Greening Corridors

Transition towards Circular Supply Chain Management for Logistic Service Providers

A case study

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Abstract

This paper aims to explore the key challenges and opportunities in the transition towards circular supply chains (CSCs), specifically as seen by logistic service providers.

Design/methodology approach – This adapts a single case study, exploring in depth the perspective of the logistic services provider regarding the challenges and opportunities of the transition towards CSCs.

Findings In total, we identified twenty challenges and seventeen opportunities. The most salient findings derive from the following four main factors:

1. most of the opportunities relate to economic benefits, whereas most of the challenges relate to a knowledge or skills gap concerning CSC design aspects;
2. Industry 4.0 technology aspects are perceived as pre-requisites for collaborations in CSCs.
3. the challenges and opportunities relate almost equally to strategic/tactical decision-making, and to tactical/operational decision-elements;
4. more stringent legislation and compliance aspects are changing the rules of the game for the LSP in a CSC.

Originality - As research in circular supply chains is rather immature, the paper provides more knowledge ad a better understanding in the concept of circular supply chains.

Research limitations/implications – The paper shows the need for comprehensively reviewing and elaborating on the research gap in the transition towards circular supply. Furthermore, our data exposes the interdisciplinary nature of the problem.

Practical implications – The results of this paper do not present a managerial blueprint but can be helpful for practitioners dealing with aspects of decision-making in the transition towards circular supply chains.

Social implications – The findings add value, as an effective transition towards circular supply chains may create momentum for a higher level of circularity, and thereby sustainability.

Introduction

In the past decades, various green and sustainable supply chain management practices have been initiated to reduce negative environmental impact. Recently, increasing interest is also noticeable in the concept of a circular economy (CE) that focuses mainly on the cycles of resources, while sustainability encompasses the 3Ps: people, planet, profit (Elkington, 2013; Lengyel et al., 2021). CE represents one of the most promising avenues for addressing the ecological degradation that threatens the global environment (Hazen et al., 2021). 'Circular economy pushes the frontiers of environmental sustainability by emphasising the idea of transforming products in such a way that there are workable relationships between ecological systems and economic growth' (Genovese et al., 2017, p.344). This suggests that the transition towards circular economy (CE) principles within supply chains reflects a broader societal shift towards sustainable development strategies. Various technological developments, limited resources, environmental issues and directives also support this shift (Rosa, Sassanelli, & Terzi, 2019). Given the need to become more sustainable, CE is increasingly recognized as better than the dominant linear economic model (take, make, and dispose) (Farooque et al., 2019). This forces the whole supply chain to rethink their rather traditional supply chain principles and adapt to CE principles (Bals, Tate, & Ellram, 2022; Gatenholm, Halldórsson, & Bäckstrand, 2021). Circular Supply Chain Management (CSCM) 'offers a compelling perspective that includes the vision of a zero-waste economy and the restorative and regenerative cycles design based on circular thinking' (González-Sánchez et al., 2020, p. 7). This involves more return processes, initiated by the restorative and regenerative cycles, with the accompanying challenges posed by aspects such as more actors, new relationships, and the involvement of more than one sector.

A transition towards circular supply chains (CSCs) involves a change from traditional linear or closed loop supply chain patterns towards open loop supply chains, also referred to as circular pattern characteristics (Bals, Tate, & Ellram, 2022; Taddei et al., 2022) (see Figure 1).

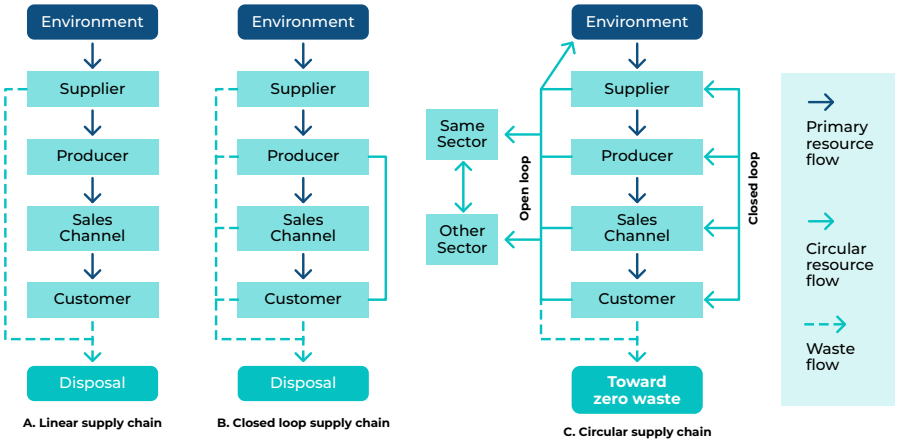

Figure 1 Linear, closed loop and circular supply chains (Farooque et al., 2019)

This transition suggests that collaboration between organisations in CSCs should also play a critical role in maintaining and improving performance, creating competitive advantage, and supporting the CE principles (Akkermans, Bogerd, & Vos, 1999; Barratt, 2004; Nimmy, Arjun, & Madhusudanan, 2019; Simatupang & Sridharan, 2008; Wankmüller & Reiner, 2020). According to Zhang et al. (2019), 'A transition to circular economy requires a paradigm shift to an innovative and more sustainable supply chain ecosystem.' This ecosystem will include competitive CSCs, which must be managed and aligned on the basis of their specific characteristics, as well as increasing progressive sustainability directives. Christopher (2016) stated that there is no "one size fits all" supply chain since product and market characteristics differ per situation. This suggests that in the design of CSCs a similar challenge arises involving how to make the CSC fit the requirements of the product/market environment (Malhotra, 2023).

In existing literature, much attention has already been paid to this transition towards a CE from governmental perspectives, macro-economic aspects, public dimensions, and social development (Mangla et al., 2018; Masi et al., 2018). Supply chain management in general is well-established, yet a review of the extant literature shows that a comprehensive integrated view of CSCM is still absent. This suggests the need for further research on the adaptation of the chain to CE principles (González-Sánchez et al., 2020; Homrich et al., 2018; Rosa, Sassanelli, & Terzi, 2019), to further develop knowledge and deepen the insights. This paper responds to the urgent need

for more focus on developing the insights and knowledge to explore how logistic service providers (LSPs) need to adapt to the pioneering transition towards a circular supply chain (Abbasi & Nilsson, 2016; Lieb & Lieb, 2010)). The role and perspective of LSPs in supply chains provides new insights into making supply chains circular, since they play a dominant role in CSCs in distribution, handling, and storing of freight as a result of the increased outsourcing of logistical services to LSPs (Abbasi & Nilsson, 2016; Wolf & Seuring, 2010). As CSC efficiency and competitiveness remain essential for business continuation, it is of interest to gain a better understanding of how LSPs can support this transition, while remaining open to new emerging beneficial business propositions as a result of the new sustainable development strategies. The research question that will be answered in this paper is:

What are the key challenges and opportunities for logistics service providers in the transition towards circular supply chains?

The results presented in this paper are based on a single case study, exploring in depth the perspective of the logistic services provider regarding the challenges and opportunities of the transition towards CSCs. Our study seeks to identify and explore key challenges and opportunities in the transition towards a circular supply chain, while focusing on the view of the logistic service provider. In addition, we explore how the findings lead to discussion and suggestions for further avenues of research in CE principles.

This paper is structured as follows. We will first describe the existing theoretical background as it relates to CE supply chain principles. This is followed by an explanation of the research methodology employed, and the results of the collected empirical data. Subsequently, the paper provides a thematic case study analysis, which leads to the discussion and suggestions for further avenues of research.

Theoretical Background

Circular supply chains: the landscape

Circular Supply Chain Management (CSCM), which integrates the philosophy of the circular economy into supply chain management, offers a new and compelling perspective to the supply chain sustainability domain (Farooque et al., 2019). Since the 1990s, supply chains instead of individual firms started to compete with each other (Christopher, 2016; Jägers, Jansen, & Steenbakkers, 1998). In the past, the primary focus was on creating a single plan for the internal flow of products and information through a business; currently, in circular supply chains (CSCs), more effort needs to be put into inter-organisational collaboration.

Definitions of CSCs originate in labels such as 'supply chain 4.0', 'green supply chain', 'closed-loop supply chain', 'sustainable supply chain', 'circular supply chain (collaboration)'. Geissdoerfer et al. (2018) define CSC as: 'The supply chain that allows to close, narrow, slow down, intensify, and dematerialize resource loops.' Singhal, Tripathy and Jena (2019) define CSC as: 'CSC helps organizations in making efficient use of resources and results in increased value to the society.'

It is interesting to conclude from existing systematic literature reviews that next to the various denominations, also the enablers or drivers for CSCs can vary a lot. Key enablers or drivers for CSC are described as (Lahane, Kant, & Shankar, 2020; Mota et al., 2015; Roci et al., 2022): business and economic benefit, risk perception, environmental demands, scarcity of resources, circular value proposition, policy, laws and directives, training and education. Moreover, these various enablers or drivers denote that the definitions also differ in the level of abstractness, and thereby the process details. As the goal in this paper is to identify and explore challenges and opportunities in the transition towards CSCs, there is a need for more process details in the definition. A lower level of abstractness is preferable. Therefore, we will apply the definition of Singhal, Tripathy and Jena (2019), who state that 'the efficient use of resources and results in increased value to the society' can be taken as a starting point to explore the CSC challenges and opportunities.

CSC Challenges, opportunities and drivers from extant literature

Various systematic literature reviews summarize identified challenges and opportunities for the development and implementation of CSC based on existing literature (Hazen et al., 2021; Lahane, Kant, & Shankar, 2020; Taddei et al., 2022). This sums up many identified challenges, mostly relating to the manufacturing context (Taddei et al., 2022). Some key challenges (see Table 1) mentioned are: lack of expertise, high costs of remanufacturing products, lack of performance measurement systems, organizational needs, lack of information exchange between stakeholders, and lack of information in general.

Table 1 CSCM challenges (Lahane, Kant, & Shankar, 2020, p.13)

Author & Year	Barriers/Obstacles	Application/Industry/Country
Agyemang et al. (2019)	Lack of expertise, Lack of awareness, Resistance to change, Cost and financial constraint, Lack of technical and technological capacity, Learning process and associated risk, Lack of resource, Profit and market demand level, Feasibility of CE implementation, Quality of recovered material, Lack of government policies, Lack of industrial support, Lack of supply chain integration, Lack of supply chain complexity	CSM; Automobile; China
Levering and Vos (2019)	Economies of scale, High costs of CE, Lack of Stakeholders interests, Organizational needs.	CSM; Manufacturing; Netherlands
Tura et al. (2019)	Lack of top management support, High cost of remanufacture products, Lack of performance measurement system, Lack of social awareness, Consumer behaviour towards remanufacture products, Lack of market for remanufacture products, Lack of clear incentives, Lack of regulatory acts, Lack of governmental support, Lack of information and knowledge, Lack of technologies and technical skills, Lack of support and partners, Strong industrial focus on linear models, Lack of collaboration and resources, Incompatibility with existing (linear) operations and development targets, Lack of risk management, Conflicts with existing business culture, Lack of internal cooperation among employees, Heavy organizational hierarchy.	CSM; Manufacturing; Finland
Vermunt et al. (2019)	Lack of financial resources, High upfront investment, Higher costs related to the new circular business model, Administrative burden, Lack of proper organizational structure for CE implementation, Complex management and planning processes, Lack of technical expertise, Lack of information, Lack of quality products, Design challenge, Lack of resources, Higher dependence on external parties, Lack of information exchange between supply chain actors, Lack of circular design aspects, Reluctance of other parties, Lack of government interest, Resistance from stakeholders, Ineffective recycling policies, Lack of management support, Lack of standard and guidelines for refurbishment products, Lack of awareness and sense of urgency.	CSM; Manufacturing; Netherlands
Govindan and Hasanagic (2018)	Lack of standard system for performance measurement, Unclear vision, Lack of laws and policies, Insufficient fund, High upfront investment cost, High production cost, Design challenges, Lack of information, Lack of awareness, Lack of knowledge, Poor leadership, Lack of flexible framework, Consumers behaviour towards remanufacture products, Take-back issues, Lack of standards on refurbished products, Limited availability of reuse products.	CSM; Manufacturing; Denmark

Mangla et al. (2018)	Lack of industrial incentives for green environmental laws and regulations, Lack of preferential tax policies, Lack of employee involvement in promoting greener products, Lack of customer awareness, Poor acceptance for environmentally superior technologies, Lack of partnerships, Lack of knowledge, Lack of training and education, Lack of effective planning and management, Lack of systematic information systems, Lack of coordination and collaboration among SC members, Resistance from stakeholders, Lack of economic benefits.	CSM; Manufacturing; India
Masi et al. (2018)	Lack of awareness and sense of urgency, High up-front investment, High cost of remanufacture products, Higher costs for management and planning of business, Competition legislation inhibits, Collaboration between companies, Lack of recycling policies, Lack of responsibilities, Liabilities and ownership, Lack of sustainable business models, Lack of an information exchange system between different stakeholders, Lack of performance measurement system, Lack of products design attention to CE perspectives, Lack of recycling material availability.	CSM; Manufacturing; England

Research states that the wide range of challenges and opportunities relates to specific dimensions of CSC, and this provides possibilities to categorize the findings. Taddei et al. (2022), describe four dimensions that are suitable for categorizing the CSC challenges and opportunities: Life cycle phase (related to product phases), Industry 4.0 technology (intelligent technology aspects, such as IoT, , Big Data, Blockchain and Robotics AI), Triple Bottom Line (TBL, related to the alignment of Economic, Environmental, Social aspects), and CE strategy (related to aspects, such as R-ladder, servitization, circular design). This framework is helpful by providing a conceptual structure that can assist in organizing and categorizing opportunities and barriers in the field of CSC.

According to Hazen et al. (2021), several drivers of CE development within SCM can be distinguished: Customer relationship management, Supplier relationship management, Customer service management, Demand management, Order fulfilment management, Manufacturing flow management, Product development and commercialization and Return management. This suggests that this research area of CE development in supply chains is quite interdisciplinary in nature and should be handled as such (van Beusekom–Thoolen et al., 2023).

For this paper, the three dimensions of Taddei et al. (2022) will serve as a loose framework (Lämsä & Takala, 2000) to organise and categorise the findings emerging from the empirical data, which are Triple Bottom Line, CE strategy and Industry 4.0 technology. Triple Bottom Line (TBL) addresses aspects of economic, environmental, or social opportunities and/or challenges, CE strategies relates to the reuse-recycle-remanufacturing, waste management, material, and energy efficiency as prevalent topics. Industry 4.0 Technology relates to the integration of intelligent digital technologies into manufacturing and other industrial processes. These three dimensions have been included in the analysis due to their relevance for exploring and categorizing the specifics of the research context, logistics service providers, investigated in this study.

Logistic service providers and Circular Supply Chains

LSPs represent a key supply chain position that can be more or less upstream, midstream, or downstream in the CSC (van Hoek, 1999). It is interesting to note that LSPs can add value upstream as well as downstream in CSCs. Based on existing literature, we can identify primary logistics activities for stimulating the development towards CSC from a LSP perspective, such as: a) internal resources efficiency, effectiveness, and utilization, b) circular behavioural cautiousness, and c) measurement and assessment (Abbasi & Nilsson, 2016). Secondary activities for stimulating this transition are identified as: a) taking initiatives (such as the UN Global Compact), b) compliance with legislation and standards, c) efficient utilization of external logistical infrastructure, d) well-connected information and goods flows, and e) vertical & horizontal collaboration. However, clear and empirically validated insights into the challenges and opportunities of these logistics activities in the transition towards CSC, in the view of the LSPs, are still scarce.

Research methods

Exploratory study

Given the relatively scarce availability of research into the transition towards circular supply chains, from the point of view of the logistics service provider, there is a need to better understand the challenges and opportunities involved in this transition. We employed an exploratory, qualitative research design. In our research we aim to study and understand the phenomenon of the transition towards circular supply chains, with its interaction between various business, policy, and social contexts. By remaining open to emergent phenomena, our understanding of the dynamics of this transition within its complex social reality is expected to increase. Our aim to study the transition towards a circular supply chain suggests that a qualitative approach may help us explore what happens during this transition.

In our research we have opted for a single case study, gathering the information from a leading international logistic service provider, in order to better understand the context and provide more compelling results (Yin, 2018). A single well-chosen case study can be a powerful example to illustrate a phenomenon, in our research the transition towards circular supply chains. The depth of a case study can lead to a better understanding of the underlying mechanisms and factors that influence this transition for LSPs. In other words, the immersion in rich data enables the use of case studies as inspiration for new ideas (Siggelkow, 2007, p. 21). A single case can effectively illustrate theoretical constructs and causal relationships by providing concrete examples within a specific context. While a single case may not be statistically representative, it can be strategically selected for its ability to provide unique insights that other cases might not. The depth and detail provided by a single case can highlight important variables and relationships that might be missed in larger, less detailed studies.

The truth-value is addressed by the details described in which the results surfaced from the data (Lincoln & Guba, 1985). Traceability is addressed by describing and following the study protocol in our dataset, creating an audit trail with a research journal, and filing the collected data.

Data collection and analysis method

Three representatives of a large international LSP were asked to elaborate on their insights into the challenges and opportunities in the transition towards a circular supply chain. The interviews were conducted in June 2024. One participant was selected from the existing network of contacts of the researchers involved, the other two were selected by snowball-sampling. The representatives are employed at the LSP as: head of business development, QESH manager, and marketing manager. The participants are responsible for the decision-making process in this transition, mainly from a strategic and sustainability perspective within their organisation.

The aim of the semi-structured interview was to collect rich in-depth data, experiences, and views, with regard to the challenges and opportunities in the transition towards a CSC. The semi-structured interview was transcribed and coded (Miles & Huberman, 1994). Finally, the data was analysed by coding the transcript by two of the authors, which led to the thematic analysis (Braun & Clarke, 2006). The data was analysed using an abductive research approach, as we neither followed the pattern of pure deductive nor of pure inductive: we adopted theory-building elements by simultaneously performing the data collection and theory development (Kovács & Spens, 2005). Coding was done based on the question ‘What are the key challenges and opportunities in the transition towards a circular supply chain?’. After

coding, the code list was checked for duplication and similarities, and codes were combined or deleted. The emerged codes are organised and categorised based on the primary content the interviewee discussed in relation to one of the dimensions of Taddei et al. (2022): Triple Bottom Line, CE strategy and Industry 4.0 technology.

Finally, our research team has expertise in different relevant disciplines (logistics and supply chain management, sustainability, circular economy, and organisational science), strengthening the interdisciplinary character of the study.

Findings

Thematic analysis: emergence of key challenges and opportunities

A thematic analysis of the textual data generated led to the identification of twenty challenges and seventeen opportunities (see Table 2).

Table 2 Emerged challenges and opportunities for the transition towards circular supply chains.

Dimension	Emerged opportunities for the transition towards circular supply chains	Decision-making level
CE strategy	Become more knowledgeable in the CE principies	Strategic/tactical
CE strategy	Add on to existing CE developments at the customer	Tactical/operational
CE strategy	New return flow concepts - downstream the SC	Tactical/operational
CE strategy	New logistic concepts due to new (EU) legislation	Tactical/operational
CE strategy	Create a wide distribution/ consolidation network for collection hubs	Tactical/operational
CE strategy	Support CE product design to make a transition more easily	Tactical/operational
CE strategy	Seize opportunities by concverting existing business with CE principles	Strategic/tactical
Industry 4.0 technology	Initiate discussion on automation feasibility	Tactical/operational
Triple Bottom Line	Become more pro-active towards customers dealing with upcoming CE principles	Strategic/tactical
Triple Bottom Line	Develop jointly new propositions with your customers	Strategic/tactical
Triple Bottom Line	Adapt to individual (potential) customer demands	Tactical/operational
Triple Bottom Line	Long term contracts with customers build strong relationships	Strategic/tactical
Triple Bottom Line	Initiate development due to legislation/directives	Strategic/tactical
Triple Bottom Line	Develop new business models	Strategic/tactical

Triple Bottom Line	New business by focusing on market potential	Strategic/tactical
Triple Bottom Line	Join frontrunner-customers in their development	Strategic/tactical
Triple Bottom Line	New logistics business propositions	Strategic/tactical
Dimension	Emerged challenges for the transition towards circular supply chains	Decision-making level
CE strategy	Undear to what extend decision-making elements prioritize sustainability aspects for the customer	Strategic/tactical
CE strategy	Undear if sustainability is induded in the decision-making elements at the customer	Strategic/tactical
CE strategy	Lack of being innovative as LSP, focus on traditional business	Strategic/tactical
CE strategy	Lack of knowledge of business impact due to CE principles	Strategic/tactical
CE strategy	Changes related to CE principles mainly originated on market demand (re-active)	Strategic/tactical
CE strategy	Limited knowledge and experience within LSP's of business opportunities based on CE principles	Strategic/tactical
Industry 4.0 technology	Lack of an intelligent IT platform to offer smart return solutions	Strategic/tactical
Industry 4.0 technology	Lack of a company wide IT network to connect the various locations/hubs	Strategic/tactical
Triple Bottom Line	Lack of circular mindset of consumers	Strategic/tactical
Triple Bottom Line	Inconsistency of customers how to prioritize people, plant, profit aspects	Strategic/tactical
CE strategy	Lack of knowledge how to deal with the return flow at the (end)consumer and stores	Tactical/operational
CE strategy	Lack of insight in to potential volumes of the return good flows	Tactical/operational
CE strategy	Lack of insight in to willingness of consumers to return products	Tactical/operational
CE strategy	Lack of a central data collection location	Tactical/operational
CE strategy	Lack of human supervision of the return flows at locations	Tactical/operational
CE strategy	Lack of upscaling knowledge	Tactical/operational
CE strategy	Lack of knowledge world-wide, at what locations, the returns flows should be handled	Tactical/operational
Triple Bottom Line	Lack of executing sustainability goals due to higher costs	Tactical/operational
Triple Bottom Line	High costs for upscaling the network	Tactical/operational
Triple Bottom Line	Limited business impact for thin return flows	Tactical/operational

When comparing the results that emerged from the data, no distinct differences are apparent in the views on the challenges, or the opportunities as seen by the three representatives.

Analysis of emerged challenges and opportunities

Our analysis of the emerged challenges and opportunities indicates that opportunities related to the economic benefits (TBL) were most strongly emphasized in the interviews, whereas knowledge or skills gap as part of CSC design aspects (CE strategy) were most strongly stressed as the main challenge for a transition towards CSCs. This suggests a balancing act: the LSP must consider how much they are willing to invest now, in bridging this knowledge gap, in order to gain economic benefit in the future. As these CSCs can be perceived as a rather new and innovative research area, the existing knowledge might not yet be integrated within the LSP. Another explanation for the existing knowledge gap might be that the required skills for LSP personnel are changing. By further analysing the findings, we can also conclude that the lack of knowledge relates to various research areas, such as supply chain design, procurement and supplier management, operation management, strategic management, digital transformation, consumer behaviour, quality management, and circular economy. These various research areas indicate the need for more extensive interdisciplinary research, to better understand and deepen the knowledge and support the transition towards CSCs.

Another marked finding is that Industry 4.0 technology aspects are only discussed briefly, even though respondents stated that IT platforms and data sharing are seen as pre-requisites for all collaboration in CSCs.

Quote Business development: "[...] and having realised an actual start for all your locations, it requires that they are connected through an IT platform. In my opinion, that is the foundation for trends like this."

This suggests that the role of data and intelligence technologies (Industry 4.0 technology) in the CSC deserves further study. An explanation for the limited attention paid may be that they consider this matter rather evident, and so these insights become rather implicit. Another explanation might be that the representatives themselves are not familiar with intelligent technology aspects, and so just state the importance without discussing the means in depth.

The analysis also suggests that the LSP appears to struggle with what role they should play in CSCs towards their customers: a more leading or rather a more following role? The representatives mention that they perceive various new business opportunities, which could enhance the economic benefits. By pro-actively stimulating their customers in the transition towards CSCs, they could take a leading role in these CSCs. On the other hand, they also appear to realize that their organisation tends to be rather pragmatic and cost-focused in nature, re-actively following the market demand.

Quote QESH "So, when goods are transported to the customer.... what happens then? Some shops convince their customers to return their old clothing to their stores.....if that is the case, we play no significant role. But I can imagine that if we can offer various propositions in supporting the organisation of the return flow (from customers towards one of the warehouses) [...], that could be more difficult but may be a good service to offer from our perspective. I feel that as the higher the level of difficulty is perceived, the more you can differentiate yourself from your competition."

An explanation for this ambivalent role might be that the position of the LSP in the supply chain is gradually changing. In the last decades, developments such as an increasing volume of e-commerce activities are clearly noticeable, impacting the position of the LSP by providing more power in the supply chain. Consequently, this is also changing the LSP's view on external collaborations and supply chain integration. Furthermore, it is noticeable that the length of the contracts with customers appear to increase, as shippers realize the scarcity in the LSP resources. A further explanation might be that the LSPs increasingly offer supply chain solutions for their customers, instead of only focusing on storage and transportation activities. The longer contract periods between the LSP and the customer also suggest more focus on building stronger, long-term relationships.

Furthermore, our analysis also shows that the emerged challenges and opportunities relate almost equally to strategic/tactical decision-making elements on the one hand, and tactical/operational ones on the other. On tactical/operational level, most of the mentioned challenges and opportunities relate to (circular) supply chain design questions regarding volume and locations of return flows. On strategic/tactical level, most aspects relate to the potential business impact. This suggests that the internal LSP organisation needs to create momentum on all decision-making levels to support the transition to become competitive as a LSP in the CE market.

Finally, a key finding is that more stringent (EU) policies, such as the CSRD legislation, can be a game changer for the LSP, as it enforces companies to change the rules of the game in elements such as data sharing and supply chain design elements. It would be interesting for LSPs to guide customers more intensively in dealing with the upcoming legal requirements, return flows, data sharing, upscaling of volumes, sustainability improvements etc., and turn all this into new business propositions, and thereby economic benefit. This might create a more dominant role for the LSP in the CSC.

Discussion

In this section, we will discuss key findings of the identified challenges and opportunities for LSPs in the transition towards CSC.

Identified challenges and opportunities

Our data shows that the identified challenges and opportunities cover a wide range of interdisciplinary research fields in supply chain management, similar to the findings in the study of van Beusekom–Thoolen et al. (2023). We identified various challenges and opportunities in the transition towards CSC that correspond to findings in studies of Govindan and Hasanagic (2018); Levering and Vos (2019); Mangla et al. (2018); Masi et al. (2018); Tura et al. (2019); Vermunt et al. (2019), as they also indicate that aspects such as lack of resources, lack of information, design challenges and lack of knowledge, might interfere with a smooth transition towards CSCs.

A distinct difference in our findings compared to previous literature is that the following challenges are not discussed: 'measurement and assessment' (Abbasi & Nilsson, 2016), 'lack of financial resources' (Tura et al., 2019), 'the lack of technical and technological capacity' (Levering & Vos, 2019), 'poor leadership' (Vermunt et al., 2019), 'Lack of employee involvement in promoting greener products' (Vermunt et al., 2019), 'High up-front governmental support' (Agyemang et al., 2019), and 'Conflicts with existing business culture' (Tura et al., 2019). An explanation for this absence might be the research scope. Previous studies focused primarily on manufacturing, whereas we focus on the view of the LSP. Another explanation might be that the LSP is not far enough in the process of the CSC transition to have a full insight into all challenges and opportunities, such as aspects of capacity management.

Furthermore, in exploring the challenges and opportunities, aspects of cultural (organisational) change are not discussed in our study, although authors such as Mangla et al. (2018), Govindan and Hasanagic (2018) and Tura et al. (2019) mention this explicitly. Impact of cultural aspects on decision-making process are empirically tested in earlier studies (Folkerts & Koehorst, 1997; Handayati, Simatupang, & Perdana, 2015). The lack of discussion by the representatives in our study may be due to a lack of awareness, but it may also be implicit knowledge for them. More empirical research needs to be conducted to better understand and deepen the insights into the impact of cultural aspects, in the society at large as well as for the organisations involved in the CSC.

CSC knowledge gaps: interdisciplinary in nature

As our study seeks to contribute to insights into the transition towards CSCs, from the point of view of the LSP, our findings support that the challenges and opportunities

cover a wide field of research topics. This reinforces the interdisciplinary nature of this research area, concurring with previous research findings by among others Hazen et al. (2021) who state that the transition covers a wide research field: strategy & organisation, (circular) supply chain design, risk management, collaboration, human decision-making, supplier management, operations management, marketing & consumer behaviour, policy, and governance. Therefore, the expertise of these various disciplines must be integrated in joint, synchronised knowledge development to be effective.

Furthermore, the various emerged challenges related to 'lack of knowledge' suggest the need for adequate knowledge development as the Collingridge dilemma (Genus & Stirling, 2018) links this lack to limited process control in these early transition phases. As the required opportunities and challenges appear to link to a rather interdisciplinary approach, further research is needed to better understand the extend of interdisciplinarity for implementing CSCs.

Role of data in the CSC

Our research findings indicate that the role of data in the CSC needs further study. This corresponds to Ren et al. (2019), who state that for an effective CSC, integration of the product life cycle data is a necessity, and for that, aggregation and integration of data are essential. The increased visibility and traceability provide decision-makers, in the field of CSCs, with tools with which to formulate and implement sustainable policies and procedures in SCM such as the digital product passport (Langley et al., 2023). Through data sharing and its consequent analysis, energy consumption, emissions, and legal and technical compliance can be monitored. Information and data sharing aims at the optimization of supply chains across various aspects, such as planning, inventory control, customer service, and resilience (Kembro, Näslund, & Olhager, 2017).

The transparency in SCs implies that organizations share relevant information while being in line with the sustainability goals. In adopting transparency, organizations adopt both vertical and horizontal coordination across the SCs while implementing common sustainable standards and information sharing (Mageto, Prinsloo, & Luke, 2020). Khan and Abonyi (2022) identified the various effects of SC transparency with regard to information sharing such as better service and time performance, increased operational performance, increased accountability, access and cost-effectiveness, reduced perceived risks, increased product safety, increased resilience against disruptions and increased trust in organizational partnership, among others. Dev, Shankar and Qaiser (2020) also showed that adopting an appropriate information-sharing strategy provides the potential to enhance the environmental and economic performances in digital technologies and reverse logistics-oriented environment.

From the environmental sustainability and economic performance perspective, however, there are some challenges faced by CSCM including how to achieve real-time information for tasks and vehicles with the goals of reducing (i) cost, (ii) fuel consumption, (iii) CO_2 emission, and (iv) waiting time (Ganzha et al., 2017). In this context, Mangla et al. (2019) identified some key dimensions that need to be addressed to improve sustainable supply chains including flexibility, collaboration, transparency, innovation, and relational capabilities between the echelons of the supply chain.

Since the timing and the number of returns is uncertain in a CSC, the activities require collaboration in the form of coordination between functional areas of reverse logistics (Guide Jr, 2000).

Role of Intelligent technology in CSC

Our findings also indicate that next to data, it is interesting to better understand the role of (intelligent) technology (Industry 4.0 technologies) in CSC as they are perceived as pre-requisite to be effective. This concurs to findings of Vishkaei (2022), as these intelligent technologies, such as IoT, AI, Big Data, Blockchain and Robotics, can comprehend the integration of data in effective CSCs. Implementation of CSCM necessitates the integration of digital technologies, especially in managing reverse flows tied to international frameworks. Our study findings related to the challenges of return flow (design) also correspond and underscore this need. Digital technologies play a pivotal role in extracting real-time information on return values. Industry 4.0 technologies enable products to communicate their performance, usability, and deterioration to firms and consumers (De Giovanni, 2019). Blockchain technology could stand out for ensuring transparency and reliability while enabling consumers to trace sustainable production processes and track products' locations in real-time, thus optimizing reverse logistics operations (De Giovanni, 2021). The effectiveness of technology is maximized when it complements existing logistics systems and integrates omnichannel solutions (Naclerio & De Giovanni, 2022; Sammarco et al., 2022). The Internet of Things (IoT) emerges as another critical technology, particularly in enhancing process-oriented performance and reducing energy consumption within reverse logistics management (Garrido-Hidalgo et al., 2020). IoT devices communicate and coordinate actions within a network, facilitating data collection and information dissemination across supply chain stakeholders (Xu, Wu, & Guo, 2011).

Conclusions & Recommendations

Conclusions

This research dealt with the exploration and identification of opportunities and challenges for the transition towards CSC, in the view of the LSP. Supply chain management, sustainability and circular economy are usually separate fields that are studied by different groups in academia. This research integrates these fields and shows that it is useful to better understand the complexity of the CSC to come to an effective decision-making process in these CSCs. The theory of supply chain management is mainly focused on integrating vertical and horizontal collaborations between the actors in closed-loop collaborations, whereas the theories of sustainability and circular economy are primarily focused on aligning elements of people, planet, and profit in restorative and regenerative cycles. Our empirical data supports the need to integrate these theories as the concept of CSC strives for a more integrated, flexible and effective supply chain approach to address interdisciplinary challenges. More attention needs to be paid to integrate the various supply chain positions in the open loop collaborations for the restorative and regenerative cycles.

To answer the research question, we identified twenty challenges and seventeen opportunities for the transition towards CSCs, in the view of the LSP. Firstly, the study findings show that most of the opportunities relate to economic benefits, whereas most of the challenges relate to a knowledge or skills gap for CSC design aspects. This suggests an equilibrium the LSP must achieve, balancing how much they are willing to invest in bridging this knowledge gap to gain economic benefit. Therefore, we encourage the need for more robust research in CSC to extend and deepen the knowledge and insights. Secondly, the findings suggests that Industry 4.0 technology aspects are perceived as pre-requisites for collaborations in CSCs. This suggest that the role of data and intelligent technologies (Industry 4.0 technology) in the CSC need to be further studied. Thirdly, the role of the supply chain position LSP appears to be changing, becoming more dominant and leading. However, more empirical research is needed to better understand how this change can be most effective for the LSP. Fourthly, the study indicates that the challenges and opportunities relate almost equally to strategic/tactical decision-making and to tactical/operational decision-elements. On tactical/operational level, most of the mentioned challenges and opportunities relate to (circular) supply chain design questions on volume and locations of return flows. On strategic/tactical level, most aspects relate to the potential business impact. Finally, the study shows that more stringent policies, and compliance aspects, are changing the rules of the game for the LSP in a CSC. We hope to encourage an active debate on the CSC research agenda and stimulate researchers to study interdisciplinary aspects of CSCs to contribute to finding solutions for environmental issues.

Recommendations to interdisciplinary field of CSC practice

The results of our study do not present a concrete managerial guideline for LSPs dealing with the transition towards CSCs. Still, the findings will help practitioners to better understand the challenges and opportunities for this transition. This can be a starting point for discussion between different fields within the organisation of the LSP. It helps them to reflect on their decisions in the process of creating more circularity. Moreover, it suggests areas for discussion with their customers, to better integrate the CSC.

Furthermore, the results provide insight into the views of what the LSP perceives as challenges and opportunities in the process of creating CSCs. As those views might distinctly differ with respect to the challenges and opportunities from other supply chain positions, it is helpful for managers to better understand the perspective of the LSP. The LSP can apply these insights to further enhance the effectiveness of the logistic activities and also may create new business propositions. Finally, besides the managerial contributions, the findings add value for the general public, as effective CSCs contribute to consumer's trust in how supply chains deal with environmental issues, and continue to deliver the required service to the end-consumer. As legislation will become more stringent, and consumer behaviour will demand more and more circularity in their consumption products, and thereby the involved supply chains, and society at large, the need to contribute to knowledge is evident.

Limitations

While this study is based on empirical data obtained at a large international LSP, our approach has some limitations. Firstly, by applying a single case-study, at one company, we realize that the generalizability is limited. What we found effective in the research process is the collaboration with both the participants of the study and the team of fellow researchers. The data collection was started and interpreted within our own experiences and existing ideas as researchers. Future studies are recommended to further explore and develop guidelines for designing and implementing CSCs. A second limitation relates to the participants, the experts. As the topic of CSC is perceived as highly innovative for LSPs, the level of experience, skills and knowledge of each of the experts may differ. It is recommended that future studies apply a similar protocol and collect more data with respect to not only the LSP as a supply chain position, but explore and integrate the views of more supply chain positions into this transition towards CSCs. Future studies are also recommended to explore how other stakeholders, such as the end consumers and politicians, may influence effective decision-making in the CSC by for example new compliance/legislation or human behaviour.

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