Implementing supply chain collaboration practices to support successful circular economy: a best case from textile industry

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Abstract

In recent years circular economy (CE) has received increasing attention worldwide because of the greater emphasis on transparency in resources supply and efficiency in their use. In this context, we analyse a single case-study about a closed-loop supply chain (SC) in the textile industry. We conducted interviews at multiple levels of the SC to gain an in-depth view of its circularity. The aim is to demonstrate that a collaborative SC management has a major role to play in the transition towards a CE as it is necessary the commitment of all the different players involved in the product life-cycle.

Keywords: Circular economy, Sustainability, Supply chain management

Introduction

In the last 150 years, the traditional linear model of production and consumption has dominated the economic context, causing the degradation of the environment (Franco, 2017). The increasing concern of society about the issues of natural resource depletion and environmental degradation has led both academics and businesses to focus on the circular economy (CE) concept (Sauvé et al., 2016). This comes as a solution to environmental and socio-economic issues (Witjes and Lozano, 2016), reinventing the economic model in the interest of both natural capital and human needs, thanks to the

creation of closed loops (Yong, 2007), in which the materials are transformed into useful goods and services (Webster, 2013). However, pursuing a CE strategy requires the commitment and participation of all the stakeholders involved, including customers, governments and companies (Van Buren et al., 2016). In particular, it has been argued that the configuration and coordination of the supply chain (SC) plays an important role (Zhu et al., 2010).

Among others, the textile industry can benefit significantly from the development of a circular SC that can help in the creation of more sustainable businesses. Being the textile industry one of the most polluting in the world (Muthu, 2017), its management is critical from both environmental and social point of views (Ellen Macarthur Foundation, 2013; Lieder and Rashid, 2016). In addition, over the last 15 years, clothing production has approximately doubled, probably due to the 'fast fashion' phenomenon, that focuses on speed and low costs (Ellen MacArthur Foundation, 2017). Furthermore, this industry is characterized by very complex and long SCs (Accenture, 2014), which therefore require greater coordination and collaboration (Kozniewski et al., 2017). The textile companies, indeed, usually operate according to linear production system, using large quantities of resources (Ellen MacArthur Foundation, 2017). An estimation assessed that every year more than USD 500 billions of value are lost because the linear SC is not characterized by product recovery (Ellen MacArthur Foundation, 2017).

In such a context, the aim of this paper is to expand the knowledge and awareness of the links and synergies between SC collaboration and the creation of a circular and more sustainable economy, with a specific focus on the textile industry.

The paper is structured as follows. First, a literature review provides a brief overview on the CE concept and tries to summarize the contribution of previous researches about the identification of collaboration practices and their application to the context of CE. Then, the relevance of the textile sector is justified. A description of the methodology follows and finally the case-study object of the analysis is widely presented and discussed. The conclusions and directions for future researches end the paper.

Literature review

Circular economy

A CE is a system where all activities, starting from the extraction of raw materials and the manufacturing of products, are organized so that the waste generated becomes a resource for other actors in the economic system (Rizos et al., 2017). The concept of CE has its roots in various schools of thought and theories that undermine the current economic system based on the over-consumption of natural resources (Rizos et al., 2017). Recently, CE has received growing attention worldwide because of the increasing emphasis on transparency and reliability of the supply of resources and efficiency in their use that have been recognized as two fundamental points for the prosperity of economies and businesses (Rizos et al., 2017).

From the first formal use of the term CE (Bennett et al., 1991), there have been several attempts to find a univocal definition of this concept. Some authors provided resource-oriented interpretations, emphasizing the need to create closed-loop material flows and reduce the consumption of virgin resources and harmful environmental impacts (Van Buren et al., 2016; Webster, 2013; Witjes and Lozano, 2016; Yong, 2007).

Other authors extended the concept to the use of sustainable energy and the sustainable exploitation of all the natural resources (Rizos et al., 2017; Zhu et al., 2010). In some

cases, the economic dimension of the CE has been also taken into consideration (Bennett et al., 1991; Preston, 2012).

One of the most cited definitions of CE that incorporates elements of various disciplines has been provided by the Ellen MacArthur Foundation (Ellen Macarthur Foundation, 2013), which describes the CE as "*an industrial system that is restorative or regenerative by intention and design. It replaces the 'end-of-life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impairs reuse, and aims for the elimination of waste through the superior design of materials, products, systems, and, within this, business models*".

This concept has been adopted by several governments and companies worldwide that consider CE a solution to reconcile objectives linked to economic growth and environmental sustainability, that at first sight seem to be in conflict with each other (European Environment Agency, 2014; Mitchell, 2015; Preston, 2012; Witjes and Lozano, 2016).

The change in the linear economic model, which remained dominant since the beginning of the first industrial revolution, is by no means an easy task and involves a transformation in the current models of production and consumption. Innovative transformation technologies, such as digital and engineering technologies, combined with the creative thinking of CE, are the way to guide these fundamental changes in all the value chains (Bastein et al., 2013; Ghisellini et al., 2016; Heck, 2006; Su et al., 2013).

Such an important transformation would have a significant impact on economy, environment, and society. Understanding the relevance of these impacts is essential for researchers and policy makers to develop effective future policies to be applied in this area (Rizos et al., 2017).

Supply chain collaboration for circular economy

The structure and the configuration of the SC plays an important role to pursue a CE strategy (Zhu et al., 2010). Winkler (2011) showed that, through an adequate and sustainable SC management, a CE involving the different actors can be created.

In particular, CE requires to rely on SC collaborations (Cao et al., 2010; Manthou et al., 2004) and that the companies of the same supply network are committed in sustainable activities (Genovese et al., 2017), pursuing the same ideals. Therefore, it is unthinkable that a single company can implement CE on its own (Winkler, 2011). Indeed, when companies establish long-term relationships and work closely by sharing common goals, information, resources, and risks, and making joint decisions, they achieve more benefits than acting autonomously (Scholten and Schilder, 2015; Sheu et al., 2006).

SC collaboration can be defined as "*connecting a network of actors in their SC by managing data transparency, material flows and exchanges, responsibilities, predictability and sharing benefits*" (Leising et al., 2017).

As suggested by Cao et al. (2010), seven main practices characterise SC collaboration (Table I.)

Table 1 - Collaboration practices

Collaboration practice	**Description**	**References**
Information sharing	Sharing ideas, plans and procedures.	Cao et al. (2010); Manthou et al. (2004); Simatupang and Sridharan (2005)
Goal congruence	Sharing the same objectives among SC partners.	Cao et al. (2010)

Decision synchronization	Organizing the decisions related to SC planning, operations and solution seeking, in order to optimise SC benefits.	Cao et al. (2010); Simatupang and Sridharan (2005)
Incentive alignment	Sharing costs and risks among SC partners.	Cao et al., (2010); Paulraj et al. (2008); Simatupang and Sridharan (2005)
Resource sharing	Sharing of capabilities and assets.	Sheu et al. (2006); Cao et al. (2010)
Collaborative communication	Means the frequency, direction and mode of the transmission process of contacts and messages among SC partners.	Paulraj et al. (2008); Cao et al. (2010)
Joint knowledge creation	To develop "*a better understanding of and response to the market and competitive environment by learning and working together*".	Cao et al. (2010)

SC collaboration can provide benefits in the CE field, by achieving higher value-added product recovery and leading to new business models (Kozniewski et al., 2017).

The CE increased complexity and an expanded scope of SC operations (Rizos et al., 2016) require thorough knowledge of the network of actors (Genovese et al., 2017; Nasir et al., 2017), where the management of activities is conducted by a plurality of actors and the role of leader can be covered by different players and modified over time, as required in a networked system. Here, the priorities are to achieve an effective connection throughout the system and to maintain high flexibility regarding changes in final demand. The distinctive innovations and skills on which the networked enterprise is based are of a strategic-organisational nature, as they tend to develop a global entrepreneurial vision and manage many relationships in order to create synergies and to pursue common goals. In particular, the configuration of sustainable SC networks, intended as a "*set of different companies that work together to realize a sustainable CE*", is recommended in the context of CE, in order to close process chains (Winkler, 2011).

Therefore, through our research we want to shed light on the following research questions:

RQ1: Can SC collaboration practices among SC partners help to strengthen a CE strategy in the textile industry?

RQ2: What are the best collaboration practices that carry out this task?

By answering to these questions, we hope to reach a better understanding on how the textile industry approaches the environmental challenges posed by a linear (i.e. traditional) SC.

Methodology

As stated in the introduction, the topic of CE is still unexplored, therefore there is room to conduct case study research and identify concepts, constructs and variables worthy to be analysed (Ketokivi and Choi, 2014).

Particularly, we selected SC as unit of analysis to gain an in-depth view of the circularity characterizing it. As the aim of this research was to analyse the strategies adopted within a circular SC and the relationships among the different actors that helped in the transition towards a CE, a single-based case study characterised by interviews at multiple levels of its SC was identified as the best approach to follow (Gerring, 2004; Meredith, 1998).

A company and its SC, that are leading the way to a CE in the textile sector, were studied. In particular, the case we decided to rely on is the MUD Jeans SC. MUD Jeans is a Dutch company, founded in 2012, that is having success thanks to the offering of

clothing products realized from recycled denim. We started by interviewing MUD Jeans' CEO in September 2017, and then we climbed the SC up by meeting first-tier and second-tier suppliers. Table 2 reports a general description of the interviewed companies' data.

Table 2 - Interviewed companies' data

Company	Position in the SC	Core business	Country	Turnover (2016)	Number of employees (2016)	Interviewed people
MUD Jeans	Retailer	Retail and recovery of jeans and jumpers	Netherland	1 mln €[1]	10[1]	Entrepreneur and CEO
Salgari	Weaving	Fabrics for clothing products (jumpers for MUD Jeans)	Italy	4.5 mln €	215	CEO and Production chain responsible
Orta Anadolu	Weaving	Ecologic fabrics for denim	Turkey	138 mln €	1534 (2013)[2]	Marketing director and sustainability responsible
Pinori Filati	Spinning	Ecologic yarns	Italy	10.5 mln €	48	Entrepreneur and CEO

All the interviews were recorded and then transcribed. We also triangulated data with multiple sources: companies' websites, literature and press articles about the companies, databases with balance sheets data. All the information has undergone a coding process that involved multiple researchers with background in different disciplines in order to identify all the aspects of interest (Voss et al., 2016).

Results

The case company

MUD Jeans is a Dutch sustainable denim brand certified B Corp (bcorporation.eu). MUD Jeans is continually taking steps in its journey towards the making of a zero-waste denim cycle. The garments marketed by MUD Jeans are produced using exclusively denim fabric, which is manufactured using organic and recycled cotton. The used fabrics consist of 40% recycled yarns, the highest percentage ever used in denim. The decision to market this kind of products arises from the initial idea of operating from a CE perspective, based on concepts such as the recovery, reuse and recycling of products and materials. In order to operate in this economic context, MUD Jeans has adopted a use-oriented business model (Tukker, 2004); this has been identified as one of the possible enabling actions for the implementation of CE strategies (Genovese et al., 2017; Sheu et al., 2006).

In 2013, indeed, MUD Jeans introduced the innovative 'Lease A Jeans' business model. This service is achieving resounding success among the consumers. It allows the company to get back its products (recovery) and to re-introduce denim into final market (reuse) or to re-introduce the materials into the production cycle through recycling processes, generating new products (recycling). This initiative, as shown in Figure 1, is aligned with the company philosophy of operating in a CE context where products are recovered after their use and reinserted into the production cycle, thus closing the loop.

[1] Data provided by the CEO during the interview. Secondary data not available.
[2] Data in the Corporate Social Responsibility report. 2013 was the last year available.

MUD Jeans, indeed, designs its products adopting a circular design approach, avoiding the use of leather labels, using printed ones (Circular Design). The worn jeans are shredded, cut into pieces and mixed with virgin cotton (Recycle). Even old jeans are recycled, and they are sold as vintage products (Upcycle). For production, only GOTS (Global Organic Textile Standard) certified cottons are used (Produce). It is possible to either buy or rent a jeans, becoming part of the MUD community (Lease or Buy). Finally, the worn jeans can be returned to the company, starting a new phase of recycling (Use & Return).

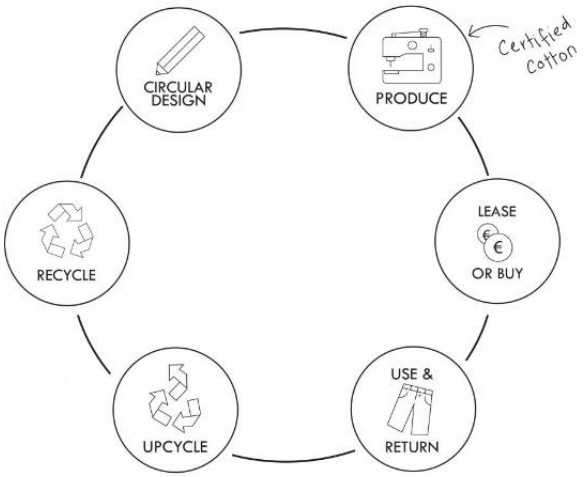

Figure 1 - CE by MUD Jeans
Source: www.mudjeans.eu

Furthermore, the company is always trying to improve the production methods, e.g. by increasing the percentage of recycled denim of its products, thanks to the collaboration with Recover and Royo, two suppliers located in Valencia. While Recover is an expert on unravelling and spinning process, Royo is a specialist of weaving and dyeing: each has its own skills and expertise and thus the circle can be closed together. In fact, MUD Jeans is a retailer since the activities performed directly just concern the relationship with the end customer (sale/lease, recovery of the garments), while all the production and recycling activities are entrusted to external companies.

As shown in Figure 2, the partners of MUD Jeans are mainly located in the Mediterranean area to foster communication and collaboration, and for technical and social issues (e.g. employee working conditions). MUD Jeans selects its partners not only on an economic, technological, qualitative and technical basis, but also with environmental and social sustainability criteria, as stated by its CEO and founder:

"At MUD Jeans we keep our list of suppliers short and only choose factories that are innovative in their thinking on sustainability".

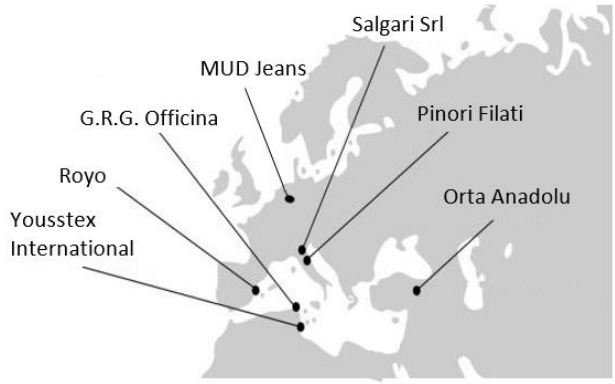

Figure 2 - MUD Jeans' partners
Source: www.mudjeans.eu

To guarantee that the final products meet high quality and environmental standards, the company must ensure that all the partners involved in the different stages of the SC (cotton supplier, spinning mill, weaving factory, etc.) operate in a responsible and sustainable manner, in line with CE philosophy.

Figure 3 clearly shows that MUD's worn out jeans are sent to Recover, in Spain, or to Pinori Filati, in Italy. Here the jeans are shredded and mixed with new organic cotton and new spun yarns containing recycled denim are created and with them new products (denim and jumpers) are manufactured[3].

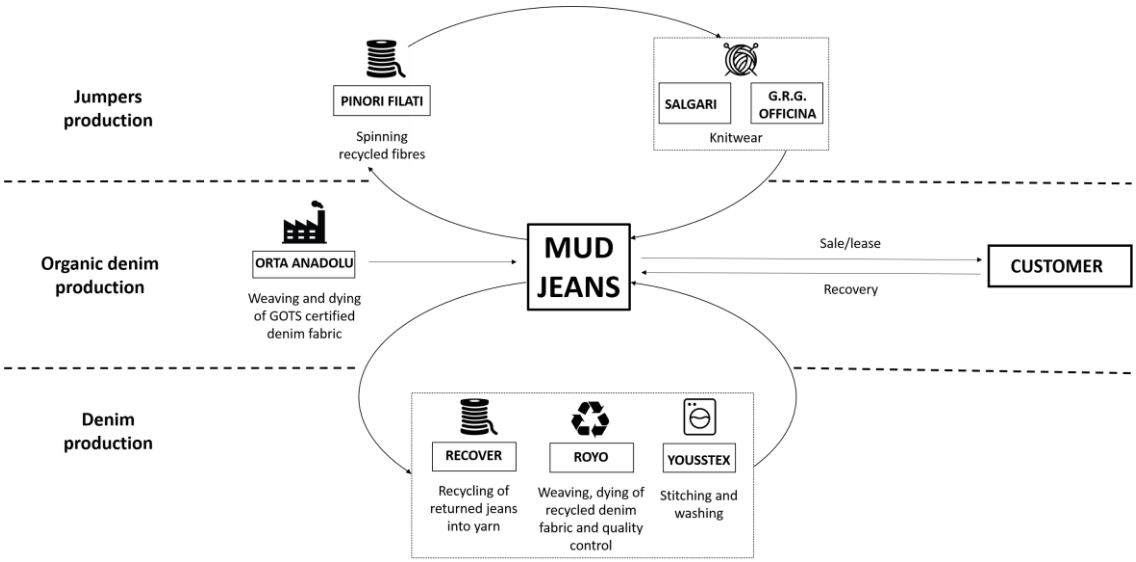

Figure 3 - MUD Jeans' SC

Supply chain collaboration

MUD Jeans, like many other brands of the apparel industry, has chosen a networked organization. Since circular business models are by their nature networked, collaboration, communication, and coordination among different actors emerge as essential (Antikainen and Valkokari, 2016; Van Buren et al., 2016; Rizos et al., 2017), as also stated by the Sustainability Manager of Orta Anadolu, a Turkish denim manufacturer and MUD Jeans' partner: *"No big change can be done by single attempts; big revolutions require big*

[3] www.mudjeans.eu

efforts. This is why a unity within the industry is very important and precious; it is also why we value collaborations in our aim to change for better".

In order to implement its idea of CE in the textile industry, MUD Jeans searches for and establish strong collaborations and partnerships with companies that share its same objectives in terms of sustainability, recycling and recovery of materials, as shown in Table 3.

Table 3 - MUD Jeans' collaboration practices

Collaboration practices	Examples from MUD Jeans
Information sharing	- Sharing a variety of complete and confidential plans and information with its SC partners and customers.
Goal congruence	- As MUD Jeans, also the partners place sustainability at the core of all their activities, since "sustainability is 'business as usual'"[4], hence their main goal is sustainable production.
Decision synchronization	- MUD Jeans designed and industrialized a new kind of product working together Salgari, his main supplier of knitwear. They also plan together product assortment.
Incentive alignment	- Royo in 2014 created a fabric made out of recycled denim fibres, sharing costs, risks and benefits with MUD Jeans.
Resource sharing	- Orta Anadolu[4] works on a regular basis on a MUD Jeans' GOTS certified product, using its eco-friendly dyeing process called Indigo Flow.
Collaborative communication	- For MUD Jeans it is important to have a close and trustful relationship with the people who work with it.
Joint knowledge creation	- Orta Anadolu[4] worked together with MUD Jeans to communicate what Indigo Flow is and how it works, putting joint knowledge creation in practice. - With over 80% of sales being in denim, MUD Jeans has decided to work with only one garment manufacturer (Yousstex). which also has its in-house laundry. In that way, MUD Jeans creates a win-win partnership and it is able to get a leverage on its supplier.

Discussion

Compared to other companies, that look at sustainability and CE as secondary businesses, MUD Jeans considers them as its core-businesses. However, the endeavour of MUD Jeans is not easy, due to the common belief that recycled fabrics have no durability and low quality. The company therefore, together with its partners, has to work hard to ensure high-quality products using recycled textiles fibres, creating a lot of benefits for customers (i.e. creating high-quality and eco-friendly products). In such a context, the establishment of closed-loop production systems supports the realization of economic and environmental improvements for the companies (Winkler, 2011) and, in this regard, the realization of circular SC plays a strategic role. In particular, as reinforced by the interviews, the difficulties to achieve benefits in terms of CE are overcome by establishing a strong commitment among the different players involved in product and service life cycle (Paulraj et al., 2008; Simatupang and Sridharan, 2005). Such empirical evidence demonstrates that SC collaboration practices among SC partners help strengthen the CE strategy (RQ1). Moreover, it reinforce theory about SC, underlying that that collaborative SC management has a major role in the transition towards a CE (Genovese et al., 2017), while a joint support of all stakeholders is necessary to successfully implement the CE concept at large scale (Witjes and Lozano, 2016).

As regard to the second research question, we found that all the practices for SC collaboration identified in literature (Cao et al., 2010) are adopted by our best case, even

[4] www.ortaanadolu.com

if some of them are much more strategic in creating value (e.g. goal congruence, resource sharing and joint knowledge creation). Interestingly, we found that all the partners have understood the importance of these practices, so much that their adoption spread also at the lowest level of the SC. For example, Salgari and Pinori Filati have jointly collaborated in the creation of a new recycled product, sponsored by MUD Jeans that, as SC coordinator, fosters these collaborations among its partners.

Conclusions, limitations, and future research

In this paper, the key role played by all the actors in creating a circular SC and thus supporting the transition towards a CE is discussed and used to shed lights on how close collaboration with partners can be a key factor to drive sustainable improvements across the entire value chain (Rizos et al., 2016; Sheu et al., 2006). This contributes to deepen our knowledge about CE and its effects on SC management.

This study does not come without limitations, thus leaving room for future developments. First, additional case studies from textile industry could confirm the presented results. Moreover, since the focus is on the textile sector, case studies from other industries could generalize the findings. Another point not considered in this research is the economic dimension of CE. Future studies may also evaluate the economic convenience of the different SC collaboration practices.

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