but frequently legislations do not reflect this (Stahel, 2013). Scholars also cite the lack of adequate financial incentives as a factor that hinder the CE practice adoption (Masi et al., 2017). Furthermore, a commonly recognised system of measures, metrics and indicators to monitor CE progress is still missing (#11) (Rauer and Kaufmann, 2015). For instance, most of the existing micro and macro indicators – such as the Gross Domestic Product or, at the micro level, the company turnover – were built around the linear economy perspective, aiming to maximise throughput and sales. CE, on the other hand, shifts the focus from a purely volume-driven economy towards a more conservative one, where the stock of products, materials and resources is optimised, rather than their flow (Stahel, 2013). This lack of measures has led researchers to develop ad hoc indicators to monitor the progress of CE activities inside companies (Huysman et al., 2017). Finally, a lack of standards (#12) regarding CE processes, activities and materials is widely acknowledged in literature (Bouzon et al., 2018).

4.5. Supply chain Management

The return flows uncertainty (#13) regarding the quantity, the mix, the quality, the time and the place of return of products decreases the probability of achieving an economic scale in reverse logistics and renovation activities (Densley Tingley et al., 2017; Franco, 2017). Currently, significant volumes of products originally sold by OEMs never return, limiting renovation activities (Rizos et al., 2016). Time and place of collection are critical too (Linder and Williander, 2017). All the aforementioned uncertainties create difficulties in estimating the return flows of products from customers, as well as the type and quality of returned products, thus reducing the ability to plan and execute renovation activities. In many CE schemes, end-of-use products must be collected from utilisation places and sent back to specialised sites for renovation; then they are sent back to where a new utilization cycle can take place. Thus, transportation costs and the related environmental impacts increase (#14), especially if not all the involved activities are planned in an appropriate way (Ongondo et al., 2013). The availability of suitable supply chain partners (#15) is another challenge widely recognised in literature (Rauer and Kaufmann, 2015). Companies who decide to move towards CE often experience difficulty in finding partners with appropriate skills and the same CE commitment (Rizos et al., 2016). Moreover, even when companies can count on a set of suitable partners, coordination and information sharing (#16) is difficult to achieve (Saidani et al., 2018), especially because of competition among the supply chain tiers, information sensitivity and poor IT system integration. To enable the introduction of CE into supply chains, several information should be tracked and gathered from products, thus improving the efficiency and effectiveness of collection and renovation processes (Despeisse et al., 2017). However, some product traceability concerns (#17) may arise, since the organisation of business processes as well as the limitations of hardware (e.g. sensors or RFID) and software tools frequently do not allow to store and share this information in a useful way (Franco, 2017). Finally, internal resistance to change as well as limited awareness and commitment (#18) from both top management and employees (cultural issues) frequently prevent or make more difficult and troublesome the introduction of a circular supply chain (Lieder and Rashid, 2016).

4.6. Technology

So far, many end-of-use processes – especially recycling – result too expensive or inefficient (#19) from an eco-efficiency technological perspective (Shahbazi et al., 2016). For instance, the WEEE recycling 'shred and separate' process results in materials contamination and losses (Parajuly and Wenzel, 2017). Moreover, product technology improvement hampers circularity (#20): 'circular' products, being designed to last, might not participate in the continuous technology improvement processes (Murray et al., 2017): Old energy-related products may consume more energy than newer ones, if not properly updated (Bakker et al., 2014). Finally, concerns about privacy and data security (#21) inhibit the adoption of supply chain redesign for CE (Saidani et al., 2018). For instance, users are reluctant to return their used smartphones, since they fear that their personal data could be retrieved and shared (Whalen et al., 2018). Given a general trend towards the manufacturing of more smart, intelligent and connected products, this challenge is gaining increasingly attention. Moreover, it also points out great opportunities in a CE: when products become smart through the adoption of the Internet of Things, it is possible to collect huge amount of data regarding their operations. These data may in turn be used to improve the design of products or their maintenance (Bressanelli et al., 2018). Unfortunately, these data are not often utilised since customers are reluctant to give access to them.

4.7. Users' behaviour

Some users may not be attracted by servitised BMs that offer product access instead of ownership (Rizos et al., 2016). In fact, users may fear the loss of ownership values (#22) such as the sense of control, availability, self-esteem or status symbol connected with the product ownership (Tukker, 2015). Moreover, since in servitised BMs users no longer own products, a careless behaviour in product usage (#23) may also arise (Tukker, 2015), increasing repair and maintenance activities and generating relational drawbacks such as legal issues. Finally, users' willingness to pay (#24) is critical: the price of 'circular' (e.g. designed to last) products, if sold under traditional transaction-based models, is higher than that of ordinary ones (Whalen et al., 2018). However, customers may not recognise a 'premium value' to them. As well, customers usually look for substantial savings when purchasing renovated or 'second-hand' products, even though they are as-good-as-new (Shahbazi et al., 2016), but costs for renovating processes might prevent to sell them at such a lower price.

5. Discussion and Conclusion

Even though implementing a circular supply chain poses several challenges, a systemic and holistic view has not been proposed yet. Thus, this paper contributes to research through a categorisation of challenges in supply chain redesign for CE, by conducting a systematic literature review that has led to the identification of 24 challenges, grouped into seven categories.

The descriptive analysis about the distribution of the selected paper over time (Figure 1) confirms the findings from previous literature, which position CE as an emerging phenomenon that is gaining momentum among researchers (Lieder and Rashid, 2016). In fact, the majority of papers (about 70%) have been published after 2015. Moreover, since 10 out of the 25 papers appear in 10 different journals (Figure 2), the multidisciplinary character of CE highlighted by previous studies is here confirmed (Murray et al., 2017). Finally, the keywords analysis of the selected papers (Table 2) confirms the sustainability aim of the CE at the micro level (24% of papers uses the keyword 'sustainability' to position their research), as well as the practical point of view of circular supply chains (about 10% of the papers focuses on practical actions to reach CE such as reuse, eco-design and reverse logistics).

Moreover, the analysis (see Table 3) shows that the challenges are quite distributed among the different lifecycle phases. Therefore, implementing a circular supply chain affects not only the end of life stages, but instead it brings several challenges during supply, manufacturing, distribution and usage phases. This finding contrasts with the common popular thinking related to CE, which associates supply chain redesign for CE to only the reverse logistics aspect (Franklin-Johnson et al., 2016). Conversely, companies who desire to implement a circular supply chain should be prepared to face challenges related to both direct and reverse flows. Moreover, literature acknowledges that, to introduce the CE paradigm, companies should invest on four main levers (Ellen MacArthur Foundation, 2012). As shown by the analysis (Table 3), a non-negligible number of challenges arises within each CE lever. As a result, a 'challenges-free' lever does not exist, thus confirming the need for a systemic and holistic approach when supply chain are redesigned for CE (Lieder and Rashid, 2016). Furthermore, the most frequent challenges identified in literature (see Appendix A) are the 'return flows uncertainties' and the 'availability of suitable supply chain partners', which both appear in the 46% the analysed papers. These two challenges come from the closed loop supply chain literature (Lieder and Rashid, 2016) and confirm the key role played by supply chain management even in circular supply chains. Finally, the paper provides managers with a clear understanding of the challenges that must be faced when supply chain are redesigned for CE. Therefore, managers may use the set of challenges to anticipate likely barriers that arise in the transition towards CE.

The study has some limitations, which call for an extension of the research. First, the literature review focuses on a limited number of papers, which result from the strong inclusion criteria adopted in the selection of papers (i.e. only the micro level and only the technical cycle of materials). Since CE has powerful implications also to the meso and macro implementation levels as well as to the biological cycles, an extension of the analysis to comprise these fields should be considered. Moreover, the set of challenges has been deducted from literature, but not empirically tested in a real context. Therefore, an empirical investigation of the challenges through a case study research is needed.

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Appendix A. Complete overview of the challenges identified, their categorisation and references

Category	ID	Challenge	(Bakker et al., 2014)	(Bouzon et al., 2018)	(Cucchiella et al., 2015)	(Densley Tingley et al., 2017)	(Despeisse et al., 2017)	(Franco, 2017)	(Geng and Doberstein, 2008)	(Huysman et al., 2017)	(Kane et al., 2018)	(Krikke, 2011)	(Lieder and Rashid, 2016)	(Linder and Williander, 2017)	(Masi et al., 2017)	(Mont, 2008)	(Murray et al., 2017)	(Ongondo et al., 2013)	(Parajuly and Wenzel, 2017)	(Rauer and Kaufmann, 2015)	(Rizos et al., 2016)	(Saidani et al., 2018)	(Shahbazi et al., 2016)	(Singh and Ordoñez, 2016)	(Stahel, 2013)	(Tukker, 2015)	(Whalen et al., 2018)	TOTAL
Economic and financial viability	1	Time mismatch between revenue and cost streams																			X		X			X		**3**
	2	Financial risk										X		X		X										X		**4**
	3	Operational risk										X		X		X						X				X		**5**
Market and competition	4	Cannibalisation		X							X	X		X		X		X	X							X		**8**
	5	Intellectual property and know-how access					X				X									X		X					X	**5**
	6	Brand Image																									X	**1**
Product characteristics	7	Fashion change						X						X												X		**3**
	8	Product complexity					X	X		X	X													X				**5**
	9	Product (mass) customisation					X	X			X													X				**4**
Standards and Regulation	10	Taxation and incentives misalignment		X					X					X	X						X	X			X		X	**8**
	11	Measures, metrics, indicators								X					X					X			X		X			**5**
	12	Lack of standards		X			X													X								**3**
Supply chain Management	13	Return flows uncertainty		X	X	X	X	X						X				X			X	X	X				X	**11**
	14	Transportation and infrastructure	X		X		X					X				X		X									X	**7**
	15	Availability of suitable supply chain partners		X			X		X				X	X	X			X		X	X					X	X	**11**
	16	Coordination and information sharing		X		X			X						X					X	X	X						**7**
	17	Product traceability				X	X	X											X		X	X						**6**
	18	Cultural issues				X		X	X				X		X					X	X		X					**8**
Technology	19	Eco-efficiency of technological processes		X			X	X	X						X				X			X	X					**8**
	20	Product technology improvement	X								X						X					X						**4**
	21	Data security					X															X					X	**3**
Users' behaviour	22	Ownership value					X								X						X					X		**4**
	23	Careless behaviour in product usage																								X		**1**
	24	Users' willingness to pay		X		X			X						X							X	X	X			X	**8**
		TOTAL	**2**	**8**	**2**	**5**	**11**	**7**	**6**	**2**	**5**	**4**	**2**	**7**	**8**	**4**	**1**	**4**	**3**	**6**	**8**	**10**	**6**	**3**	**2**	**8**	**8**	