Int. J. Production Economics 245 (2022) 108402

Contents lists available at ScienceDirect

International Journal of Production Economics

journal homepage: www.elsevier.com/locate/ijpe

Supply chain collaboration and sustainability performance in circular economy: A systematic literature review

Jayani Ishara Sudusinghe *, Stefan Seuring

Chair of Supply Chain Management, University of Kassel, Kleine Rosenstraße 1–3, 34109, Kassel, Germany

ARTICLE INFO

Keywords:
Collaboration
Circular economy
Supply chain management
Sustainability
Systematic literature review

ABSTRACT

With the emergence of the circular economy (CE), conventional supply chains are transitioning towards circular supply chains (CSCs) that achieve improved sustainability performance. Inter-organisational relationships across supply chains need to be redefined to achieve this. We perform a systematic literature review to examine how collaboration may improve sustainability performance in implementing circularity in supply chains. A content analysis has been conducted on 82 journal articles published in the last five years using deductively derived constructs related to supply chain collaboration practices, CE implementation strategies, and sustainability outcomes. Further, a contingency analysis has been conducted to enhance the findings of the content analysis and understand the associations among constructs. Based on the analysis, a conceptual framework is developed to identify appropriate collaboration practices to enhance symbiotic relationships internally and externally in CSCs to improve sustainability performance. Sharing information, penalties and incentives, sharing responsibility for product recovery, risk-sharing, and joint product design are the prominent external vertical collaboration practices advocated for successful CE implementation. Cross-functional coordination and collaboration with government agencies are the most acknowledged internal and external horizontal collaboration practices, respectively. The study reflects that the main focus of CSCs is on improving environmental and economic aspects rather than social performance. The engagement of external parties such as governmental, non-governmental organisations, entrepreneurs, and research institutes complements managerial understanding on collaboration to improve the sustainability performance of CSCs. The study provides a foundation for future empirical work to assess the implications of different collaboration practices in CSCs.

1. Introduction

Collaboration has become crucial in managing supply chains with the increasing complexity of supply chains and different parties involved (Wu et al., 2014). Hence, collaboration is adopted as a strategy for organisations to work together in a recursive process to achieve shared goals (Liao et al., 2017). With the initial focus on dyadic relationships (supplier-buyer relationships) (Son et al., 2016), collaboration has evolved to engage many external organisations such as training bodies, government agencies and non-governmental organisations (NGOs) over the years (Liao and Kuo, 2014).

Companies tend to collaborate mainly to improve both individual and supply chain performance (Barratt, 2004) against turbulent environments (Zhang and Cao, 2018). For years, this disposition has received close attention in the supply chain management (SCM) discourse (Ramanathan and Gunasekaran, 2014). Eventually, the focus of supply chain performance has advanced from conventional economic aspect to environmental and social aspects, considering the triple bottom line (TBL) perspective of sustainability performance in supply chains (Chen et al., 2017). Collaboration has also been identified as a pertinent strategy to induce sustainability performance in supply chains (Kumar et al., 2018). However, the sustainability performance of a supply chain can be affected by the changes in the supply chain orientation of the companies involved in collaboration (Jadhav et al., 2019). Hence, Chen et al. (2017) proposed exploring how collaboration needs to differ when companies embrace new trends and changes in supply chains (e.g., supply chains in the circular economy context) to achieve sustainability performance.

Commercial supply chains are adopting circular thinking at the operational level and transitioning towards circular supply chains (CSCs) with the introduction of the circular economy (CE) (Farooque et al., 2019a). Patagonia and Rolex (providing repair services for

* Corresponding author.
E-mail addresses: Jayani_Sudusinghe@uni-kassel.de (J.I. Sudusinghe), seuring@uni-kassel.de (S. Seuring).

https://doi.org/10.1016/j.ijpe.2021.108402
Received 23 September 2020; Received in revised form 22 December 2021; Accepted 23 December 2021
Available online 29 December 2021
0925-5273/

long-lasting products), Xerox and Philips (providing performance or results-based solutions such as printing as a service and lighting as a service) and H&M (clothing return initiatives) are such well-known few companies transitioning towards the CE (Hofmann, 2019). Since the purpose of CE lies in the efficient use of resources while eliminating resource inputs and leakages in the system (Geissdoerfer et al., 2017), resource loops received special interest in the scholarly discussion. Bocken et al. (2016) introduced different resource flows: slowing loops – prolonging use and reuse of products, closing loops – reusing materials by recycling and narrowing loops – reducing the use of resources. Hence, supply chains in the CE context tend to integrate at least one of these resource flows, while collaboration is identified as a key organisational element in this integration (Fischer and Pascucci, 2017).

CSCs have been interchangeably referred to as closed-loop supply chains (CLSCs) in the literature (Taghikhah et al., 2019). However, as the scholarly debate in SCM discourse is developing, scholars such as Batista et al. (2019) defined that CSCs as an extension of CLSCs with the introduction of open-loop supply chains (OLSCs). While CLSCs are focused on original equipment manufacturers (OEMs) to recover materials and end-of-life (EoL) products (Guide and Wassenhove, 2009), these OLSCs integrate third parties who are not OEMs (Genovese et al., 2017). Hence, the supply chains in the CE context are introduced as CSCs to cascade and circulate products and materials (Howard et al., 2019). Consequently, the definition for CSCs in this study aligns with the definitions of Batista et al. (2018, 2019). These CSCs enable materials and EoL products to reenter a supply chain as a product input while expanding the sustainability performance boundaries in supply chains (Nasir et al., 2017). This integration of CLSCs and OLSCs highlights the need of maintaining strong symbiotic relationships among different supply chain actors.

Surprisingly, limited research has been conducted on the supply chain collaborations in the CE context despite its pivotal role emphasised by many scholars (Bressanelli et al., 2018; De Angelis et al., 2018). For instance, while Del Giudice et al. (2020) emphasised the importance of building value-added relationships in CSCs, Kazancoglu et al. (2020a, 2020b) identified that the difficulty of cooperating is a barrier to integrating CE implementation strategies into supply chains. Even from a practitioner's viewpoint, industries encounter the problem of comprehending how to define a successful collaboration in CSCs (Leder et al., 2020). González-Sánchez et al. (2020) also proposed that collaboration positively affects the environmental and economic sustainability performances in CSCs. However, discussion on how to implement and improve collaborations through actions in CSCs to improve sustainability performance is lacking. To bridge this gap, scholars such as Lahane et al. (2020) and Dora (2020) proposed studying CSC collaboration in future studies. Hence, an in-depth analysis of collaboration practices is needed to comprehensively understand different collaboration practices improving sustainability performance with the interrelations among supply chain partners in the CE.

To address the research gaps mentioned above and highlight scholarly contributions, we conducted a systematic literature review (SLR) as guided by Tranfield et al. (2003), exploring the current state of the literature. Moreover, our study answers the following research questions (RQs).

RQ (1) What are the different collaboration practices leading to improved sustainability performance in CSCs?

RQ (2) What are the managerial and theoretical implications to ensure the implementation of CSCs through collaboration?

The rest of the paper is outlined as follows. In Section 2, we discuss the evolution of collaboration in SCM discourse and introduce the role of collaboration in CSCs. This elaboration is followed by Section 3, explaining the research methodology. Finally, in Sections 4, 5, and 6, we will be presenting the findings, discussion and research directions, and conclusion, respectively.

2. Background and conceptual framing

The concept of collaboration is centred on connecting different actors engaged in the supply chains. Hence, Simatupang and Sridharan (2002) defined collaboration in supply chains as 'two or more independent companies work jointly to plan and execute supply chain operations with greater success than when acting in isolation' (p. 19). The discussion on collaboration in the SCM discourse has evolved from a strategic viewpoint requiring a high level of trust, commitment and information sharing (Spekman et al., 1998) to operational aspects focusing on collaborative purchasing forecasting and replenishment, vendor managed inventory, and e-collaboration (Manthou et al., 2004; Ramanathan and Gunasekaran, 2014; Sari, 2008). Moreover, the discussion on practices ensuring collaboration is also aligned with the operational performance and limited to a few key practices such as information sharing, resource sharing, decision synchronisation (Liao and Kuo, 2014; Ramanathan and Gunasekaran, 2014; Simatupang and Sridharan, 2005). However, nowadays, companies focus on achieving sustainability performance, apart from competitive advantage, by collaborating with different supply chain partners (Chen et al., 2017).

In line with the well-established nature of scholarly discussions, augmentation of collaboration practices is crucial due to three main reasons. Firstly, collaboration practices need further development to meet the operational complexities in supply chains. For instance, as supply chains have expanded to networks with operational complexities, Ramanathan and Gunasekaran (2014) and Vachon and Klassen (2008) claimed that collaboration needs to evolve beyond typical dyadic relationships where the focus lies only on the supplier-buyer relationships. Similarly, Liao and Kuo (2014) argued that more comprehensive practices are needed to manage collaboration among different actors in upstream, midstream, and downstream of the supply chains. Scholars such as Masten and Kim (2015) and Farooque et al. (2019b) also emphasised the importance of integrating the perspectives of a diverse group of partners such as third-party coordinators in the supply chain collaboration. Further supporting this argument, Soosay and Hyland (2015) hinted at the importance of considering multi-firm perspectives in supply chain collaboration after investigating a decade long scholarly debate in the SCM discourse.

Secondly, the initial purpose of the collaboration is vital in deciding the applicable collaboration practices to achieve the shared vision of the involved parties. Soosay and Hyland (2015) claimed the importance of exploring the circumstances under which collaboration occurs. For instance, the mutual objective of collaboration can focus on improving the firm performance. Liao and Kuo (2014) studied this achievement as the primary purpose of supply chain collaboration leading to competitive advantage, while Jin et al. (2019) explored this collaboration-performance link from a strategic viewpoint. However, the majority of the scholars narrowed the focus of firm performance towards economic performance. For instance, scholars such as Ramanathan and Gunasekaran (2014) elaborated on how economic performance is achieved through collaboration, while Wu et al. (2014) discussed how this linkage differs in financial and non-financial performance. Eventually, scholars such as Ding et al. (2016), Kuiti et al. (2020), and Vachon and Klassen (2008) initiated focusing on supply chain collaborations to achieve environmental performance. Flygansvær et al. (2018) studied the role of reverse supply chains highlighting that collaboration influences environmental and economic performance. However, a comprehensive investigation on economic, environmental and social sustainability is lacking. Recently, Lechler et al. (2019) studied the expanded connection towards the sustainability performance based on the TBL approach. Even the scholars such as Chen et al. (2017) investigating the contribution of collaboration to sustainability do not directly address this link. Hence, it is evident that only a limited number of studies comprehensively discuss the link between sustainability performance and collaboration (Kumar et al., 2018).

Thirdly, collaboration practices need to change, given the context of supply chains. For instance, Min et al. (2005) argued that the degree of collaboration needs to differ from one industry to the other. The industries need to rethink managing good relationships to prosper their businesses without exhausting primary materials and energy as their dependence on resources is improved (Rajala et al., 2018). Similarly, the role of collaboration in the CE context needs to differ from linear supply chains due to various reasons. Hussain and Malik (2020) argued that supply chain collaboration is an organisational enabler facilitating the transition towards CSCs while improving sustainability performance. Del Giudice et al. (2020) also pointed out that collaboration with external partners is vital for a firm to implement CE objectives in its supply chain. Going further beyond, Kalverkamp (2018) emphasised the importance of collaborating with multiple supply chains to integrate actors in OLSCs. Similarly, the shift of circular business models from product ownership to service-based strategies has led to reorganising producer-consumer relationships in the CSCs (Hofmann, 2019). However, despite emphasising this topic, there is a lack of discussion on how supply chain collaboration enables the integration of CE into supply chains (Farooque et al., 2019b) while understanding how sustainability performance is improved with new collaboration opportunities (Leder et al., 2020). Hence, we conceptualised the initial idea of our study, as illustrated in Fig. 1. Then through the content and contingency analyses, we explored how they are associated with each other.

We selected three main frameworks discussing collaboration practices, sustainability performance, and CE implementation strategies to understand how supply chain collaboration achieves sustainability performance in the CE context. Each framework consists of several constructs collectively elaborated through different items (see Appendix A – items have been integrated into the description). These items are used to operationalise and measure the constructs while explaining the link between construct and framework (Shao et al., 2012).

We considered the framework proposed by Chen et al. (2017) identifying supply chain collaboration practices that improve sustainability performance. One of the main reasons for selecting this framework was how they studied the role of collaboration based on a generic and comprehensive list of practices in supply chains to improve environmental, social, and economic sustainability performances. Moreover, this framework elaborates on how collaboration could be expanded internally and externally of the focal firm giving a clear explanation of the diversity of the practices. However, as certain categories such as supplier collaboration, supplier integration and customer collaboration proposed by Chen et al. (2017) were too broad, we also adopted several constructs from the framework proposed by Ni and Sun (2019). This adoption of constructs such as product design/modification, quality improvement and long term agreement from the framework of Ni and Sun (2019) further enhanced the coverage of collaborative practices. In addition, we also included certain missing external parties such as government and NGOs who are key players in CSCs (Murray et al., 2017) to ensure the comprehensiveness of our study. Appendix A (see Table A1) discusses how we operationalised the identified constructs in these frameworks.

To study sustainability performances in supply chains, we selected constructs from the framework proposed by Saeed and Kersten (2017), given the comprehensiveness of the presented sustainability outcomes covering the TBL. We have further elaborated on these outcomes in Appendix A (see Table A2).

To create a meaningful discussion relating to the supply chains in the CE context, we selected the ten R imperatives (10Rs) suggested by Reike et al. (2018) in CE literature. The 10Rs discussed in this framework are ten value retention options in the CE context, supporting conserving resources and extending the product lifecycle. In addition, the authors provide a broader scope for operationalising the CE context with a product-related generalisation. Hence, we selected this framework to derive constructs related to the strategies driving CE since they are linked back to different operations in the supply chain. Appendix A (see Table A3) offers details on how these Rs appear in SCM literature.

3. Methodology

This section presents the steps of content and contingency analyses we applied in this study, exploring different supply chain collaboration practices, CE strategies, sustainability performance and their interrelationships.

3.1. Content analysis

As Webster and Watson (2002) argued, there can be two different types of SLRs. One type would consider a mature topic with an accumulated body of literature and propose a conceptual model that synthesises and extends the existing body of knowledge. In the second type, an emerging topic would be explored to understand the potential theoretical foundations, ultimately developing a conceptual model from those theoretical foundations. As CSC management is an emerging topic, this study falls under the second type.

We followed the three-stage guideline provided by Tranfield et al. (2003) to conduct this SLR. With this rule-governed procedure, we were able to enhance the replicability of the study while improving the traceability of the arguments. Consequently, the reliability and the validity of the findings were also further improved with this scientific approach (Seuring and Gold, 2012).

Stage 1 – Planning the review.

Under this stage, we identified the need for the SLR, prepared the proposal and developed the review protocol as discussed in the previous sections of this study.

Stage 2 – Conducting the review.

Under this stage, we initiated collecting relevant materials using Scopus and Web of Science databases. The main reason for selecting both databases was to retrieve a comprehensive set of research articles, especially the Scopus database is known for its broad coverage of journals in management and environmental sciences (Ahi and Searcy, 2015). We identified keywords and built search strings to capture all articles that lie within the scope of the study. We identified two clusters of keywords as listed below.

- Related to supply chain collaboration: We referred to the search strings used by Chen et al. (2017) and Wankmüller and Reiner (2019) and adopted the keywords such as 'collaboration',

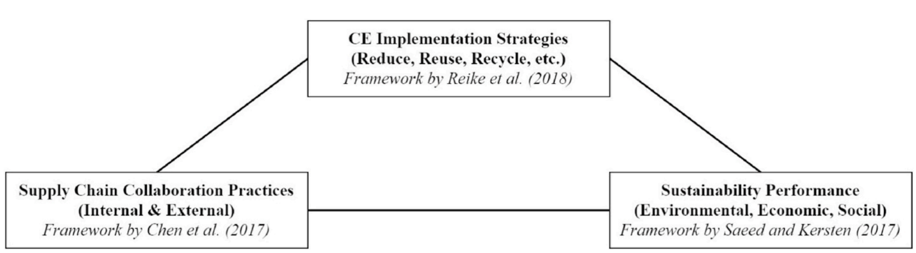

Fig. 1. Initial conceptual framing of supply chain collaboration in the CE context.

'cooperation', 'coordination', 'integration', 'relationship', 'partnership', 'alliance'.

- Related to CE: Keywords such as 'circular economy', 'circular supply chain*', 'supply chain*', 'reverse supply chain*', 'closed-loop supply chain*', 'open-loop supply chain*' along with the 10Rs listed by Reike et al. (2018) (e.g. 'reduc*', 'reus*', 'recycl*', 'recover*').

The search strings were developed as a combination of these keywords. For instance, one combination would be 'collaboration AND circular economy AND supply chain*'; another would be 'cooperation AND circular supply chain* AND recycl*'. Two independent researchers developed these search strings and conducted the initial search to improve the reliability and validity of the article search. The search was conducted at the beginning of the year 2021 and we focused only on peer-reviewed journal articles published in the English language. The search was carried out on 'title-abstract-keywords' in both databases. As shown in Fig. 2, the initial search retrieved 988 journal articles from both Scopus and Web of Science databases. After removing duplicates, the article set was reduced to 504 articles. Then we removed articles that focus on non-managerial areas such as chemistry, physics, optics. As a result, 183 articles were extracted to screen the title, abstract and keywords to select the articles addressing the supply chain collaboration in the CE context. Ultimately, 168 articles were filtered for the final step, as shown in Fig. 2. We screened full papers to capture only the articles discussing at least one of the identified supply chain collaboration practices in the CE context. We finally retrieved 82 journal articles written in the English language in peer-reviewed journals.

Stage 3 – Reporting and dissemination.

The data extraction from the research papers was conducted using MaxQDA and MS Excel software. Under this stage, firstly, we present the results of the 'descriptive analysis' by studying how the selected 82 journal articles have been distributed over time and their published journals. The results of this analysis are presented under Subsection 4.1.

Secondly, we analysed the content of the papers based on the theoretical lenses we initially identified. The identified constructs to explore supply chain collaboration, sustainability performance and CE implementation strategies are presented in Appendix A (see Table A1, A2 and A3) to provide more profound knowledge on each analytic category selected for this study. Under this step, we followed a deductive approach and coded the identified constructs against the retrieved literature using MaxQDA software after thoroughly reading each article. We kept the original interpretation of the codes in mind during the coding process to ensure construct validity. The codings of the papers were initially done by a single researcher while seeking assistance from the rest of the research team in ambiguous cases to improve the coding reliability. Then, the codings were analysed to draw conclusions from the content analysis step. The results of the content analysis are presented in the Findings section under Subsection 4.2.

Since the content analysis results are limited to individual constructs (Kremic et al., 2006), we conducted a contingency analysis to unveil hidden associations among constructs. Krippendorf (2012) proposed the contingency analysis method to move beyond the mere descriptive nature of the analysis and adopt a quantitative approach to derive broader conclusions.

3.2. Contingency analysis

Contingency analysis was developed by Osgood et al. (1956) based on the 'observation that symbols often occur in pairs of opposites, that concepts or ideas form clusters' (Krippendorf, 2012, p. 203). The contingency analysis identifies 'pairs of categories which occur relatively more frequently together in one paper than the product of their single probabilities would suggest' (Gold et al., 2010). Hence, the contingency analysis compares constructs in pairs to understand the link between them based on statistical justifications.

We used SPSS 27.0 software package for the contingency analysis step. Firstly, we selected the constructs with frequencies greater than 10% for the contingency analysis to improve the further validity of this method. Secondly, cross-tabulation was conducted among different pairs of these identified constructs and developed the contingency tables (Pearson, 1904). Thirdly, we identified the significant associations between constructs by evaluating the chi-square test results. Moreover, the phi-coefficient (φ) was evaluated to identify the strength of these associations. The underlying idea in this analysis is that we considered only the statistically significant association with chi-squared test value below 0.05 and the φ value equal to or above 0.3 (Fleiss et al., 2003). Finally, these shortlisted associations were justified against the relevant literature as contingencies do not determine the causality of the links (Khalid and Seuring, 2019; Sauer and Seuring, 2017).

Further, to ensure the quality of this SLR, we tested for its *transparency*, *inclusivity*, *explanatory* and *heuristic* nature (Denyer and Tranfield, 2008). We followed the review methods suggested by Tranfield et al. (2003) openly and explicitly to aid *transparency* of the process. To ensure the *inclusivity* of research papers, we operationalised a comprehensive paper retrieval process by including rigorous inclusion and exclusion criteria, as shown in Fig. 2. Further, we performed both content and contingency analyses to the content of the study to provide a synthesis while *explaining* the individual pieces in a more holistic approach drawing broader conclusions. This *explanatory* nature is reflected in the Findings section. To ensure the *heuristic* nature of this study, we guide practitioners with ideas and clues to ensure CE implementation with the support of supply chain collaboration under

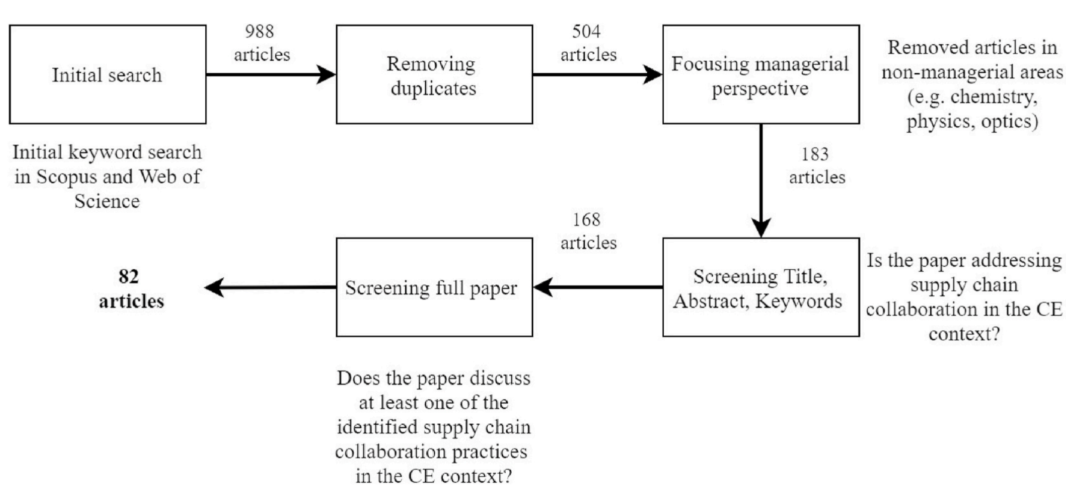

Fig. 2. Step-wise research paper retrieval process.

managerial implications listed in Section 5.

The combination of content and contingency analyses improves the depth of an SLR. While the content analysis step reveals a wide set of information related to coded constructs, it has limited value when observed individually. Therefore, contingency analysis plays a crucial role in exposing the hidden links and associations between constructs and drawing broader conclusions. For instance, Sauer and Seuring (2017) pointed out that such a combination allows excavating significant research gaps and links in the literature sample while answering research questions. Hence, this combined approach has been followed in the literature by other scholars such as Zhu et al. (2017) and Tröster and Hiete (2018). Importantly, it is also recommended to consider the intrinsic limitations of the contingency method prior to following this combined approach.

The main drawback of this contingency method is understanding the direction of the connections. Hence, the links are justified against the existing literature to understand the causality. Further, it is crucial to ensure that the analysis is not misled by the contingencies occurred due to a marginal number of papers. Hence, it is advisable to consider constructs appearing in at least 10% of the base sample of papers (Siems et al., 2021).

4. Findings

This section sets forth descriptive findings such as the distribution of the 82 articles over time and the journals published. Then, with the content analysis, we portray different supply chain collaboration practices, CE strategies and the most achieved sustainability performances in the CE context. Finally, we present the results of the contingency analysis depicting the connections among different supply chain collaboration practices, CE strategies, and sustainability outcomes.

4.1. Descriptive analysis

When considering the distribution of articles over the journals, 82 articles have been published in 33 different journals. However, our analysis found that only five journals published more than two articles, representing 60% (49) of the articles in the sample. Fig. 3 shows the distribution of articles over these five journals. This distribution shows that CSC is an emerging research topic even in well-recognised research journals focusing on sustainability. Similarly, Fig. 4 illustrates the paper distribution over the years. It depicts that supply chain collaboration in the CE context is still an emerging area with an increasing number of publications in recent years (2018, 2019 and 2020). Hence, with this study, we understand the current scholarly debate while paving the path towards an emerging arena of CE focused operations and supply chain research.

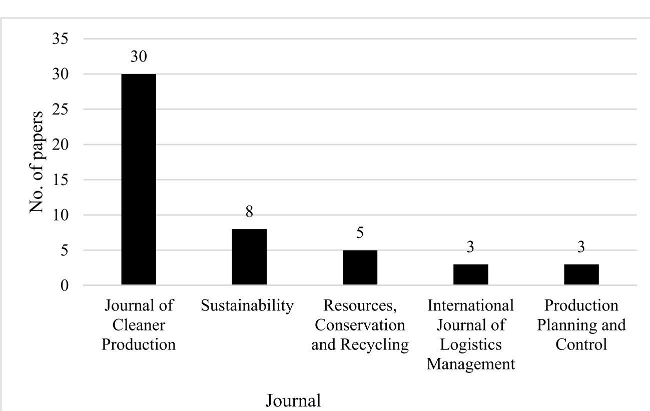

Fig. 3. Distribution of articles over journals.

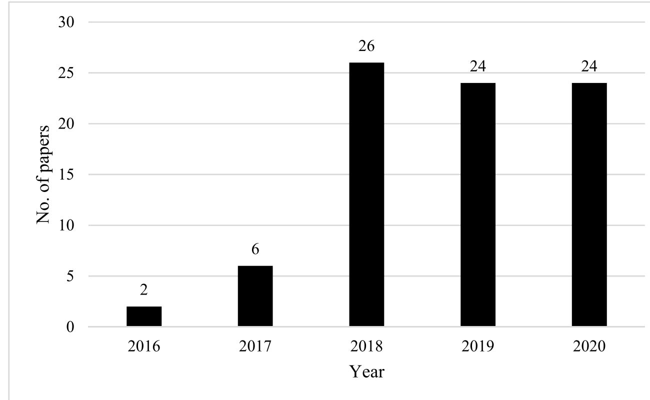

Fig. 4. Publication distribution over time.

4.2. Content analysis

Under this section, we discuss the content of the papers focusing on supply chain collaboration practices, CE strategies, and sustainability outcomes while understanding the main attributes discussed under each framework.

4.2.1. Supply chain collaboration practices

Table A1 (see Appendix A) lists supply chain collaboration practices under three main aspects as internal collaboration, external vertical collaboration, and external horizontal collaboration. The internal collaboration focuses on the collaboration practices at the operational level within the organisation, while the external vertical and horizontal collaboration aim to build relationships respectively with upstream and downstream supply chain players (e.g., suppliers, customers, service providers) and other external parties in the supply chains (e.g., government, competitors, NGOs).

Implementing cross-functional coordination (16%) was the most frequently discussed practice under internal collaboration. The ease of optimal distribution of information (Leising et al., 2018) and improved personal relationships (Ünal et al., 2019) through cross-functional training (Kurilova-Palisaitiene et al., 2018) within an organisation can be highlighted as the two main reasons for this scenario. Hence, this practice has been crucial when internally employing a transformation towards sustainability.

As per the frequencies, it is evident that the most commonly discussed practices belong to the external vertical collaboration. Those practices include *sharing information with key suppliers/customers* (75%), *penalties and incentives for sustainability related actions* (68%), *sharing responsibility for product recovery* (56%), *risk sharing* (54%) and *product design/modification* (53%). While *sharing information with key suppliers/customers* has already been recognised as a key collaboration practice in the SCM context (Flygansvær et al., 2018), other practices are crucial for implementing circularity in supply chains. For instance, *penalties and incentives for sustainability related actions* and *sharing responsibility for product recovery* are two leading practices ensuring the product returns in the CE context (Mishra et al., 2018). While *risk sharing* is considered a common strategy to adopt CE, *product design/modification* is recognised as a cornerstone for CSCs to adopt a holistic approach to address different aspects of sustainability (Farooque et al., 2019b).

When considering the external horizontal collaboration practices, the most frequently discussed practice was *collaboration with government* (48%). The government further promotes such collaborations due to the growing pressure on regulatory bodies to ensure societies become more sustainable with CE transitions (Velenturf and Jopson, 2019). However, the research focus on how businesses collaborate with the government and other external parties, such as academic institutions, to drive supply chains towards improved sustainability standards is limited (Dubey et al., 2019).

A few practices received the least attention in the CE context, including *supplier development* (8%), *Just in Time* (4%), *NGOs acting as a bridge for* funding (4%), *Kanban* (1%) and *continuous replenishment* (1%). Interestingly, traditional supply chain collaboration practices such as *Vendor managed inventory* did not receive the attention of the scholars under the CE context. Therefore, as the majority of these least discussed collaboration practices are related to supply chain operations, it is evident that the integration of collaboration practices into the operational aspect of CSCs is an area needing more attention in the future.

4.2.2. CE strategies

Table A3 (see Appendix A) offers the definitions and frequencies of CE strategies derived from Reike et al. (2018). The most frequently discussed CE strategies are *R2 Resell/Reuse* (80%), *R5 Remanufacture* (61%) and *R7 Recycling* (85%). Interestingly, these strategies fall under the short-, medium- and long-term loops, respectively, as Reike et al. (2018) introduced. Accordingly, *R2 Resell/Reuse* focuses on extending the product life cycle, while *R5 Remanufacture* creates indirect links with the customers via commissioners, whereas *R7 Recycling* serves as a strategy to extract inputs to short- and medium-term loops. This distribution depicts the diverse representation of CE strategies in the SCM context. However, there is an ongoing debate whether these three strategies ensure the circularity of supply chains and improve sustainability under different environmental and socio-economic conditions (Garcia-Muiña et al., 2018).

R0 Refuse (5%) and *R9 Remine* (4%) are the least discussed CE strategies. This finding in SCM discourse further aligns with Reike et al. (2018), where they discussed that *R2 Resell/Reuse* has overshadowed the focus on *R0 Refuse*, while *R9 Remine* is an emerging research focus in the CE context (Li et al., 2017).

4.2.3. Sustainability outcomes

Table A2 (see Appendix A) illustrates the sustainability outcomes. We identified *stability & profitability* (73%) under the economic outcomes, *training & education* (39%) under social outcomes, and *waste management* (75%) and *emissions* (70%) under environmental outcomes as the most frequently discussed in the literature. These frequencies indicate that the focus is on mainstream environmental and economic outcomes. The discussion on the social sustainability outcomes still lacks under the CE context in SCM discourse. This positioning is further supported when sifting the overall distribution of the practices, as shown in Fig. 5 with the number of papers and their percentages.

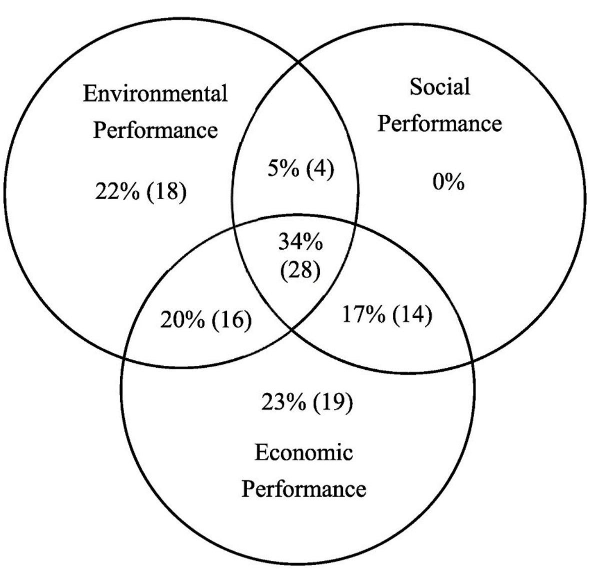

Fig. 5. Distribution of sustainability outcomes in TBL.

When observing the overall distribution of papers related to the TBL approach, our analysis highlighted that the CE focus is more biased towards two sustainability dimensions, including the environmental performance with 66 papers and economic performance with 77 papers. By further investigating the integration among sustainability outcomes, it is evident that the majority of the papers (28) focused on the best sustainability performance at the intersection. However, most of these 28 papers merely mentioned the sustainability outcomes in CSCs (e.g., Flygansvær et al., 2018; Herczeg et al., 2018). Hence, it is evident that after the economic performance, the main focus lies with the achievement of environmental performance. Interestingly, no single paper discusses the social dimension alone under supply chain collaboration in the CE context. As a result, Fig. 5 further reflects the main aim of CE as a sustainable development approach in the SCM debate.

4.3. Contingency analysis

This section presents the contingencies within and among frameworks and explores how supply chain collaboration practices are linked to CE strategies and sustainability outcomes.

4.3.1. Supply chain collaboration practices

The contingencies within collaboration practices were only evident in the external vertical and horizontal collaboration categories, as shown in Tables B1 and B2 (see Appendix B). The contingencies among external vertical collaboration practices are illustrated in Fig. 6.

The most frequently discussed *sharing information with key suppliers/customers* has three connections: *communication with key suppliers/customers*, *product development*, and *process design/modification*. These connections are very straightforward, given the important role of information in these practices. The link with communication is straightforward as communication is crucial for sharing information. For instance, Kalverkamp (2018) pointed out e-procurement as a solution to improve communication and enhance information sharing among supply chain partners. When considering the other links with product development and process design, it is understandable that insufficient information sharing can tarnish the progress of operational activities due to several repercussions such as failures in learning capacities and mismanaged standards of the operations. (Kurilova-Palisaitiene et al., 2018).

Despite the comparably low frequency, *technological integration* also connects with three other practices: *communication with key suppliers/customers*, *logistical integration* and *sharing responsibility for product recovery*. These connections depict how technology can improve the operations in CSCs. For instance, Garcia-Muiña et al. (2018) claimed that real-time monitoring on operational flows and performance occurring with technological integration leads to quality decision making. Similarly, technological integration through the latest technologies such as blockchain technology assists in the CE context to communicate with suppliers and customers while keeping close contacts (Rajala et al., 2018).

Product development also connects with *process design/modification* and *infrastructure integration*. The first connection is understandable as different parties involved in developing new products need to be engaged in the process design to ensure a seamless flow for the final production. For instance, Kurilova-Palisaitiene et al. (2018) demonstrated this connection relating to remanufacturing in the CE context. Similarly, the second connection is evident during the transition towards the CE as business networks get together to share different infrastructure to manage complex operations (Hofmann, 2019). De Angelis et al. (2018) also pointed out that supply chain actors can share their underutilised physical resources and promote asset reuse while developing new products advocating CE models.

When considering the other very frequently discussed external vertical collaboration practices, it is observable that most of them are associated with each other. For instance, *sharing responsibility for product*

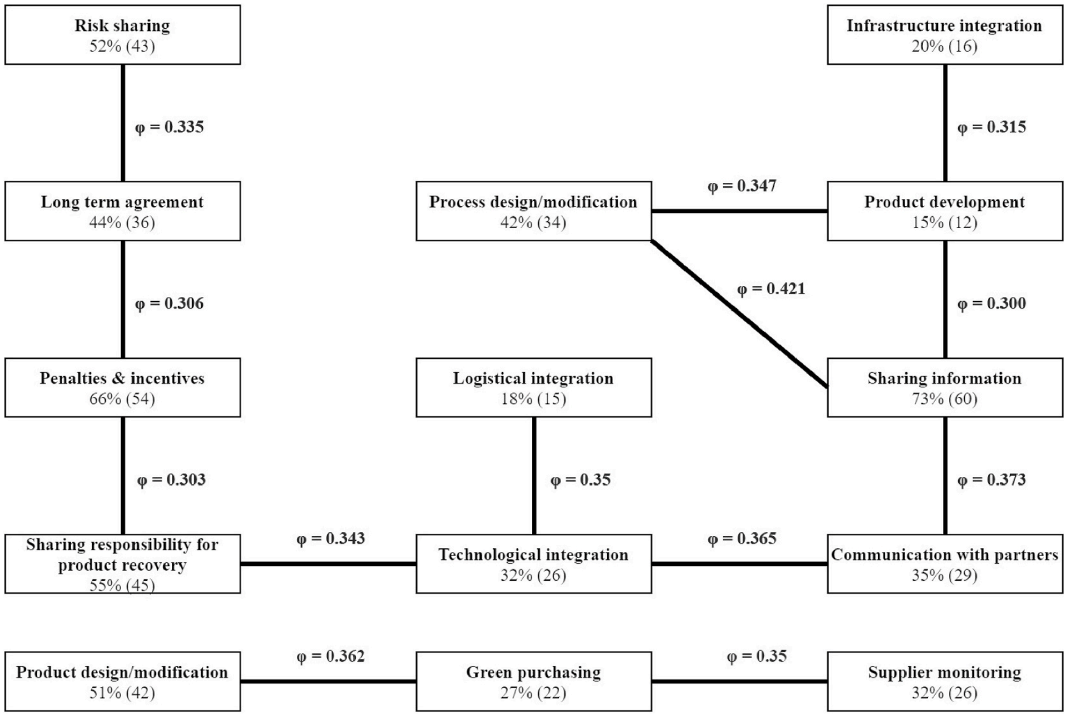

Fig. 6. Contingencies among supply chain external vertical collaboration practices.

recovery and *penalties and incentives for sustainability related actions* are connected. Despite this connection, both these practices were identified as essential in operations management (OM) decision-making under relationship management in CSCs (Jabbour et al., 2019). Although the causality of this connection is not depicted through contingency analysis, it is in line with the arguments of Larsen et al. (2018), pointing out an inverse relationship between the willingness of the consumer to return products and the incentives needed to acquire the used products. For instance, if the willingness is low, the incentives should be high. Hence, with this contingency, it is clear that incentives are crucial to urge the sharing of responsibility for returning products.

While *penalties and incentives for sustainability related actions* is associated with *long term agreement*, the latter is again connected to *risk sharing*. The former connection is caused as partnerships tend to include penalties and incentives as a clause when drawing contracts among supply chain actors (Flygansvær et al., 2018). The connection between *long term agreement* and *risk sharing* depicts the most common risk-sharing approach in SCM (Zacho et al., 2018) as contracts are considered formal governance instruments to share risks (Cardoso de Oliveira et al., 2019). However, drawing detailed agreements for sharing risks in CSCs is difficult compared to the forward supply chains as return flows are highly uncertain in the reverse supply chains (Larsen et al., 2018).

Product design/modification is another frequently discussed external vertical collaboration practice interlinked with *green purchasing*. This connection is coherent, considering the joint efforts of supply chain actors towards improving sustainability. For instance, when a product is designed collectively in the CE context, the involved parties decide which raw materials are to be included in the production process and where to purchase them (Farooque et al., 2019b). These decisions lead towards green purchasing.

Consequently, despite their low frequencies, *green purchasing* connects with *supplier monitoring*. This connection is somewhat self-explanatory, given that the decision to choose a supplier in green purchasing is made by monitoring the supplier. Mishra et al. (2018) further highlighted that having no supply chain coordination to audit or verify the suppliers' environmental performance due to external barriers such as political conflicts and civil wars is the main reason for the lack of green purchasing practices in supply chains.

Secondly, we focused on the contingencies among external horizontal collaboration practices, as depicted in Fig. 7. All the contingencies are focused on *other organisations*.

Other organisations is linked with *Entrepreneurs/Innovators*, *government* and *NGOs in sharing knowledge and experiences*. These are connected mainly due to the expertise and collaboration platforms provided by third-party organisations to each other. For instance, academic institutions can collaborate with all these three parties for research & development purposes in CE (Veleva and Bodkin, 2018). Industry associations also assist in industrial symbiosis networks by creating platforms to engage with these third parties (Patricio et al., 2018).

4.3.2. CE strategies

The contingencies among the CE strategies are summed up in Table B3 (see Appendix B), and how they are connected is visualised in Fig. 8.

Interestingly, the two CE strategies with the highest frequencies, *R2 Resell/Reuse* and *R7 Recycling*, only link with each other. It is understandable, given their compatibility. Producers use reusable parts and recycled materials in different processes under the CE context (Levänen et al., 2018). However, certain components initially identified as reusable are yet sent to recycling due to specific standard issues (Kalverkamp, 2018).

R4 Refurbish has three contingencies with *R1 Reduce*, *R3 Repair* and *R5 Remanufacture* despite its low frequency. The connection with *R1 Reduce* is evident from a consumer's perspective in the CE context. If consumers tend to use a product less frequently, they prefer refurbished products rather than buying a new one. The contingency of *R4 Refurbish* and *R3 Repair* is self-explanatory as repairing is also connected with the refurbishing process. The connection with *R5 Remanufacture* is in line with the arguments of Reike et al. (2018) and Howard et al. (2019), where they asserted that by adding new parts to a product, they could upgrade to the original version rather than being 'like new'. In such a scenario, remanufacturing can also result in a refurbished product. *R5 Remanufacture* is also connected with *R3 Repair*. This connection is

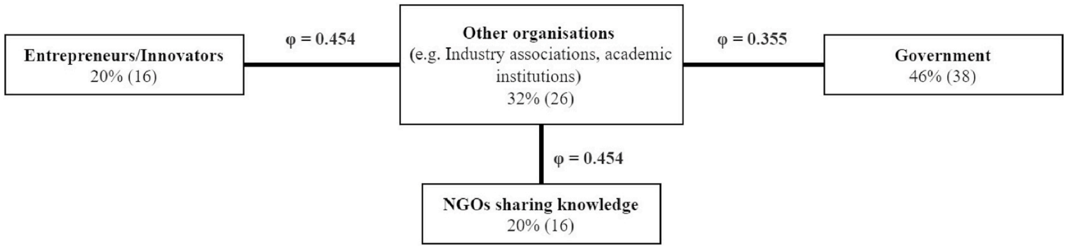

Fig. 7. Contingencies among supply chain external horizontal collaboration practices.

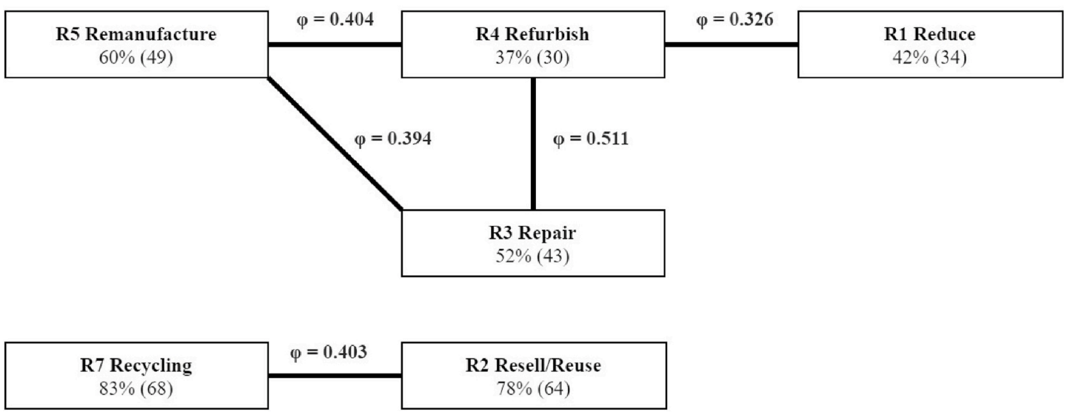

Fig. 8. Contingencies among the CE strategies.

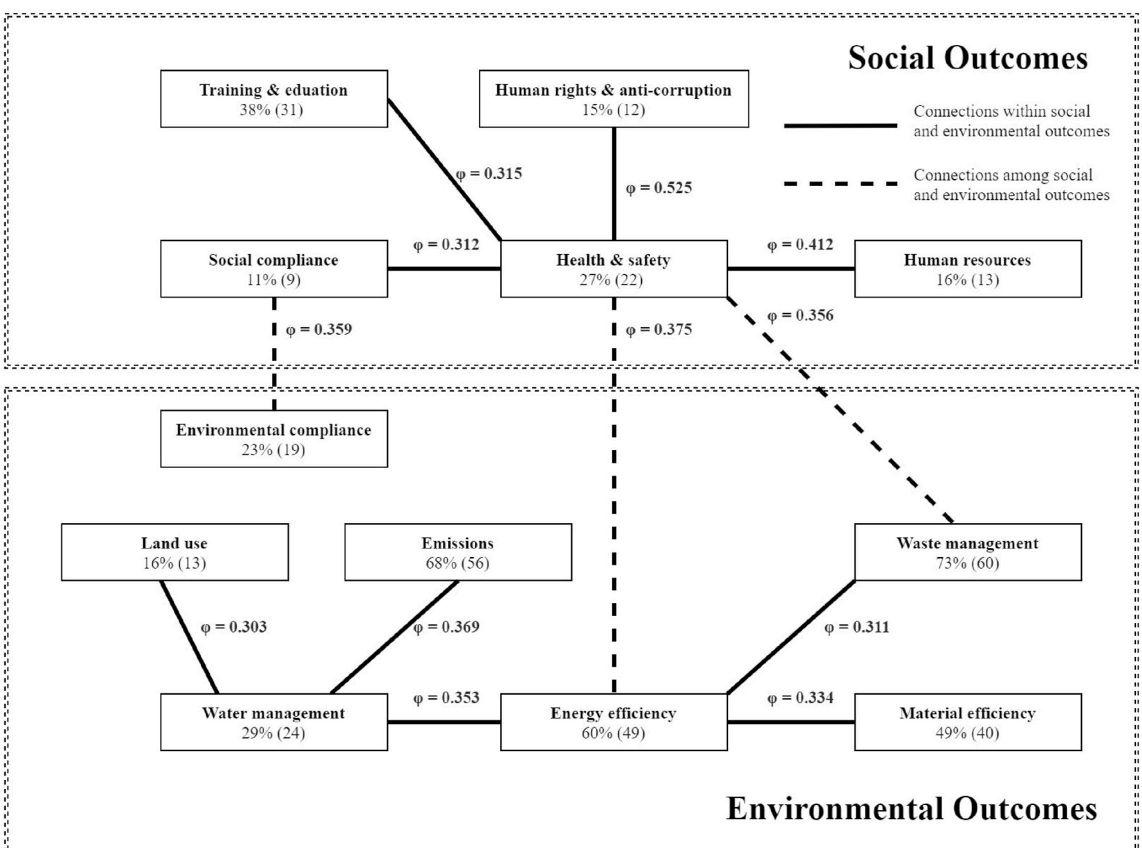

Fig. 9. Contingencies among sustainability outcomes.

apparent as repairing is a part of the remanufacturing process.

4.3.3. Sustainability outcomes

The connections among sustainability outcomes are listed in Table B4 (see Appendix B) and illustrated in Fig. 9. Interestingly, contingencies are limited to social and environmental sustainability outcomes out of the three sustainability performances.

Firstly, considering the contingencies among social outcomes, we observe that *health & safety* is connected with four other outcomes: *social compliance*, *training & education*, *human rights & anti-corruption* and *human resources*. This is due to health and safety being a major concern for the other four social outcomes.

Secondly, when considering the contingencies among environmental outcomes, *water management* connects with three other outcomes: *emissions*, *energy efficiency* and *land use*. When considering all papers discussing *water management*, they focus on *emissions* and *energy efficiency* as environmental outcomes (e.g., Howard et al., 2019; Walmsley et al., 2019). Hence, due to the popularity of these environmental outcomes, such contingencies are justified. The link with *land use* is coherent as it sets a key constraint for proper water management, considering the possible land footprint (Walmsley et al., 2018).

Additionally, *energy efficiency* is connected with *material efficiency* and *waste management*. These connections are apparent, mainly due to the objectives of CE to minimise resource and energy consumption. Hence, these three environmental outcomes were discussed together in the CE context (e.g., Walmsley et al. (2019); Genovese et al. (2017)).

The logic behind the contingencies between social and environmental outcomes is then carefully observed. All environmental outcomes, except for *environmental and social compliance*, have comparably high frequencies. With their well-established nature as sustainability outcomes, they tend to appear together, causing these contingencies. This coincidence can also be observed in the contingency between *social compliance* and *environmental compliance* despite their low frequencies. Scholars mentioned social compliance together with frequently discussed environmental compliance under the sustainability compliance in SCM discourse (e.g., Cardoso de Oliveira et al., 2019; Howard et al., 2019). Hence, it is apparent that these connections occurred by the frequent mentioning of sustainability outcomes due to their popularity in the scholarly discussion. Interestingly, none of the economic outcomes is linked with each other or other environmental and social outcomes.

4.3.4. Overall connections

In order to get an overview idea of how CE strategies, three different types of collaboration practices, and sustainability outcomes are interconnected, we considered the contingencies among the constructs of three frameworks, as shown in Tables B5, B6, B7, B8 and B9 (see Appendix B).

When considering the collaboration practices creating contingencies with CE strategies and sustainability outcomes, they can be categorised into three main groups as ‘relational collaboration practices’, ‘operational collaboration practices’ and ‘stakeholders’ as depicted in Fig. 10. Collaboration practices such as *sharing responsibility for product recovery*, *penalties & incentives* were considered under ‘relational collaboration practices’ as they are effective governance mechanisms employed to achieve relational rents as per the relational view of Dyer and Singh

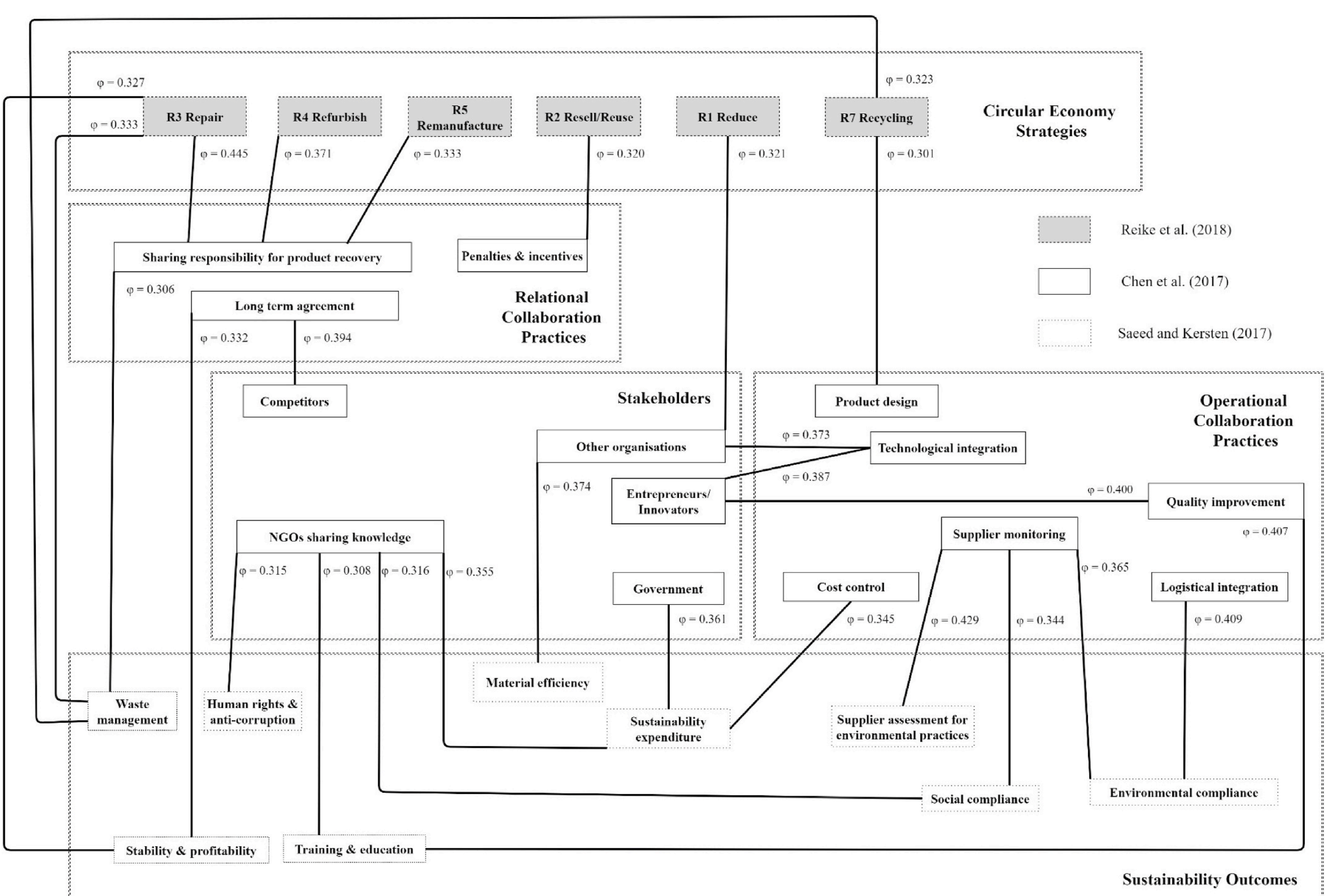

Fig. 10. Contingencies among collaboration, CE strategies and sustainability outcomes Contingency results among stakeholders, relational and operational collaboration practices.

(1998). While 'operational collaboration practices' were categorised based on their link to supply chain operations, we defined external parties involved in external horizontal collaboration practices as the 'stakeholders'.

Table B5 (see Appendix B) depicts the contingencies among stakeholders and relational and operational collaboration practices.

The main stakeholder creating the most contingencies with collaboration practices is *entrepreneurs/innovators,* as most entrepreneurial companies develop sustainable technologies in the CE context (Scheepens et al., 2016). Hence, they provide supportive platforms for technological and infrastructure integration (e.g., during return product collection) (Veleva and Bodkin, 2018). Similarly, they assist firms in ensuring the improved quality of returned materials and newly developed circular products (Veleva and Bodkin, 2018). *Other organisations* is connected with *technological integration*, given the role of technology in the CE context. Technology has brought different parties to common platforms, including the non-traditional supply chain actors (Leder et al., 2020), discussed under *other organisations* and linked to improving the circularity of operations. Moreover, the role of *competitors* is connected with *long term agreement*. Competitors collaborate through long term agreements to mitigate the competition and reduce costs to pursue suppliers to change their practices towards sustainability (Veleva and Bodkin, 2018).

- Contingency results among collaboration practices, stakeholders and CE strategies

Table B6 (see Appendix B) shows that *sharing responsibility for product recovery* is the most connected collaboration practice with the CE strategies. With the introduction of product take-back systems under the shared responsibility to recover products, the rate of repairing, refurbishing, and remanufacturing has been increased (Jensen et al., 2019; Zacho et al., 2018). Hence, these connections further reflect the importance of collaborating with supply chain actors for collecting return/EoL products to ensure the circularity of supply chains.

Penalties and incentives for sustainability related actions is connected with *R2 Resell/Reuse*, while *product design/modification* is associated with *R7 Recycling*. The first connection makes sense as the quality of the collected waste can be improved while encouraging reuse by assigning penalties and incentives (Zacho et al., 2018). The latter connection is a hot topic in the scholarly debate as the recyclability of a product needs to be decided at the initial stage of product design (Jabbour et al., 2019).

Other organisations is connected with *R1 Reduce* as research institutes tend to focus on resource utilisation in the CE context and support the notion of reducing virgin material usage in circular products (Dijkstra et al., 2020).

- Contingency results among collaboration practices and sustainability outcomes

Since the focus of this study lies with collaboration in CSCs, we studied the contingencies from a collaboration perspective in this section. Hence, with the information in Table B7 (see Appendix B), the highest number of contingencies are with *supplier monitoring*. Since the main focus of supplier monitoring is to ensure that suppliers adhere to environmental and social guidelines of the focal firm (Howard et al., 2019), these connections with *environmental compliance*, *social compliance* and *supplier assessment for environmental practices* are self-explanatory.

Logistical integration is associated with *environmental compliance*. This connection is understandable as improved sustainability performance is one of the main reasons for logistical integration (Beske and Seuring, 2014). Further, logistical integration can also be identified as a means of value creation to slow down the resource loops by managing take-back logistics systems in CSCs (Hofmann, 2019).

Quality improvement and *cost control* are connected with *training & education* and *sustainability expenditure*, respectively. These connections are also self-explanatory. For instance, skilled labour enhanced through training is crucial for improving quality standards of processes in the CE context (Kazancoglu et al., 2020a). Similarly, through a well-designed cost-efficient schedule, not only the transport costs, penalties for delays can be reduced but also the sustainability related costs such as costs for emissions (González-Sánchez et al., 2020).

Out of the relational collaboration practices, *sharing responsibility for product recovery* is linked with environmental performance, while *long term agreement* is linked with economic performance. These contingencies are comprehensible, aligning with the primary purposes of these collaboration practices relating to sustainability performance in CSCs (Batista et al., 2018).

- Contingency results among stakeholders and sustainability outcomes

Examining the contingencies among stakeholders and sustainability outcomes is shown in Table B8 (see Appendix B); *NGOs sharing knowledge and experiences* has the highest number of contingencies with social and economic outcomes. This connection is the evidence that the CE knowledge shared by NGOs such as the Ellen McArthur Foundation assists companies in reaching the next level of sustainability performance (Hofmann, 2019). Consequently, NGOs are involved in developing standards for packaging designs and processes across supply chains (Meherishi et al., 2019).

Meanwhile, collaboration with *government* is connected with the economic outcome (*sustainability expenditure*), while collaboration with *other organisations* is linked with the environmental outcome (*material efficiency*). The first link is evident as the government tends to invest in infrastructure for waste collection and categorisation to support the circulation of circular materials (Kazancoglu et al., 2020a). The latter connection is explainable due to the research and development (R&D) support extended by research institutes and universities to improve material efficiency (Dijkstra et al., 2020).

- Contingency results among CE strategies and sustainability outcomes

As per the contingencies in Table B9 (see Appendix B), *R3 Repair* and *R7 Recycling* create contingencies with sustainability outcomes, and they are connected only to environmental (*waste management*) and economic (*stability and profitability*) outcomes. This finding further supports the arguments of Ghisellini et al. (2016) that the main focus of CE strategies is still narrowed down towards environmental and economic sustainability objectives reflecting the nature of CE as a sustainable development approach.

4.4. Conceptualising the findings

As the contingencies among constructs are distributed among five figures (Figs. 6–10) and the content analysis, we reconceptualised the findings to aggregate our arguments as shown in Fig. 11.

We start the conceptualisation from CE implementation strategies in supply chains. Achieving the main objectives of the CE as a sustainable development approach, these strategies enable environmental and economic performance.

CE implementation strategies affect supply chain collaboration in three different ways. Firstly, CE implementation strategies such as repair, refurbish, remanufacture and resell/reuse encourage relational collaboration practices such as sharing responsibility for product recovery, penalties and incentives and long term agreements. This motivation acts as a catalyst to improve OM decision making in managing relationships, given the importance to engage other supply chain partners under the extended producer responsibility in the CE context (Jabbour et al., 2019). Similarly, this disposition towards relational collaboration aligns with the main aims of CSCs to recover products and redirect EoL products back to the supply chain (Nasir et al., 2017) while

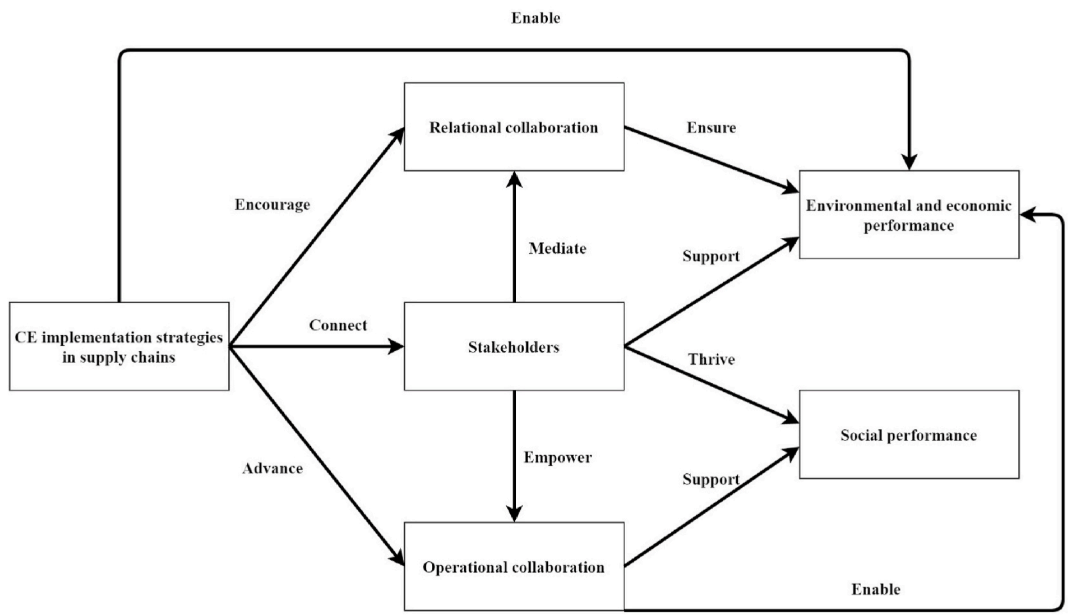

Fig. 11. Conceptualising core arguments of supply chain collaboration and sustainability performance in the CE context.

reducing waste and increasing new sale opportunities with the refurbished products (Kühl et al., 2020). Hence, these relational collaboration practices ensure improving environmental and economic performances in CSCs.

Secondly, CE implementation strategies advance operational collaboration practices as they mainly focus on improving the circularity of operations in CSCs. For instance, product design can be advanced with innovative digital technologies such as additive manufacturing (AM) to accommodate the use of recycled materials (Rosa et al., 2020). This progression engages new supply chain partners such as AM system vendors in the product design process (Mellor et al., 2014), expanding the operational collaboration practices. The initial focus of these operational collaboration practices is directed towards achieving environmental and economic performance. Eventually, understanding the social issues in the industries, these practices tend to support the social sustainability performance improvement. For instance, the social dimension is considered a key driver when deciding on well-established operational collaboration practices such as green purchasing, supplier monitoring and development (Howard et al., 2019; Zeng et al., 2017).

Thirdly, CE implementation strategies connect stakeholders into CSCs. This connection with stakeholders such as governments, entrepreneurs and NGOs is crucial to overcoming management limitations relating to physical flows (Korhonen et al., 2018). The eco-industrial park is a good example to explain the effect of this connection as government regulations affect the implementation of such initiatives at regional levels (Herczeg et al., 2018). Moreover, Zacho et al. (2018) and Farooque et al. (2019a) emphasised the importance of building industry-specific relationships with stakeholders such as local government to enhance product recovery rates. These examples also indicate that such stakeholders tend to mediate relational collaboration practices. On the other hand, stakeholders such as entrepreneurs can be helpful to overcome technical barriers in improving operational collaboration practices such as technological and logistical integration (Veleva and Bodkin, 2018). Such a progressive involvement of stakeholders can empower operational collaboration practices.

Stakeholders demanding circularity practices ensure their main aim is to improve sustainability performance in the CE context (Zeng et al., 2017). Hence, they support the continuity of environmental and economic performance. For instance, government actions such as introducing new laws to reduce waste and signing international agreements for sustainable development (Velenturf and Jopson, 2019) and NGOs sharing knowledge to encourage the adoption of industrial ecology (Shih et al., 2018) are existent proof for this effort. Similarly, stakeholders also come up with novel solutions to understand sustainability issues. Entrepreneurial ideas towards social ventures have set such an example in the CE context to thrive social performance (Jensen et al., 2019). Hence, the role of stakeholders contributes to achieving sustainability performance in the CE context.

5. Discussion and research directions

5.1. *Contribution to theory building*

The contribution of this paper relates to the supply chain collaboration debate in five folds. Firstly, this study presents a framework for achieving sustainability performance through supply chain collaboration. Even though this conceptualisation is based on the supply chains in the CE context, the generalisability is justifiable, aligning with the previous scholarly work. For instance, compared to the previous similar work of Chen et al. (2017), this paper distinguishes the contribution of different supply chain collaboration practices towards achieving the three dimensions in sustainability performance. Hence, from a scholarly perspective, this framework contributes to theory development connecting supply chain collaboration and sustainability performance while filling the research gap of lacking comprehensive studies on this integration.

Secondly, this paper contributes to understanding how collaboration needs to be evolved in supply chains. Relationships among different supply chain actors have diverged from the traditional dyadic relationship towards the multi-tier perspectives of supply chains. This extension is in line with the current topic of multi-tier supply chains achieving sustainability performance (Mishra et al., 2018). However, this study extends beyond the tier perspective and engages external parties such as governments, entrepreneurs and NGOs into the supply chain while bringing more vibrant to the complexity of relationships. This complexity is evident based on the contingency analysis. For instance, the partnership between a focal firm (e.g., a large-scale or multi-national company) and a technology-driven innovative entrepreneur can assist in bringing improved sustainability performance of the focal firm. However, Kiefer et al. (2019) highlighted that this relationship could be further nurtured or impaired by external pressure enforced by the government introducing new industry standards and policies. In such a scenario, additional collaboration with the government can positively affect this collaborative performance, given the common goal of the collaboration. Hence, understanding the individual role of different stakeholders such as government, entrepreneurs, competitors and their collective impact in the CSC implementation process has become essential in the SCM discourse (De Angelis et al., 2018). This scenario aligns with the research gaps pointed out by Veleva and Bodkin (2018), leading the supply chain to achieve greater performance with the improved connection among stakeholders in complex relationships.

Thirdly, our study highlights why the upstream and downstream perspectives on collaboration need to be changed. The boundary between upstream and downstream gets blurred in supply chain relationships in the CE context, mainly due to two reasons. One reason is the previously mentioned complex connectivity of external parties to the supply chain, further represented by the contingencies between collaboration practices and stakeholders. These linkages encourage that the complex nature of relationships should be addressed through a network approach rather than traditional linear segregation. The second reason highlights the dual role of a single player. Due to this duality nature, the traditional segregation of players under 'upstream' and 'downstream' supply chains becomes dynamic, blurring the boundary between production and consumption (Veleva and Bodkin, 2018) hence highlighting the network perspective. Our proposition is in line with the arguments of Cardoso de Oliveira et al. (2019), where they pointed out the importance of considering the network perspective to understand the role of collaboration in CSCs compared to traditional thinking. The importance of the network approach for CSC collaboration is further proven considering the implementation of eco-industrial parks and how different actors collaboratively work to achieve better sustainability performance (Patricio et al., 2018).

Fourthly, we accentuate how supply chain collaboration practices need to be changed, given the context. On the one hand, the importance of internal collaboration through practices such as cross-functional coordination is emphasised while agreeing upon the arguments of Flygansvær et al. (2018), highlighting that collaboration is essential for developing the inter-firm culture in an organisation to adopt circularity in supply chains. On the other hand, considering the external collaboration practices, new collaboration practices such as *sharing responsibility for product recovery* and *incentives and penalties* have emerged in the CE context despite the traditional collaboration practices such as *just in time* and *logistical integration*, discussed by Spekman et al. (1998) for traditional SCM. Hence, with the implementation of circularity into supply chains, it is essential to understand what collaboration practices are to be prioritised amidst traditional practices. Similarly, the discussion on core topics related to collaboration, such as trust, needs to be further discussed in the literature.

Additionally, when considering how the CE strategies connect with collaboration practices in the contingency analysis, it is evident that specific CE strategies are not connected as they have received minimal attention in the literature. For instance, a CE strategy such as *re-mine* plays a vital role in the product recovery process. Jabbour et al. (2019) highlighted the extensive involvement of informal sectors in this approach, which is highly essential, yet neglected in the literature. This research gap is further emphasised by the contingency analysis and highlights the necessity of exploring how to achieve such under-discussed CE strategies through collaboration practices.

Finally, this study explores the linkage between supply chain collaboration and sustainability performance. Aligning with the findings of Flygansvær et al. (2018), Huybrechts et al. (2018) and Zeng et al. (2017), this study emphasises that the purpose of collaboration mainly lies in achieving environmental and economic outcomes while social outcomes become their next priority. This finding aligns with Flygansvær et al. (2018), where they found that the sustainability focus of CSCs is also limited to environmental and economic performance. Hence, the main purpose of the collaboration is also aligned with the objectives of CSCs. This argument further agrees with the propositions of Chen (2018) and Meherishi et al. (2019) to explore further the social sustainability dimension relating to CSCs.

5.2. Managerial implications

With the investigation of collaboration practices, this study is an initiative guiding managerial decision making to choose appropriate collaboration practices to implement CSCs while understanding how different collaboration practices assist in achieving enhanced sustainability performance. The management should especially focus on how traditional collaboration practices such as *vendor managed inventory* and *just-in-time* can be useful during the transitioning to CSCs in the organisation's internal operations. Moreover, collaboration with other stakeholders such as NGOs, research institutes and universities is becoming the trend among practitioners willing to advance in CE implementation. Especially considering the successful knowledge and experience sharing that occurred through these partnerships, both practitioners and academia can help each other advance their progress towards CE.

5.3. Limitations

This study contains the inherent limitations of any SLR. Firstly, the literature search is limited only to academic journals. The findings presented in this study are based on the academic perspective leading to the conceptual nature of the study. The conceptualisation is also bounded by the inherent limitations of the followed contingency analysis, mainly caused by the number of papers published on the intersection of the themes addressed in this study. Hence, future empirical studies are needed to operationalise the identified categories and observe whether these connections are in practice. Especially, the real-world application of these practices and their success are noteworthy to study through empirical studies to gain further knowledge and validate the conceptual framework presented in Fig. 11. Similarly, since the main focus of the studied academic work lies on SCM in the CE context, the focus on the core CE perspective is limited. Hence, a similar study can be extended to other research avenues such as industrial ecology and industrial symbiosis to delve into CE. Secondly, the propositions we discussed in this study are limited mainly to the CE context. Although there is generalisability to a certain extent regarding the collaboration practices, how they can improve sustainability performance is limited to the CE context. Finally, the findings of this study are limited to the boundaries of the selected frameworks. For instance, the CE strategies followed in this study are more product oriented. However, as supply chains are moving towards service-oriented CE strategies (Chen, 2018), this study can be further improved in the future towards initiatives such as product-service-systems and understand how collaboration practices should change in such scenarios. Similarly, the selected collaboration frameworks are more focused on managing relationships with external parties. Therefore, future research can expand considering internal collaborative approaches such as cultural elements, openness and mutuality needed to the transition towards CE.

6. Conclusion

This study presents different collaboration practices that can be initiated in CSC implementation. Relational collaboration practices, such as sharing responsibility for product recovery, incentives, and penalties, enhance the circularity of supply chains by enabling the return process of EoL products. Operational collaboration supports these return processes through practices such as process design and logistical integration. The engagement of external parties such as governments and NGOs influences these practices positively and negatively and affects sustainability performance. While all collaboration types support achieving the environmental and economic performance of CSCs, the lacking focus on social sustainability performance tends to be mainly thrived by external parties such as entrepreneurs who propose novel ideas to address social issues in circular operations. Nevertheless, the bias towards the economic and environmental performance of CSCs should move towards a more balanced TBL approach to achieve sustainable development while understanding the needed evolution of supply chain relationships with external parties. The conceptual framework provided in this study guides the managers in deciding which collaboration practices are worth their investments to achieve improved sustainability performance in CSCs. Further, this transition towards CSCs is relieved with the managerial understanding of expanding the relationships to the next level with external parties.

Acknowledgement

This research has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie Innovative Training Networks (H2020-MSCA-ITN-2018) scheme, grant agreement number 814247 (ReTraCE project).

Appendix A

Table A1
Overview of constructs with definitions, examples and frequencies in supply chain collaboration (constructs were derived from framework by Chen et al. (2017))

Construct	Description	Examples in CSCs	Frequency
Internal collaboration			
Implementing cross - functional coordination	Cross-functional teams working together to achieve sustainability (Chen et al., 2017)	(Leising et al., 2018), (Ünal et al., 2019), (Kurilova-Palisaitiene et al., 2018)	13 (16%)
Internal process integration	Focus on internal process connectivity and internal process simplification (Chen et al., 2009)	(Walmsley et al., 2018), (Mishra et al., 2018), (Ünal et al., 2019)	13 (16%)
Adopting environmental management system (EMS)	A formal system and database which integrates procedures and processes for the training of personnel, monitoring, summarising, and reporting of specialised environmental performance information to internal and external stakeholders of the firm (Sroufe, 2003)	(Masi et al., 2018), (Kiefer et al., 2019), (Cardoso de Oliveira et al., 2019)	10 (12%)
External Vertical Collaboration			
*Sharing information with key suppliers/customers	Sharing information relating to sales forecasts, production plans, order tracking, and tracing, delivery status, stock level with suppliers and customers	(Flygansvær et al., 2018), (Kurilova-Palisaitiene et al., 2018), (Howard et al., 2019)	60 (73%)
Penalties and incentives for sustainability related actions	Assigning penalties and incentives along the supply chain to promote sustainable behavior of players (e.g., penalties – reduced business, incentives - preferred supplier status such as priority for future business) (Porteous et al., 2015)	(Mishra et al., 2018), (Jabbour et al., 2019), (Larsen et al., 2018)	54 (66%)
Sharing responsibility for product recovery	Sharing the responsibility among suppliers and customers to recover the used/EoL products under the extended responsibility of the producer (Jacobs and Subramanian, 2012)	(Mishra et al., 2018), (Jabbour et al., 2019), (Larsen et al., 2018)	45 (55%)
*Risk sharing	Collaborating with suppliers and customers to mitigate/reduce risks and uncertainties born by a single player in the supply chain	(Zacho et al., 2018), (Cardoso de Oliveira et al., 2019), (Kalverkamp, 2018)	43 (52%)
*Product design/modifications	Collaborating with suppliers and customers during the product design/modification stage	(Farooque et al., 2019b), (Kurilova-Palisaitiene et al., 2018), (Farooque et al., 2019a)	42 (51%)
*Long term agreement	Arranging long term agreements such as contracts and warranties with suppliers and customers to ensure the CSC implementation and continuation	(Flygansvær et al., 2018), (Zacho et al., 2018), (Cardoso de Oliveira et al., 2019)	36 (44%)
*Process design/modification	Collaborating with suppliers and customers during the process design/modification stage	(Farooque et al., 2019b), (Hofmann, 2019), (Kurilova-Palisaitiene et al., 2018)	34 (42%)
Inter-organisational trust	The extent of trust placed in the partner organisation by the members of a focal organisation (Zaheer et al., 1998)	(Hofmann, 2019), (Velenturf and Jopson, 2019), (Franco, 2017)	34 (42%)
Communication with key suppliers/customers	Communication with suppliers and customers to smooth the processes in supply chains and enhance sustainability performance	(Kalverkamp, 2018), (Walmsley et al., 2018), (Flygansvær et al., 2018)	29 (35%)
Technological integration	Collaborating with suppliers and customers by integrating and aligning technological systems to improve the sustainability performance	(Farooque et al., 2019a), (Kalverkamp, 2018), (Jensen et al., 2019)	26 (32%)
Supplier monitoring	Activities such as assessment guides and questionnaires, verification of third-party certifications, CSR audits, social impact assessments, supplier audits and site inspections (Morali and Searcy, 2013)	(Mishra et al., 2018), (Howard et al., 2019), (Zacho et al., 2018)	26 (32%)
Green purchasing	The integration of environmental considerations into purchasing policies, programs, and actions (Large and Thomsen, 2011)	(Farooque et al., 2019b), (Mishra et al., 2018), (Cardoso de Oliveira et al., 2019)	22 (27%)
Infrastructure integration	Supply chain partners integrating infrastructure to enhance sustainability performance	(Howard et al., 2019), (Chen, 2018), (Meherishi et al., 2019)	16 (20%)
Logistical integration	Collaboration with suppliers and customers to integrate their logistics operations	(Hofmann, 2019), (Gu et al., 2019), (Jensen et al., 2019)	15 (18%)
*Quality improvement	Collaborating with suppliers and customers in quality improvement stage	(Zacho et al., 2018), (Kurilova-Palisaitiene et al., 2018), (Jensen et al., 2019)	15 (18%)
*Cost control	Collaborating with suppliers and customers to manage costs in the supply chains	(Walmsley et al., 2018), (Mishra et al., 2018), (Herczeg et al., 2018)	14 (17%)
Product development	Collaborating with suppliers and customers during the product development stage	(Chen, 2018), (Franco, 2017), (Jabbour et al., 2019)	12 (15%)
*Revenue sharing	Collaborating with suppliers and customers to share the revenues and benefits earned through collaborative practices towards sustainability	(Mishra et al., 2018), (Kühl et al., 2020), (Kurilova-Palisaitiene et al., 2018)	11 (13%)
*Supplier development	Focal firm supporting suppliers through a 'proactive practice' enabled by firm-specific capabilities (Sancha et al., 2016)	(Dubey et al., 2019), (Ünal et al., 2019), (Herczeg et al., 2018)	6 (7%)
*Just in time	Collaboration with suppliers to deliver materials immediately when necessary without storing inventory (Zimmer, 2002)	(Lahane et al., 2020), (Leder et al., 2020), (González-Sánchez et al., 2020)	3 (4%)
Continuous replenishment	Collaboration with suppliers and customers to ensure continuous availability of products	Mokhtar et al. (2019)	1 (1%)
Kanban		Kurilova-Palisaitiene et al. (2018)	1 (1%)

(continued on next page)

Table A1 (*continued*)

Construct	Description	Examples in CSCs	Frequency
	Implementing a Kanban ordering system aligning with suppliers and customers as a lean-based improvement to tackle the remanufacturing challenges leading to longer lead times		
*Vendor managed inventory	Collaboration with customers to manage the availability of products through a continuous monitoring (Yu et al., 2012)	–	0
External Horizontal Collaboration			
**Collaboration with government	To raise awareness for CE and promote the practices (e.g., improving product take-back efforts by introducing incentive schemes) while providing the top-down support to achieve sustainability performance of supply chains	(Dubey et al., 2019), (Velenturf and Jopson, 2019), (Kiefer et al., 2019)	38 (46%)
**Collaboration with other organisations	Getting the support for CE implementation from other organisations such as Industry Associations, academic/research institutions	(Veleva and Bodkin, 2018), (Patricio et al., 2018), (Genovese et al., 2017)	26 (32%)
**Collaboration with entrepreneurs/innovators	To implement CE under circular business models and continue implementation through R&D processes and innovation while improving sustainability performance	(Veleva and Bodkin, 2018), (Scheepens et al., 2016), (Jensen et al., 2019)	16 (20%)
**NGOs sharing knowledge and experiences	To improve the sustainability performance and CE implementation (e.g., assisting the buying firm to develop poor suppliers) (Rodríguez et al., 2016)	(Meherishi et al., 2019), (Veleva and Bodkin, 2018), (Hofmann, 2019)	16 (20%)
Collaboration with competitors	Through practices such as collaborative capacity sharing and joint production (Seok and Nof, 2014; Lu et al., 2014; Yazan, 2016).	(Kalverkamp, 2018), (Gu et al., 2019), (Veleva and Bodkin, 2018)	9 (11%)
**NGOs acting as a bridge for funding	To financially support for CE implementation (e.g., assisting to connect buying firms with poor suppliers, connecting the buying firm to financial institutes such as banks) (Rodríguez et al., 2016)	(Veleva and Bodkin, 2018), (Howard et al., 2019)	3 (4%)

[*] Newly added constructs from Ni and Sun (2019) framework.
[**] Newly added constructs to consider missing third parties such as government, NGOs who are key players in CSCs (Murray et al., 2017).

Table A2
Overview of constructs with definitions, examples and frequencies in sustainability outcomes (Constructs were derived from the framework by Saeed and Kersten (2017))

Construct	Description	Examples in CSCs	Frequency
Economic Outcomes			
Stability and profitability	Financial health of an organisation. (e.g., total sales/revenue, operating profit, free cash flow, and the total number of products produced)	(Patricio et al., 2018), (Flygansvær et al., 2018), (Franco, 2017)	58 (71%)
Market competitiveness	An organisation's economic performance as compared to its competitors. (e.g., organisation's market share performance, offering of competitive wages and earnings per share performance)	(Howard et al., 2019), (Ünal et al., 2019), (Jensen et al., 2019)	19 (23%)
Sustainability expenditures	Spending on sustainable initiatives (e.g., local procurement, R&D expenditures)	(Farooque et al., 2019a), (Velenturf and Jopson, 2019), (Kalverkamp, 2018)	24 (29%)
Income distribution	Salaries and benefits given to employees, payments made to government and community (in form of taxes, employee wages and benefits, community investments, and operating costs)	(Geissdoerfer et al., 2018), (Franco, 2017), (Chen, 2018)	4 (5%)
Social Outcomes			
Training & education	Training and education opportunities to employees	(Patricio et al., 2018), (Flygansvær et al., 2018), (Veleva and Bodkin, 2018)	31 (38%)
Health & safety	Health and safety issues related to the work in an organisation	(Howard et al., 2019), (Chen, 2018), (Jensen et al., 2019)	22 (27%)
Human resource	Management of human resource, creating jobs, balanced gender diversity, employee turn-over, employees' benefits/satisfaction/performance evaluations	(Velenturf and Jopson, 2019), (Herczeg et al., 2018), (Zacho et al., 2018)	13 (16%)
Human right and anti-corruption	Acting against corruption and the violation of human rights (e.g., discrimination, forced and child labor, corruption, and violation of the rights to the freedom of association)	(Veleva and Bodkin, 2018), (Franco, 2017), (Meherishi et al., 2019)	12 (15%)
Social compliance	Compliance with social regulations. (e.g., through Standards and certifications)	(Howard et al., 2019), (Cardoso de Oliveira et al., 2019). (Zacho et al., 2018)	9 (11%)
Consumer issues	Addressing consumer's complaints, product returns, and incidents of misleading, deceptive or fraudulent information conveyed to the consumer	–	0
Environmental Outcomes			
Waste management	Management of waste produced and recycled by an organisation. (e.g., hazardous waste produced)	(Farooque et al., 2019a), (Genovese et al., 2017), (Veleva and Bodkin, 2018)	60 (73%)
Emissions	Air emissions released (e.g., GHGs emission, ozone-depleting substances, and particulate matters)	(Howard et al., 2019), (Walmsley et al., 2019), (Levänen et al., 2018)	56 (68%)
Energy efficiency	Efficient use of energy and use of renewable energy	(Howard et al., 2019), (Walmsley et al., 2019), (Chen, 2018)	49 (60%)
Material efficiency	Use all forms of material input efficiently (e.g., renewable, hazardous and recycled material input)	(Walmsley et al., 2019), (Genovese et al., 2017), (Farooque et al., 2019b)	40 (49%)
Water management	Managing the water consumption (e.g., water discharge and the quality of water discharged)	(Walmsley et al., 2018), (Levänen et al., 2018), (Nasir et al., 2017)	24 (29%)
Environmental compliance	Compliance with environmental regulations (e.g., paying fines for non-compliance, environmental standards and certificates)	(Howard et al., 2019), (Cardoso de Oliveira et al., 2019), (Kiefer et al., 2019)	19 (23%)
Land use	Proper use of land for conducting organisation's operations.	(Walmsley et al., 2018), (Franco, 2017), (Genovese et al., 2017)	13 (16%)
Supplier assessment for environmental performance	Considering suppliers' environmental performance when selecting them.	(Farooque et al., 2019b), (Flygansvær et al., 2018), (Cardoso de Oliveira et al., 2019)	9 (11%)

Table A3
Overview of constructs with definitions, examples and frequencies in CE strategies (Constructs were derived from framework by Reike et al. (2018))

Construct	Description	Examples in CSCs	Frequency
Short Term Loops			
R2 Resell/Reuse	Consumers buy second-hand products or find buyers selling products not or hardly in use, Consumer may do some cleaning or minor adaptations for quality restoration. Producers directly re-use unsold returns or products with damaged packaging	(Levänen et al., 2018), (Kalverkamp, 2018), (Zacho et al., 2018)	64 (78%)
R3 Repair	Extending the lifetime of a product by repairing (e.g., replacing defective parts). This can be done by customer or a repair company	(Jensen et al., 2019), (Zacho et al., 2018), (Hofmann, 2019)	43 (52%)
R1 Reduce	Consumers use less products/use products for a longer time period Producers use less material per unit of productions (dematerialisation in product design)	(Hofmann, 2019), (Velenturf and Jopson, 2019), (Patricio et al., 2018)	34 (42%)
R0 Refuse	Consumers tend to buy/use less products (e.g., rejecting packaging waste) Producers refuse to use hazardous material and design processes to avoid waste	(Howard et al., 2019), (Farooque et al., 2019b), (Kühl et al., 2020)	4 (5%)
Medium Term Loops			
R5 Remanufacture	The full structure of the products is disassembled, cleaned and checked to see where necessary to replace and repair to bring the product 'up to original state'. Recycled components can also be used in these products	(Jensen et al., 2019), (Zacho et al., 2018), (Nasir et al., 2017)	49 (60%)
R4 Refurbish	Only the components are repaired or replaced while the overall structure of the product remains intact. This also results in an 'overall upgrade' of the product	(Jensen et al., 2019), (Zacho et al., 2018), (Masi et al., 2018)	30 (37%)
R6 Repurpose	Material of discarded products/components are used for completely different function. Mostly popular among artists. E.g., creating jewellery from the gold retrieved from discarded electronic circuits	(Farooque et al., 2019b), (Hofmann, 2019), (Ünal et al., 2019)	6 (7%)
Long term loops			
R7 Recycling	Processing of mixed streams of post-consumer products or post-producer waste streams using expensive technological equipment, including shredding, melting and other processes to capture (nearly) pure materials. Materials do not maintain any of the original product structure and can be re-applied anywhere. Primary recycling takes place in business-to-business relations, and secondary recycling is based on used end-of-life products that are collected by municipal waste collectors.	(Farooque et al., 2019b), (Chen, 2018), (Levänen et al., 2018)	68 (83%)
R8 Recover energy	Capturing energy in waste, mainly by incineration.	(Howard et al., 2019), (Velenturf and Jopson, 2019), (Meherishi et al., 2019)	19 (23%)
R9 Re-mine	Remining the landfills (urban mining). Especially this is more common in developing countries.	(Velenturf and Jopson, 2019), (Veleva and Bodkin, 2018), (Cardoso de Oliveira et al., 2019)	3 (4%)

Appendix B

Table B1
Contingency results among supply chain external vertical collaboration practices

Pair of constructs		Chi-square Significance	Phi-coefficient	Expected Frequency	Observed Frequency
Process design/modification	Sharing information	0.001	0.421	3	7
Sharing information	Communication with supply chain partners	0.001	0.373	19.2	26
Technological integration	Communication with supply chain partners	0.001	0.365	9.4	16
Product design/modification	Green purchasing	0.001	0.362	11.6	18
Technological integration	Logistical integration	0.002	0.35	4.9	10
Green purchasing	Supplier monitoring	0.002	0.35	8.2	13
Process design/modification	Product development	0.002	0.347	5.1	10
Technological integration	Sharing responsibility for product recovery	0.002	0.343	14.6	21
Long term agreement	Risk sharing	0.003	0.335	19.4	26
Product development	Infrastructure integration	0.005	0.315	2.4	6
Penalties and incentives	Long term agreement	0.006	0.306	24.3	30
Penalties and incentives	Sharing responsibility for product recovery	0.007	0.303	30.4	36
Product development	Sharing information	0.007	0.3	8	12

Table B2
Contingency results among external horizontal collaboration practices

Pair of constructs		Chi-square Significance	Phi-coefficient	Expected Frequency	Observed Frequency
Collaboration with other organisations	NGOs sharing knowledge and experiences	0	0.454	5.2	12
Collaboration with other organisations	Entrepreneurs/Innovators	0	0.454	5.2	12
Collaboration with other organisations	Government	0.001	0.355	12.4	19

Table B3
Contingency results among CE strategies

Pair of constructs		Chi-square Significance	Phi-coefficient	Expected Frequency	Observed Frequency
R3 Repair	R4 Refurbish	0	0.511	16.1	26
R4 Refurbish	R5 Remanufacture	0	0.404	18.4	26
R2 Resell/Reuse	R7 Recycling	0	0.403	54.4	59
R3 Repair	R5 Remanufacture	0	0.394	26.3	34
R1 Reduce	R4 Refurbish	0.004	0.326	12.8	19

Table B4
Contingency results among sustainability outcomes

Pair of constructs		Chi-square Significance	Phi-coefficient	Expected Frequency	Observed Frequency
Health & safety	Human right and anti-corruption	0	0.525	3.3	10
Health & safety	Human resource	0	0.412	3.6	9
Health & safety	Energy efficiency	0.001	0.375	13.5	20
Emissions	Water management	0.001	0.369	16.8	23
Social compliance	Environmental compliance	0.001	0.359	2.1	6
Health & safety	Waste management	0.001	0.356	16.5	22
Water management	Energy efficiency	0.002	0.353	14.7	21
Energy efficiency	Material efficiency	0.003	0.334	24.5	31
Health & safety	Training & education	0.005	0.315	8.5	14
Health & safety	Social compliance	0.005	0.312	2.5	6
Energy efficiency	Waste management	0.005	0.311	36.8	42
Water management	Land use	0.007	0.303	3.9	8

Table B5
Contingency results among stakeholders and collaboration practices

Pair of constructs		Chi-square Significance	Phi-coefficient	Expected Frequency	Observed Frequency
Entrepreneurs/Innovators	Quality improvement	0	0.4	3	8
Competitors	Long term agreement	0	0.394	4.1	9
Entrepreneurs/Innovators	Technological integration	0.001	0.387	5.2	11
Other organisations	Technological integration	0.001	0.373	8.5	15

Table B6
Contingency results among collaboration practices, stakeholders and CE strategies

Pair of constructs		Chi-square Significance	Phi-coefficient	Expected Frequency	Observed Frequency
Sharing responsibility for product recovery	R3 Repair	0	0.445	24.2	33
Sharing responsibility for product recovery	R4 Refurbish	0.001	0.371	16.9	24
Sharing responsibility for product recovery	R5 Remanufacture	0.003	0.333	27.6	34
Penalties and incentives	R2 Resell/Reuse	0.004	0.32	43.2	48
Product design/modification	R7 Recycling	0.007	0.301	35.7	40
Other organisations	R1 Reduce	0.004	0.321	11	17

Table B7
Contingency results among collaboration practices and sustainability outcomes

Pair of constructs		Chi-square Significance	Phi-coefficient	Expected Frequency	Observed Frequency
Supplier assessment for environmental performance	Supplier monitoring	0	0.429	2.9	8
Environmental compliance	Logistical integration	0	0.409	3.6	9
Training & education	Quality improvement	0	0.407	5.8	12
Environmental compliance	Supplier monitoring	0.001	0.365	6.2	12
Sustainability expenditures	Cost control	0.002	0.345	4.2	9
Social compliance	Supplier monitoring	0.002	0.344	2.9	7
Stability and profitability	Long term agreement	0.003	0.332	26.1	32
Waste management	Sharing responsibility for product recovery	0.006	0.306	33.8	39

Table B8
Contingency results among stakeholders and sustainability outcomes

Pair of constructs		Chi-square Significance	Phi-coefficient	Expected Frequency	Observed Frequency
Other organisations	Material efficiency	0.001	0.374	13	20
Government	Sustainability expenditures	0.001	0.361	11.4	18
NGOs sharing knowledge and experiences	Sustainability expenditures	0.002	0.355	4.8	10
NGOs sharing knowledge and experiences	Social compliance	0.005	0.316	1.8	5
NGOs sharing knowledge and experiences	Human right and anti-corruption	0.005	0.315	2.4	6
NGOs sharing knowledge and experiences	Training & education	0.006	0.308	6.2	11

Table B9
Contingency results among CE strategies and sustainability outcomes

Pair of constructs		Chi-square Significance	Phi-coefficient	Expected Frequency	Observed Frequency
R3 Repair	Waste management	0.003	0.333	32.3	38
R3 Repair	Stability and profitability	0.003	0.327	31.2	37
R7 Recycling	Waste management	0.004	0.323	51	55

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