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Le rôle de la collaboration dans la performance soutenable des supply chains circulaires

The Role of Collaboration in the Sustainable Performance of Circular Supply Chains

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Abstract

The circular economy, an emerging economic model, aims to transform the production, consumption and final disposal of goods and services. Replacing the linear model, it encourages the extended use of resources to maximize their value. Beyond the environmental aspects, it offers economic and social opportunities, contributing to job creation, innovation and long-term cost reduction. This approach supports sustainable development by balancing economic, social and environmental dimensions. The supply chain plays a central role in this transition, requiring multi-stakeholder collaboration. Social Exchange Theory is emerging as a relevant approach to understanding relationships within the circular supply chain, exploring elements such as trust, commitment, reciprocity and power. However, an integrated approach to these elements and their impact on sustainable supply chain performance remains little explored. This thesis explores the role of collaboration in the circular supply chain and its impact on sustainable performance, adopting the perspective of Social Exchange Theory. The objectives of this study are based on defining sustainable performance, characterizing a collaborative ecosystem, identifying the determinants of collaboration, and analyzing their influence on sustainable performance. To build an explanatory model, the study adopts a mixed approach integrating qualitative and quantitative analyses. This complementary methodology aims to provide a holistic understanding of the phenomenon, using case studies and cross-validation of data to ensure information saturation. This thesis, comprising four articles. The results of each article contribute to the construction of a conceptual model integrating trust, commitment, reciprocity, power, circular economy strategies, collaboration and their effects on the sustainable performance of circular supply chains. Regarding the definition of sustainable performance, the literature demonstrates its complexity and variability, linked to terms such as circular transition and sustainable competitiveness. This research attempts to harmonize a definition by considering its economic, environmental and social dimensions. With regard to collaboration, the literature highlights its crucial role in linear systems, while the need for further discussion is underlined for circular supply chains. Social behaviors, based on Social Exchange Theory, reveal trust as a crucial element positively influencing collaboration quality and sustainable performance. However, collaboration quality does not mediate the relationship between trust and sustainable performance, unlike in linear systems. These findings have theoretical implications by enriching the academic discussion on collaboration in circular supply chains, while on a practical level they can guide managers' and policymakers' decisions to boost sustainable performance. Methodological limitations include the exploratory nature of some steps and the complexity of the final model.

Keywords: Circular Supply Chain; Collaboration; Sustainable Performance.

Résumé

L'économie circulaire, modèle économique émergent, vise à transformer la production, la consommation et la disposition final des biens et services. Remplaçant le modèle linéaire, elle favorise l'utilisation prolongée des ressources pour maximiser leur valeur. Au-delà des aspects environnementaux, elle offre des opportunités économiques et sociales, contribuant à la création d'emplois, à l'innovation, et à la réduction des coûts à long terme. Cette approche soutient le développement soutenable en équilibrant les dimensions économique, sociale, et environnementale. La supply chain joue un rôle central dans ce contexte, nécessitant une collaboration multipartite. La théorie de l'échange social émerge comme un outil pertinent pour comprendre les relations au sein de la supply chain circulaire, explorant des éléments tels que la confiance, l'engagement, la réciprocité et le pouvoir. Cependant, une approche intégrée de ces éléments et leur impact sur la performance soutenable de la supply chain reste peu explorée. Cette thèse explore le rôle de la collaboration dans la supply chain circulaire et son impact sur la performance soutenable, en adoptant la perspective de la théorie de l'échange social. Les objectifs de cette étude sont basés sur la définition de la performance soutenable, la caractérisation d'un écosystème collaboratif, l'identification des déterminants de la collaboration, et l'analyse de leur influence sur la performance soutenable. Pour construire un modèle explicatif, l'étude adopte une approche mixte intégrant analyses qualitative et quantitative. Cette méthodologie complémentaire vise à fournir une compréhension holistique du phénomène, utilisant des études de cas et la validation croisée des données pour assurer la saturation des informations. Cette thèse est composée de quatre articles. Les résultats de chaque article contribuent à la construction d'un modèle conceptuel intégrant la confiance, l'engagement, la réciprocité, le pouvoir, les stratégies d'économie circulaire, la collaboration et leurs effets sur la performance soutenable des supply chains circulaires. Concernant la définition de la performance soutenable, la littérature démontre sa complexité et sa variabilité, liée à des termes tels que la transition circulaire et la compétitivité durable. Cette recherche tente d'harmoniser une définition en considérant ses dimensions économiques, environnementales, et sociales. En ce qui concerne la collaboration, la littérature souligne son rôle crucial dans les systèmes linéaires, tandis que la nécessité de discussions supplémentaires est soulignée pour les supply chains circulaires. Les comportements sociaux, fondés sur la théorie de l'échange social, révèlent la confiance comme un élément crucial influençant positivement la qualité de la collaboration et la performance soutenable. Cependant, nos résultats montrent que la qualité de la collaboration ne joue pas un rôle de médiateur dans la relation entre la confiance et la performance soutenable, contrairement aux systèmes linéaires. Ces résultats ont des implications théoriques car ils enrichissent la discussion académique sur la collaboration dans les supply chains circulaires, et sur le plan pratique, ils peuvent guider les décisions des managers et des responsables politiques pour stimuler la performance soutenable. Les limites méthodologiques incluent la nature exploratoire de certaines étapes et la simplicité du modèle final pour des raisons de complexité.

Mots clés : Supply Chain Circulaire ; Collaboration ; Performance Soutenable.

List of acronyms

CE	Circular Economy
SC	Supply Chain
CSC	Circular Supply Chains
SCM	Supply Chain Management
CSCM	Circular Supply Chain Management
SET	Social Exchange Theory
SEM	Structural Equation Modeling
EEE	Electrical and Electronic Equipment
EoL	End of Life
VC	Value Chain

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1. Introduction

The Circular Economy (CE) is an economic model that seeks to change the way goods and services are produced, consumed and disposed of. It is based on the idea of breaking the traditional linear model of "take, make, use and dispose" and replacing it with a circular system where resources are kept in use for as long as possible and their value is maximized (EMF-Ellen MacArthur Foundation, 2013). The introduction of the CE concept arose in response to the challenges facing our planet due to the overexploitation of natural resources, increasing waste and growing consumption, among others (Geissdoerfer et al., 2017). Resource depletion, pollution and climate change are clear signs that the current economic approach is not sustainable (Korhonen et al., 2018).

In contrast, CE promotes the idea of eliminate waste and pollution, circulate products and materials and regenerate natural systems (EMF-Ellen MacArthur Foundation, 2013). To this respect, the literature presents the R-imperatives, which are the strategies through which CE is operationalized and the value is retained. In this group of R-imperatives we find reduce, reuse, repair, remanufacture, refurbish, recycle, among others (Reike et al., 2018).

The CE not only focuses on environmental aspects, but also presents significant economic and social opportunities, such as job creation, promotion of innovation and long-term cost reduction, closely related with the concept of sustainable development (Korhonen et al., 2018). The World Commission on Environment and Development, stated the most commonly accepted definition of sustainability as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”(United Nations, 1988). Likewise, literature has studied the relationship between the concept of CE and sustainability, showing that CE is seen as a condition for sustainability, a beneficial relationship, or a trade-off between costs and benefits (Geissdoerfer et al., 2017). However, the concept of sustainable development is based on the balance of 3 main dimensions (economic, social and environmental) (Hernandez Marquina et al., 2022; Walker et al., 2021b) and authors express that the attention paid to these dimensions is currently partial, usually leaving aside the social dimension (Corona et al., 2019; Kristensen and Mosgaard, 2020).

In the same vain, literature suggests that integrating the concept of CE into Supply Chain Management (SCM) can provide advantages from a sustainability viewpoint, that is why, there is enthusiasm and a growing interest in SCM for CE (Farooque et al., 2019). The application of CE needs to adapt conventional economic systems at different levels that involves all stakeholders to deploy a strategy that truly supports sustainable development (Asgari and Asgari, 2021). Therefore, literature argues that SC is the key unit of action with regard to CE implementation and success and it is the basis for driving needed change (Hazen et al., 2020). In their work about the definition of Circular Supply Chain Management (CSCM), Farooque et al. (2019) present the concept of CSCM as "the integration of circular thinking into the management of the supply chain and its surrounding industrial and natural ecosystems. It systematically restores technical materials and regenerates biological materials toward a zero-waste vision through system-wide innovation in business models and supply chain functions from product/service design to end-of-life and waste management, involving all stakeholders in a product/service lifecycle including parts/product manufacturers, service providers, consumers, and users" (p.884).

Several authors have shown the necessity of a strong partnership between stakeholders into SC to achieve circular models (Hazen et al., 2020). Likewise, engagement of partners beyond SC boundaries has been recognized as critical for CE implementation (Sudusinghe and Seuring, 2022). Studies of CE shift emphasize the need for multi-stakeholder collaboration (Saccani et al., 2023; Sudusinghe and Seuring, 2022). However, limited literature provides insight into how the collaborative relationships between stakeholders can influence the sustainable performance of a Circular Supply Chain (CSC), and only few offer practical guidance to stakeholders for engaging in such collaborative processes (Hazen et al., 2020; Saccani et al., 2023; Wielopolski and Bulthuis, 2023). Suggesting that there may be elements of the collaboration that would facilitate the transition to more performing circular models, which have not yet been studied.

Boughzala and De Vreede (2015) define collaboration "as a process in which two or more agents (individuals or organizations) share resources and skills to solve problems so that they can jointly achieve one or more goals" (p.133). In the same vein, authors suggest that collaboration between stakeholders is based on effective communication,

achievement of shared understanding, and adaptation of tasks, behaviors, and resources to produce high-quality outcomes (Boughzala and De Vreede, 2015). Likewise, Scholars in SCM, highlight the positive impact of collaboration on SC performance and sustainable performance (Chen et al., 2017).

When talking about stakeholders' collaboration, academics expose the importance of an enabling ecosystem to enhance the development of the SC and at the same time to obtain sustainable benefits (Zhang et al., 2013). Likewise, literature suggests that collaboration elements may be present in the development of the ecosystem at different scales (González-Sánchez et al., 2020).

Viswanadham and Samvedi (2013) defined a supply chain ecosystem as "the elements of the supply chain and the entities that influence the goods, information and financial flows through regulations, technology, management, etc." (p.6485). Subsequently, Aarikka-Stenroos et al. (2021) define a CE ecosystems as "communities of hierarchically independent, yet interdependent heterogeneous set of actors who collectively generate a sustainable ecosystem outcome", where the sustainable ecosystem outcome is "a system-level outcome typified by circular processes of recycling, reuse, and reduction"(p.261). In turn, Whicher et al. (2018) identified nine key areas of action according with the stakeholders within a CE ecosystem: policy-makers, investors, academics and education, design, consumers and users, brands or companies, manufacturers, material experts and resource managers. Suggesting the need for synergies between the different actors in the ecosystem to achieve a performing circular system.

In SCM, the Social Exchange Theory (SET) is a theory that seeks to explain the relationships between partners within a SC (Wong and Cheung, 2005). In essence, this theory is based on basic principles of psychological and economic rewards, which analyze the social exchange system and its behavioral components, such as trust, commitment, reciprocity and power (Wu et al., 2014). As a result, SET has gained significant relevance by providing a better understanding of the collaboration between partners in a SC and how the dynamics of their relationships evolve over time (Can Saglam et al., 2022).

Meanwhile, in the CE literature, several authors have individually mentioned different elements of SET, such as *power* (González-Sánchez et al., 2020; Kapsalis et al., 2019; Kirchherr et al., 2018; Leigh and Li, 2015; Masi et al., 2017), *commitment* (Kapsalis et al., 2019; Liu et al., 2018; Paavilainen et al., 2021; Saccani et al., 2023; Tobin and Zaman, 2022; Veleva and Bodkin, 2018; Wielopolski and Bulthuis, 2023; Yadav et al., 2020), *trust* (Allais, 2015; Beske and Seuring, 2014; Carter and Rogers, 2008; Masi et al., 2017; Paavilainen et al., 2021; Tobin and Zaman, 2022), and *reciprocity* (Can Saglam et al., 2022; Davlembayeva et al., 2021; Jones and Tobin, 2018; Tobin and Zaman, 2022), as factors affecting the general collaboration among CSC partners. However, they have not considered the totality of these elements as a set of interrelated factors that can jointly influence collaboration between CSC partners, and, in turn, have an effect on its sustainable performance.

Considering the role of collaboration in the CSC and its influence on sustainable performance through the lenses of SET, the present thesis addresses the following research questions*:*

I. What is sustainable performance in a CSC context?
II. What is a collaborative ecosystem in a CSC context?
III. What are the determinants of collaboration in the CSC?
IV. How these determinants influence the sustainable performance of the CSC?

1.1. Research theme and objectives

This thesis is developed under a multidisciplinary vision, in which supply chain management, economics and industrial engineering are integrated to study the sustainable performance of CSC and how collaboration between stakeholders can influence such performance. The general objective of this research is "*to build a model that exposes how stakeholder's collaboration within a CSC influences its sustainable performance".*

This model seeks on the one hand to identify the determinants of collaboration between stakeholders in a CE ecosystem, based on SET, and thus consider aspects of social interactions such as trust, commitment, reciprocity and power. And on the other hand, to determine what is the impact of these factors on the sustainable performance of the

CSC, considering the three dimensions of sustainability (economic, social and environmental).

In this context, this thesis aims to achieve the following specific objectives, which focus on comprehending what are the motivations and determinants of stakeholder's collaborations in CSC and how these elements can influence the sustainable performance:

I. To define sustainable performance in the CSC context.
II. To define collaborative ecosystems in the CSC context.
III. To identify the determinants of collaboration in CSCs.
IV. To determine the impact of collaboration determinants on the sustainable performance of CSCs.

1.2. Motivations

This research considers a multi-disciplinary approach in which supply chain management, economics and industrial engineering converge to offer a holistic view of the problem under study. This approach integrates the study of CE practices, sustainable performance of CSC, inter-firm collaboration and social exchange behaviors of the actors in this ecosystem.

CE is an economic model that has gained increasing attention due to its potential to address critical environmental and social issues, as well as providing opportunities for more sustainable and responsible economic growth. It is seen as a key strategy for moving towards a more resilient future in harmony with planetary boundaries (Asgari and Asgari, 2021; WBSCD, 2020; Webster, 2013).

The transition to CE is an issue that concerns all actors involved in the current economic model (Asgari and Asgari, 2021). This is why governments, through regulatory frameworks and public policies, industrialists through the reinvention of their products, processes and business models, academia through research and knowledge generation and civil society through awareness and education are looking for ways to adapt current systems to more responsible ones that consider the collective growth for current and future generations (Andrews et al., 2006; WBSCD, 2020).

In recent years, there has been a great growth in the study of SCM focused on CE (Calzolari et al., 2021; Farooque et al., 2019; González-Sánchez et al., 2020; Lahane et al., 2020). Due to the advantages it brings from the point of view of sustainable development (Geissdoerfer et al., 2017; Hazen et al., 2020; Masi et al., 2017).

Farooque et al. (2019) in their literature review about CSCM show that the study of CE elements in SC sustainability literature started in the late 2000s and continued at a modest rate until 2015, then, since the beginning of 2016, there has been an increase of papers on this topic, which indicates a growing research interest in this field (Figure 1.1.).

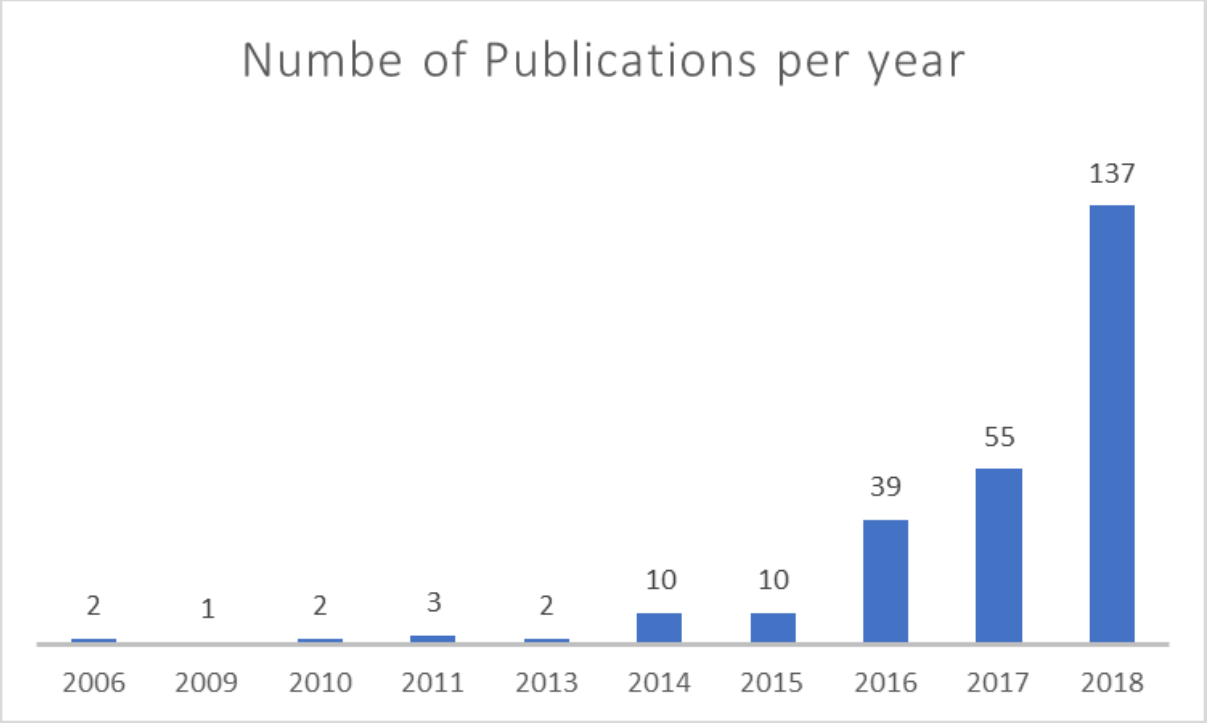


Figure 1.1. Distribution of articles about CE in SCM per year (Farooque et al., 2019)

However, literature on CSCM is still in its early stages of development where the conceptualization of how to develop CSC theories and practices to support the sustainable vision and thus achieve adequate potential in the implementation of CE is still in its infancy (Farooque et al., 2019).

Literature about barriers and enablers in the transition to CE argues that collaboration between different stakeholders in the CSC is an extremely important topic that requires further research. They point out that this area has been largely neglected in CSCM,

resulting in a crucial knowledge gap that significantly affects progress towards a circular model (Bressanelli et al., 2021; Farooque et al., 2019). Furthermore, authors expose that the success of CE transformation processes depends on a collaborative multi-stakeholder structure. However, only a limited amount of practical guidance is available to help stakeholders effectively engage in such collaborative processes (Saccani et al., 2023; Wielopolski and Bulthuis, 2023).

Sudusinghe and Seuring (2022), in their systematic literature review about SC collaboration and sustainability performance in CE indicate that SC collaboration in the CE context is still an emerging area with an increasing number of publications in recent years (Figure 1.2).

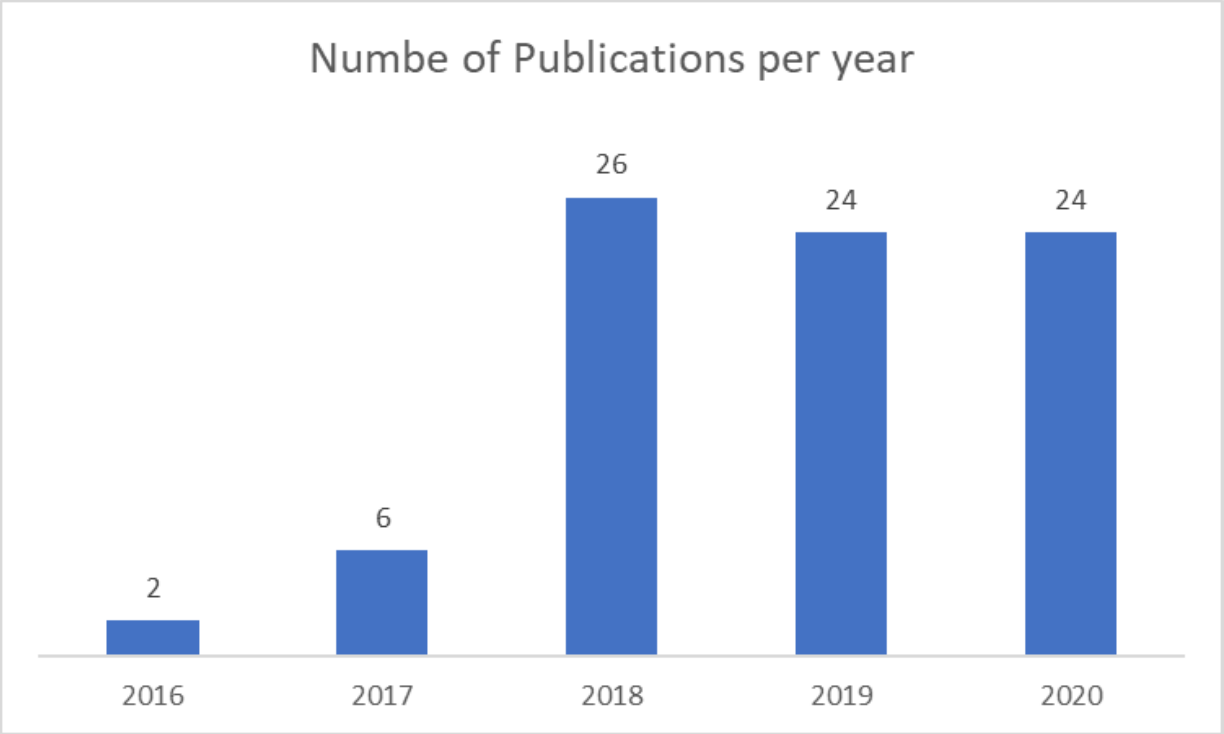


Figure 1.2. Distribution of articles about SC Collaboration and sustainability performance in SCM per year (Sudusinghe and Seuring, 2022)

Regarding sustainable performance of CSC, literature shows that there are partial and total evaluation regarding sustainable dimensions (society, environment and economics), and also these dimensions may have different weightings in terms of their importance, (Hernandez Marquina et al., 2022; Walker et al., 2021b) while the main focus of CSCs is on improving environmental and economic aspects rather than social

performance. (Corona et al., 2019; Kristensen and Mosgaard, 2020; Sudusinghe and Seuring, 2022).

In addition, academics show that collaboration, both internal and external to the CSC, has an impact on its sustainable performance. Sudusinghe and Seuring, 2022 affirm that “the engagement of external parties such as governmental, non-governmental organizations, entrepreneurs, and research institutes complements managerial understanding on collaboration to improve the sustainability performance of CSCs” (p.1). Likewise Chen et al., 2017 expose that academic discussion and the practical implication of collaboration are recognized in the SCM discourse, given the positive impact of collaboration on SC performance and sustainable performance.

Regarding the integration of innovation in circular ecosystems Wielopolski and Bulthuis (2022), suggests that “the deployment of sustainable innovations necessitates a deepening of collaboration between stakeholders with highly diverse cultures, ways of working, business models, and priorities”(p.1), and the difficulties of putting this ecosystem into practice are based on the fact that “…the versatility of the ecosystem with varying regulatory frameworks, economic interests, historical value logics, and overall conservatism posing significant challenges in finding mutual value opportunities and overcoming barriers for the adoption of true innovations” (p.4).

In SCM, SET emerges to understand and analyze the relationships and interactions between the different actors in the SC. This theory proposes that social interactions are based on the principles of exchange, where individuals or organizations enter into relationships to maximize benefits and minimize costs (Can Saglam et al., 2022). This theory is based on four pillars, corresponding to trust, commitment, reciprocity and power, and have previously been studied as antecedents of collaboration and its effects on the performance of SCs in the linear SCM (Wu et al., 2014). However, literature in CSCM shows the relevance of these pillars in the CE transition but in an isolated way.

In light of these considerations, the thesis is presented under a holistic view, in which the elements that integrate the social exchanges between stakeholders are related to the emerging themes of collaboration and CSCs. The effects of these elements on

sustainable performance are identified, considering sustainable performance as a multidimensional element integrated by society, economy and environment.

1.3. Research methodology

Based on the definition of this research theme, objectives, and motivations, this section presents the research methodology. This section provides a general view of the methodology applied and, subsequently, the structure of the thesis organized in chapters by articles.

1.3.1. Mixed approach

This thesis is based on the use of mixed approaches that integrate qualitative and quantitative analysis at different stages of the research. By integrating both approaches, we seek to complement the strengths and overcome the limitations of each method, which allows to obtain a more complete and holistic view of the phenomenon under study (Driscoll et al., 2007; Lund, 2012). In order to obtain a saturation of the data, in several stages of this research the cross-validation of different data sources and the contextual understanding through multiple case studies are applied.

Firstly, chapter 2 presents article 1, which provides a systematic literature review on CSCs definition and the different interpretations of sustainable performance and its 3 dimensions in this context. Then, in chapter 3, article 2 is introduced, based on an exploratory study through a literature review and a cross-sectional case study. In this second article, collaborative ecosystems in CE are explored, specifically in the value chain of the electrical and electronic equipment industry, allowing the collection of data from different individuals of the ecosystem in the same period of time to develop an initial understanding of the phenomenon (Gibbert et al., 2010; Lillis and Mundy, 2005). In chapter 4 (Article 3), a qualitative exploratory study is presented, in which through a systematic literature review and 10 case studies, the determinants of collaboration in CSCs are explored under the lens of the SET, resulting in the presentation of a first theoretical model. And finally, chapter 5 presents a quantitative study through article 4, in which a survey and a statistical analysis with the application of Structural Equation Modeling (SEM) are used to analyze the structural relationship between measured

variables and latent constructs (Hoyle, 2012), in order to quantitatively test the theoretical model presented in the third article.

1.3.2. Multidisciplinary perspective

This doctoral work is part of the CIRCULAR project of the University Grenoble Alpes, which employs a multidisciplinary approach to develop circular industrial systems. The project brings together 12 research teams and 3 technology platforms from the fields of engineering, social sciences, information and communication sciences and technologies to address the multidisciplinary challenges posed by the Industry of the future.

This research was carried out in collaboration with external stakeholders (entities, companies and researchers) at different stages of the research, in order to provide a holistic view of the problem under study. First of all, this research was carried out in complement with the doctoral training in innovation and entrepreneurship at the EIT Manufacturing, which allowed a 6-month exchange in Portugal. During this exchange, a collaboration with the Faculty of Engineering of Porto and the company Sonae MC was carried out, which allowed to study the collaborative ecosystem of the CSC through a case study presented in Chapter 3.

On the other hand, this work was conducted by integrating diverse players of CSCs, from different companies, industries and countries, in order to understand in depth, the collaborative relationships in this context. Initially, this was done in an exploratory way, in which their motivations and relationships were studied through multiple case studies (chapters 3 and 4). Subsequently, a confirmatory study was carried out through empirical research in partnership with researchers in economic sciences from the Gael laboratory of the University Grenoble Alpes to quantitatively test the relationships between collaboration and the sustainable performance of CSCs. For this quantitative study, the services of the company Kantar were engaged to conduct a survey of 600 industrialists in France, Portugal and Canada.

1.3.3. Research design

To meet the objectives of this study, the progress of the research is segmented into four stages, each represented by an article (Chapters 2, 3, 4, 5). A synthesis of the

research design is illustrated in Table 1.1. which articulates each of the articles with the research question, the specific objective, the method and the related stakeholder, followed by a general description of each article.

Table 1.1. thesis structure per articles

Articles	Research question	Research objectives	Method	Stakeholders involved
1	What is sustainable performance in a CSC context?	Definition of sustainable performance in the CSC context, considering the 3 dimensions of sustainability	Systematic Literature Review	Internal team
2	What is a collaborative ecosystem in a CSC context?	Definition of collaborative ecosystems in the CSC context	Literature review and cross-sectional case study	Faculty of Engineering of Porto and the company Sonae MC
3	What are the determinants of collaboration between partners in the CSC?	Identification of the determinants of collaboration between stakeholders in CSCs through the lenses of SET	Qualitative study: Systematic Literature Review and 10 case studies	Industrials belonging to the G-Scop laboratory network and EIT Manufacturing
4	How these determinants influence the sustainable performance of the CSC?	Determine the impact of collaboration determinants on the sustainable performance of CSCs	Quantitative study: survey and statistical analysis through SEM	Collaboration with researchers from Gael laboratory and Kantar company

Article 1. *"Sustainable performance of circular supply chains: A literature review".*

Paper presented at 29th CIRP Life Cycle Engineering Conference. Leuven 4-6 April 2022.

This article aims to understand the concept of sustainable performance of the CSC and analyze the different measurement methods existing in literature. Through a systematic literature review, 23 academic articles and 2 grey literature reports corresponded to indicators and assessing methods for sustainable performance of CSCs were reviewed, considering the 3 dimensions of sustainability (Social, economic and environmental). The selected articles were studied according to the unit of analysis

assessed, the sustainability dimensions covered, the stakeholders involved and the R-imperatives addressed. The results of this article allowed to define the sustainable dimensions of performance and to categorize the indicators and assessment methods according to the corresponding dimensions of sustainability which are subsequently used as inputs for articles 3 and 4.

Article 2. *"The Collaborative Ecosystem in the Circular Economy Context: Electrical and Electronic Equipment Value Chain".*

Paper presented at 30th EurOMA Conference. Leuven 3-5 July 2023.

This paper explores the collaborative ecosystem of the Electrical and Electronic Equipment (EEE) Value Chain (VC) in CE and identify key factors that facilitate the collaboration and an enabling ecosystem using a cross-sectional case study of an EEE retailer in Portugal. This work identifies the elements that compose the collaboration and an enabling ecosystem in the literature of CE and then, through the case study, the motivations behind these factors are studied, as well as the relationship with the challenges of this industry in the transition to CE. The results of this paper are afterward used as an input for articles 3 and 4.

Article 3. *"Exploring determinants of Collaboration in Circular Supply Chains: A Social Exchange Theory Perspective".*

Paper submitted in Sustainable Production and Consumption Journal in October 2023

This article aims to present a comprehensive overview of the determinants of collaboration in CSC through the lens of SET, and their influence on the sustainable performance of the CSC based on a conceptual model built from a systematic literature review and a multiple case study of 10 European companies. First, the results of the literature review are presented in order to define the variables that make up the SET pillars (trust, commitment, reciprocity and power) and the quality of collaboration, and then these data are cross-checked with 10 case studies of companies that apply strategies in CE. Subsequently, the effects of collaboration on the sustainable performance of CSCs are shown in a qualitative way and finally a theoretical model is proposed that highlights the effects of SET and the quality of collaboration on the sustainable performance of CSCs. The theoretical model resulting from this paper are afterward used as an input for the quantitative analysis in article 4.

Article 4. *"Exploring the effects of Trust in Collaboration and Sustainable Performance of Circular Supply Chains"*

Paper submitted in International Journal of Production Economics in December 2023

This paper aims to determine the impact of trust and collaboration determinants on the sustainable performance of CSCs. For the purpose of this paper, we take the theoretical model proposed in article 3 in a partial approach, focusing only on the effects of trust on the quality of collaboration and the sustainable performance of the CSC. Through a survey with 390 industrialists from Canada, France and Portugal, the model was tested with the application of SEM. This article proves the positive and significant effect of trust on the performance and collaboration quality of CSCs. This partially validates our initial model and proves that the social behaviors of CSCs positively affect their sustainable performance and the collaboration quality among the different stakeholders.

Figure 1.3 shows how these four articles are related to each other, covering the research areas of the thesis. This figure corresponds to the conceptual model on which this thesis is based, consisting of 4 constructs, corresponding to independent variables, such as SET and CE strategies, and dependent variables, corresponding to CSC stakeholder collaboration and sustainable performance. Article 1 describes the dependent variables through a systematic literature review on sustainable performance. Article 2 presents collaboration in the CSC ecosystem through a case study. Article 3 focuses on the definition of the independent variables such as SET pillars and CE strategies, and then outlines the possible interactions between the 4 constructs through a literature review and 10 case studies to present a first conceptual model. Finally, in article 4, this theoretical model is evaluated through a quantitative analysis, based on an empirical study.

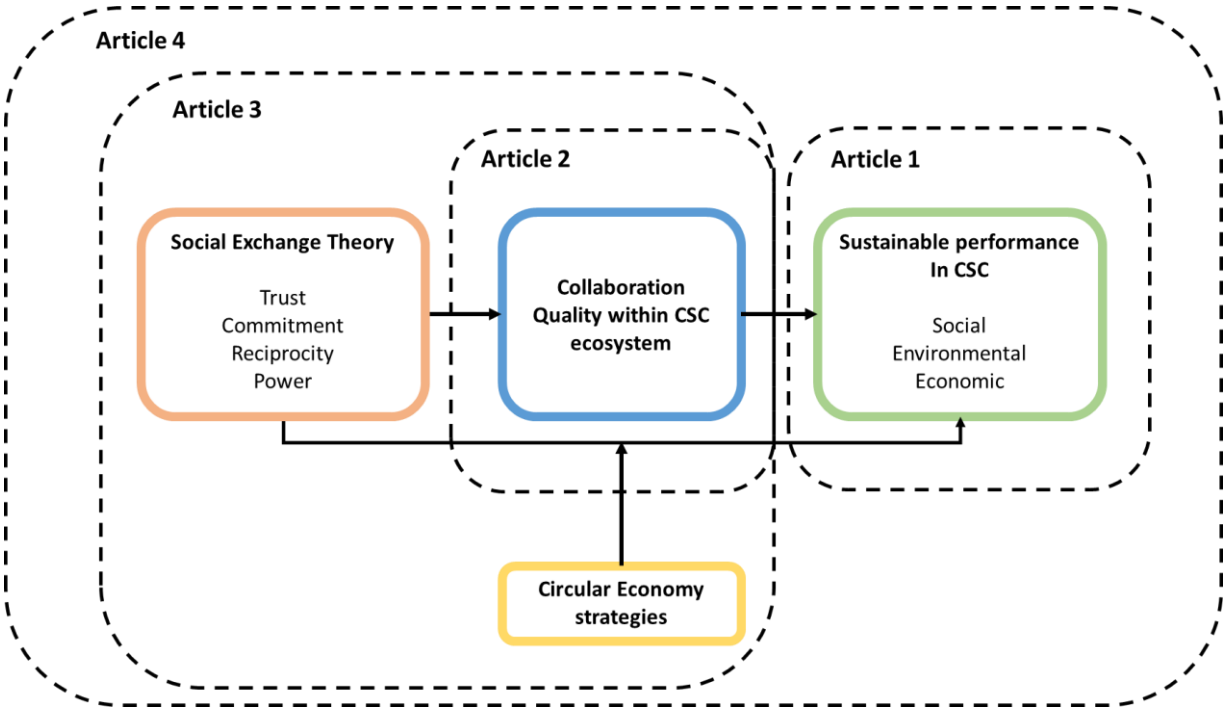


Figure 1.3. Relationship between the articles of the thesis

1.4. Limitations

The scope of this thesis is the analysis of the collaboration between the stakeholders of CSCs and how this can affect its sustainable performance, from a holistic point of view that integrates internal and external elements of the CSC. However, this research thesis is not without limitations which are presented in the following paragraphs according to the articles presented in chapters 2,3,4,5.

Firstly, the limitations related with chapter 2, are those inherent to a literature review. This review was conducted in 2021 at the beginning of this research work. This means that the results found in this paper may be updated with more recent literature. However, for the purposes of chapters 4 and 5 this literature review was complemented with literature from 2022 and 2023. On the other hand, this literature review is mostly composed of scientific publications, which might suggest that there are other means of assessing sustainable performance besides academic sources, as gray literature, composed of reports from private and public organizations and governmental documents. However, this information is further cross-checked by the case studies in chapter 4. Regarding chapter 3, in the cross-sectional case study, it was not possible to carry out interviews with all the actors of the ecosystem, this limited the access to a

global view, considering all the interactions and points of view of the stakeholders. However, the participants represent market leaders in their industry, which might suggest that the phenomenon is largely representative of the Portuguese ecosystem. On the other hand, the results obtained are not robust enough to be transferred to ecosystems in other countries. Nevertheless, it is expected to continue this line of research and to expand this study to other European countries in the near future.

With respect to chapter 4, because of its exploratory character and the constrained size of the multiple case study, supplementary data is required to completely validate the conceptual model. Additionally, it's important to note that not all of the CE strategies, R-principles, or all the participants in these CSCs were covered in the case studies, which means that the collaborative aspects of CSCs are only partially depicted. However, these results, together with the literature review, provide an insight into the understanding of CSC collaboration and its implications for sustainable performance, which is further tested quantitatively in chapter 5. Another limitation of these case studies was the impossibility of conducting a longitudinal study in which the phenomenon under study was observed over different periods of time, in order to analyze the behavior of the sample regarding collaboration through a dynamic perspective that evolves over time. However, through this study it was possible to collect the perspectives and future plans of the companies under study with respect to the application of CE strategies.

Regarding chapter 5, the theoretical model could be tested partially, without considering all the SET pillars, which represents a limitation. However, through the literature and the case studies it was noted that trust was the most commonly reported element with respect to the other pillars of SET. On the other hand, we have as another limitation the complexity of the final model with respect to the theoretical and practical findings of chapters 2, 3 and 4. During the literature review and the case studies prior to chapter 5, important influential elements such as the ecosystem were identified, which could not be added in the final quantitative test, due to the limited reliability to support the validation of the final model, because of the complexity they added. Nevertheless, these results are a valuable contribution in the study of collaboration and its influence on the sustainable performance of CSCs.

1.5. Thesis structure

This thesis proposal is structured into seven chapters. This first chapter presented the introduction composed by the research context, objectives, motivations the research methods, scope and limitations. The following chapters 2, 3, 4 and 5 correspond to journal and conference articles written during the research. The sixth chapter compiles the general results and discussions, linking the individual results of each article. Finally, the last chapter presents the general conclusions, considering theoretical, practical and political implications. The overall view of the structure of this work is presented in Figure 1.4.

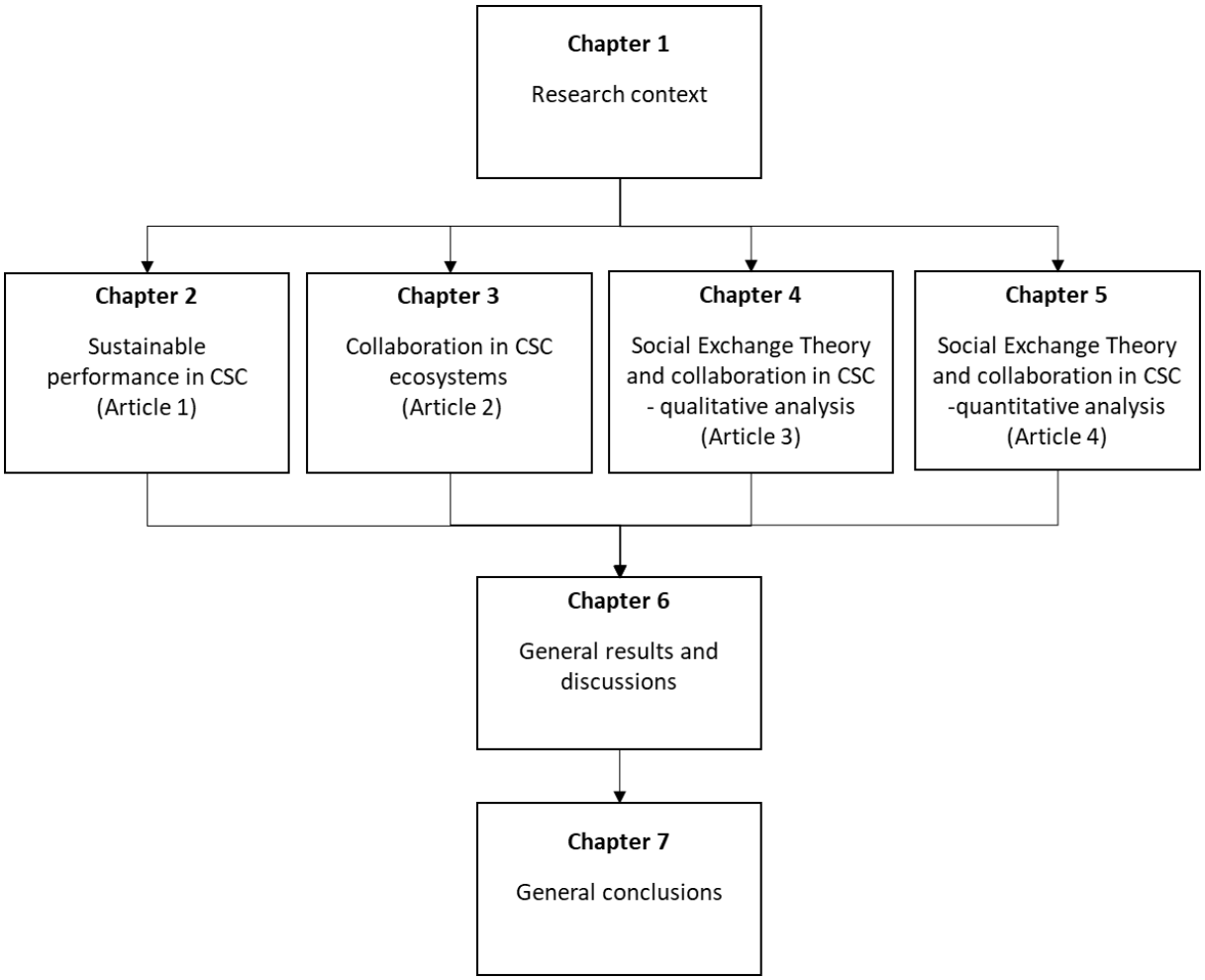


Figure 1.4. Thesis structure

2. Article 1: Sustainable Performance of Circular Supply Chains: A literature review.

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Abstract

The rapid increase in consumption of products and services is leading to the scarcity of resources and environmental crisis. The circular economy was born as a new economic model to solve these problems. It explores new techniques to rethink and redesign products and services and extend their useful life through reusing, remanufacturing, recycling, etc., to maximize the value of resources. The implementation of the circular model entails the adaptation of supply chains. In connection with sustainability, we also need to consider economic, social and environmental dimensions. This makes the evaluation of the circular systems more complex. In the past, various means are presented in the literature to evaluate and understand the sustainable dimensions for the development of the circular economy. However, the evaluation methods and the indicators are heterogeneous. Thus, it is very challenging to obtain standardized information that the different stakeholders will understand. In this paper, through a literature review, we seek to understand the measurement of the sustainable dimensions in the performance of the circular supply chains. This research is part of a thesis work, which aims to study sustainable performance in circular supply chains, grouping economic, management and industrial engineering aspects.

Keywords*:* Circular Economy; Circular Supply Chain; Sustainable Performance.

2.1. Introduction

In recent years, there has been a progressive shift towards more sustainable development. This is due to the increase in the consumption of goods and services, which brings as a consequence the depletion of resources and the environmental

crisis. From this problem, the Circular Economy (CE) was born as a new economic model based on rethinking and redesigning products and services, implementing the recirculation of resources, in order to regenerate natural systems and reduce the generation of pollution and waste (EMF-Ellen MacArthur Foundation, 2013).

Despite the growing interest in CE, the concept has garnered relatively little attention in the supply chain management literature (Lahane et al., 2020), while SCs are the key unit of action with regard to CE implementation and success and will be the foundation for driving needed change(Hazen et al., 2020).

However, some prominent literature reviews have begun to explore the link between SC management (SCM) and CE. For example, de Angelis et al. (González-Sánchez et al., 2020) reveal the need for more practical information regarding how to introduce circular supply chains (CSC) into existing context. Farooque et al., 2019 identified the different drivers, enablers and inhibitors that influence the success of a CSC. González-Sánchez et al., 2020 explored the barrier related to the CSC implementation. Notwithstanding the aforementioned reviews, there remains a lack of detailed understanding in the literature regarding how to measure sustainable circular SC performance for its design or its deployment and execution to be competitive. Developing this understanding is the primary aim of the present paper. This research is part of a thesis work, which aims to study the assessment approaches of sustainable performance in CSC, grouping economic, management and industrial engineering aspects.

2.2. Theoretical Background

This section aims to introduce the key concepts of this paper: Circular Economy, Sustainable Performance and Circular Supply Chains, to provide a direction for the literature review.

2.2.1. Circular Economy

Most of authors reported three main principles taken into consideration in the concept of CE, these principles correspond to: (a) rethinking and redesigning products and services, (b) keeping products and materials in use and (c) regenerating natural systems (Elia et al., 2020; EMF-Ellen MacArthur Foundation, 2013; Geissdoerfer et al., 2017; Kristensen and Mosgaard, 2020).

Moreover, in the literature, it was found that the application of CE is related to 4 objectives (Masi et al., 2017): (a) CE aims to become the replacement of the current linear system with the intention of being regenerative and restorative. (b) The immediate objective is to decouple economic growth from natural resource depletion and environmental degradation. (c) Increasing the resilience of the systems. (d) Create and preserve economic, social and ecological value to maximize ecosystem function and human well-being.

For the definition of the CE, end-of-life strategies (R-Principles), which encompass operational principles for closing different loops in circular systems, were also considered. In the literature there are several definitions of these principles, which take different forms depending on the strategy of the authors, such as reduce, reuse, recycle, remanufacture, refurbishment, repair, resell, repurpose, recover, (Brissaud and Zwolinski, 2017; Corona et al., 2019; Edtmayr et al., 2016; EMF-Ellen MacArthur Foundation, 2013; González-Sánchez et al., 2020; Saidani et al., 2019), among others.

On the other hand, the following definition of CE was found “an economic system that replaces the ‘end of life’ (EoL) concept with reducing, alternatively reusing, recycling, and recovering materials in production/distribution and consumption processes. It operates at the micro level (products, companies, consumers), meso level (eco-industrial parks), and macro level (city, region, nation) to accomplish sustainable development, thus simultaneously creating environmental quality, eco- nomic prosperity, and social equity to the benefit of current and future generations” (Kirchherr et al., 2017). This is the concept on which the CE will be based for the purposes of this article, as it shows the integration of the CE principles, the objectives of the model and the R-principles in order to achieve sustainable development. Subsequently, in section 4.2, this definition will be applied to the characterization of the attributes that will later allow the analysis of the results of the literature review.

2.2.2. Sustainable Performance

When referring to the CE, it is common to find links to the concepts of sustainable development (de Oliveira et al., 2021; González-Sánchez et al., 2020). Therefore, the relationship of this economic model with the three sustainable dimensions (society, environment and economy) is evidenced (Geissdoerfer et al., 2017).

However, when talking about sustainable performance within the CE model, the literature shows that there are partial and total measurements in terms of sustainable dimensions, and in turn these dimensions may have different weights in terms of their importance (Walker et al., 2021b). While the social dimension is the one that is less taken into account (Corona et al., 2019; Kristensen and Mosgaard, 2020). And furthermore, when referring to indicators, there is a great diversity of indicators, methods of measurement and evaluation of CE in terms of their specificity, scale, input elements, units of measurement, etc. Such heterogeneity makes it difficult to obtain standardized and replicable information (Corona et al., 2019; Kristensen and Mosgaard, 2020; Roos Lindgreen et al., 2020; Walker et al., 2021b). Therefore, this paper seeks to explore the measurement of the sustainable performance of CSCs.

2.2.3. Circular Supply Chains

When referring to CSC, several terms have been associated with this concept, such as open-loop and closed-loop SC, green SC and reverse SC, and although these are not exactly CSCs, together they contribute to the construction of the concept (Farooque et al., 2019; González-Sánchez et al., 2020).

In addition, Hazen et al., 2020 exposes 5 principles concerning Circular Supply Chain Management (CSCM), which correspond to closing loops (based on the recirculation of materials), slowing loops (referring to the extension of the useful life of products), intensifying loops (involving more value-intensive use phase of materials), narrowing loops (referring to the efficient use of materials) and dematerializing loops (based on the substitution of products for services).

In the case of this article, the concept that will be used for CSCM is the one presented by Farooque et al., 2019 in which it is defined as “the integration of circular thinking into the management of the supply chain and its surrounding industrial and natural ecosystems. It systematically restores technical materials and regenerates biological materials toward a zero-waste vision through system-wide innovation in business models and supply chain functions from product/service design to end-of-life and waste management, involving all stakeholders in a product/service lifecycle including parts/product manufacturers, service providers, consumers, and users”.

Figure 2.1 shows the structure of the CSC adapted from the literature (Farooque et al., 2019). This scheme will be applied to the characterization of the attributes that will later

allow the analysis of the results of the literature review in accordance with the different stakeholders (section 4.2). In the upper part of Figure 2.1 we have the raw materials extractor or supplier, which start the flow of primary resources through a conventional linear supply chain (producer, sales channels, customers). To represent a circular system, it is necessary to consider the waste management and the different ways of return the circular resource flow with the ultimate goal of zero waste. In the case of the circular flow of closed loops (right side), it can be seen that it flows in several directions, since the exchange of circular resources can occur between any SC stakeholder. On the left side are the open loops, which represent the flow of by-products and waste out of the system to external SCs of the same sector or other sectors. On this side, it can be seen that there are circular flows that can come from external SCs, which corresponds to waste and by-products that serve as raw material for this CSC.

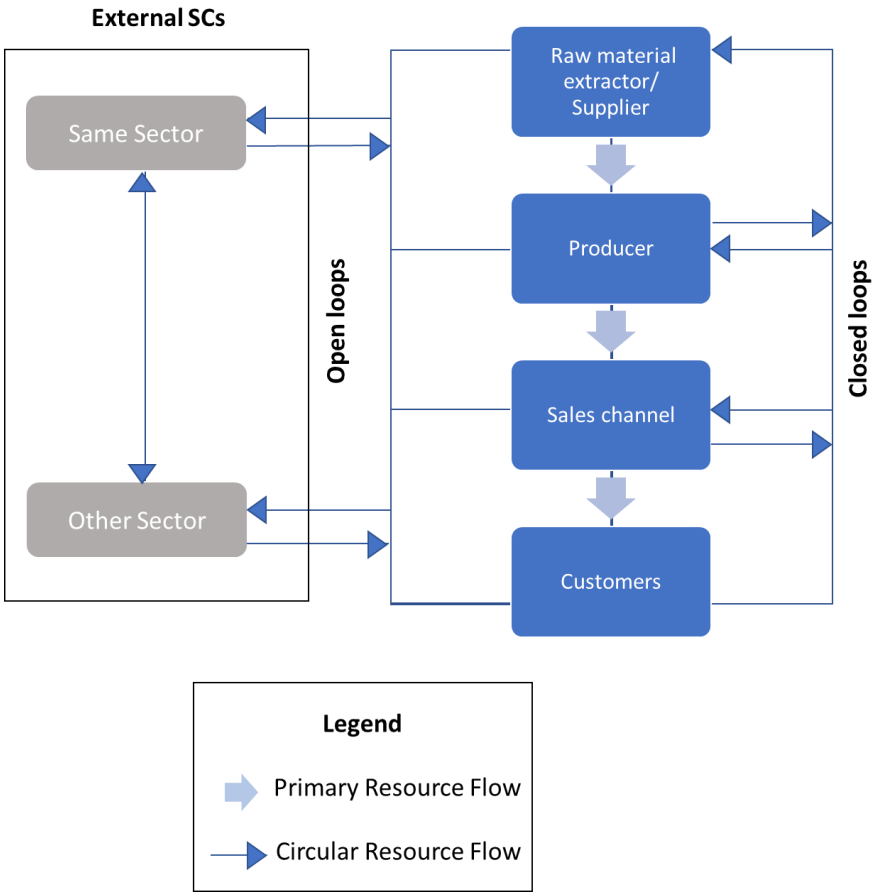


Figure 2.1. Opened and Closed loops in the CSC adapted from (Farooque et al., 2019)

2.3. Review Methodology

For the development of this work, a systematic literature review was carried out, considering academic literature composed of review articles, research articles and conference papers. And grey literature, composed of reports and manuals. For this, the search was focused on documents and articles that would support the measurement of the circular supply chain in terms of sustainable performance, in a partial or total way.

The process of searching for academic literature was carried out through Science Direct and Web of Science. This search was narrowed down to publications published in the last 5 years, and the combination of 4 areas of study (Circular Economy, Circular Supply Chain, Sustainability and Performance Evaluation) was considered. In the case of CSC, it was noted that some elements could be found related to micro-level, business model and inter-firm networks and in the case of performance evaluation, assessment, indicators, measurement, index and metrics were associated to ensure the inclusion of all possible methods. This search was carried out in titles, abstracts and key words.

At first, 214 articles were obtained, which were then filtered according to the following selection criteria: a) the articles had to mention loop closure or an R-principle; b) they had to be associated with the application of a case study or statistical field data; c) they had to address at least one of the sustainable dimensions (social, economic or environmental); d) they had to be associated with some phase of SC in relation to some stakeholder. After applying the aforementioned selection criteria, 23 academic articles and 2 grey literature reports corresponded to indicators for assessing the sustainable performance of CSCs were obtained.

2.4. Results

The results obtained from the literature review are shown below. This review was based on 25 publications of methods and indicators for evaluating CSC. First, section 4.1 describes the results obtained in relation to general attributes, such as type of publication, year of publication and journal. Secondly, section 4.2 shows the results

related to the methodological attributes, such as unit of analysis, relationship with the CSC stage and their stakeholders, sustainable dimension evaluated, perspective of its application and R principle covered.

2.4.1. Descriptive Results

Of the 25 articles of CSC assessment methods and indicators studied, 23 corresponded to scientific articles and 2 to grey literature on indicators for the transition to the CE, associated with the Ellen MacArthur Foundation and the World Business Council for Sustainable Development. Publications in the last 5 years were studied, of which 11 were published in 2018, 8 in 2017, 3 in 2021, 2 in 2020 and 1 in 2019, being 2018 the year with the highest number of publications. With respect to the journals in which this literature was published, the results are shown in Table 1. The *Journal of Cleaner Production* is the one with the highest number of publications, followed by the *Journal of Resources, Conservation and Recycling*. The gray literature is shown at the end of the table, which was published in report format.

Table 2.1. Journals and their number of publications

Journal	Number of Publications
Journal of Cleaner Production	7
Energy	1
Science of the Total Environment journal	1
Resources, Conservation and Recycling	6
Ecological Economics journal	1
sustainability	2
International Journal of Sustainable Engineering	1
Buildings	1
International Journal of Production	1
Journal of industrial ecology	1
Resources	1
Grey literature	2

2.4.2. Analysis of Sustainable Assessment in Circular Supply Chains

This section presents the results in relation to the methodological attributes of the literature reviewed. For this, 5 attributes were studied, corresponding to unit of analysis, sustainable dimension, perspective, stakeholder involved and R-principle covered.

2.4.2.1. Unit of Analysis

In our sample of papers, 5 different units of analysis were adopted by the authors: a) a material, for example the analysis of the flow of a specific material of the final product, as the evaluation of gold in the life-cycle of mobile phones (Figge et al., 2018), b) an entire product, as the evaluation of the design of prosthetics fingers to the application of CE practices (Mesa et al., 2018). c) one firm, related to its business model and processes (Rossi et al., 2020a). d) dyadic relationship, whether the relationship and sustainable performance between two firms of the SC are evaluated, as the study of the interaction between the supplier and the producer in the plastics industry(Huysman et al., 2017). Or e) the entire SC, as in the case of the environmental-social-economic indicator framework for biomass sustainability assessment (Yang et al., 2021). With respect to the unit of analysis (Figure 2.2), it is observed that most of the literature reviewed corresponds to the evaluation of 1 firm (14 publications) within the SC. This is followed by the evaluation of the whole SC under a global vision without specifying the interactions between stakeholders (4 publications). Then 3 publications to the evaluation of a specific product, 3 publications to the evaluation of a specific material within a product and finally 1 publication corresponding to the analysis of 2 firms interacting in the same supply chain.

2.4.2.2. Sustainable Dimension

The sustainable dimensions (social, economic, sustainable) refer to whether one or more of these dimensions are considered in the publications. When analysing the sustainable dimensions treated in the literature, it is observed that the highest number of publications is associated with two dimensions, the environmental dimension (9 publications) such is the case of the analysis of the environmental impact of plastic production and the use of plastic waste in different scenarios (Huysman et al., 2017), and environmental-economic dimension (9 publications), as in the case of the Eco-efficiency index (EEI) (Laso et al., 2018) which relates economic value to

environmental impacts. Followed by the integral evaluation of all dimensions (social, environmental and economic) with 6 publications and finally only the social dimension (1 publication) (Figure 2.2).

With respect to the sustainable dimensions, it is observed that at a more operational level, focused on the product, there are partial measures of the environmental and economic dimensions, while as the level goes beyond the boundaries of the organization and the SC is considered as a whole, these dimensions are treated integrally. On the other hand, it is observed that the interest of the literature continues to be focused towards the economic and environmental dimensions, leaving the social dimension neglected, which could be due to the difficulty in defining and measuring this dimension.

2.4.2.3. Perspective

It corresponds to the perspective given by the authors of the literature reviewed, which may correspond to the design of the CSC, or the monitoring of an existing CSC on the transition of the system towards the CE. In terms of perspective (Figure 2.2), most of the publications focus their evaluations on the monitoring and follow-up of the circular system (14 publications). 6 of these publications do not specify the perspective of the evaluation method, which are usually related to the evaluation of different scenarios through simulations and statistical data. 4 publications are oriented towards both, the design and monitoring of the circular system, while only one publication focuses on the design of the system or product.

With respect to the perspective of the publications, it was observed that most of them are oriented to the monitoring of circular systems, where the word "transition" is mentioned on several occasions to refer to the evolution of the systems towards the CE (Ellen MacArthur Foundation, 2020; Lèbre et al., 2017; WBCSD, 2021; Yang et al., 2021). On the other hand, the design perspective is mainly related to the stages of product development and design. In other cases, the perspective could not be placed in a monitoring or design perspective, especially in publications in which the authors evaluated different scenarios without specifying their subsequent usefulness(Adibi et al., 2017; El Wali et al., 2021; Huysman et al., 2017; Huysveld et al., 2018; Laso et al., 2018; Pauliuk, 2018).

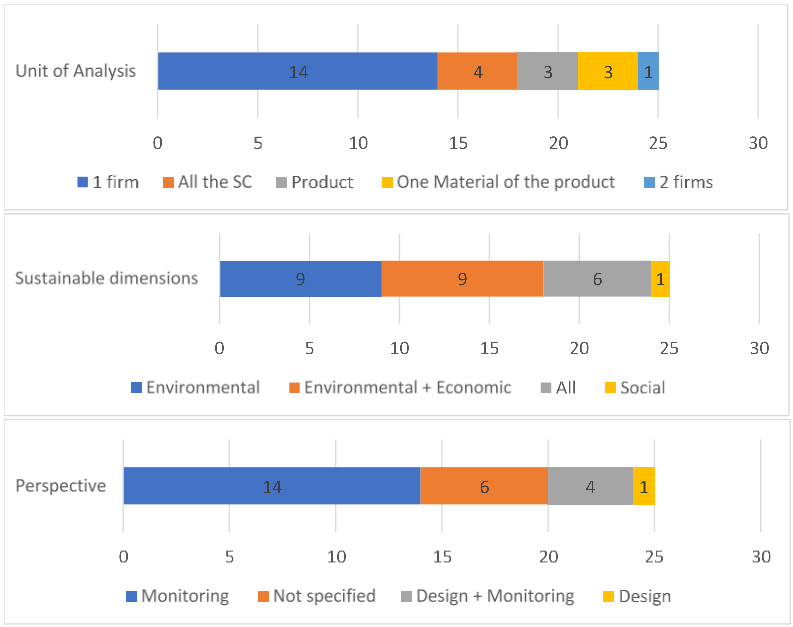


Figure 2.2. Numbers of literatures reviewed according with the attributes Unit of analysis, sustainable dimension and perspective

2.4.2.4. Stakeholder Involved

Associated to the stakeholder to whom the evaluation method is addressed, which can be the supplier or extractor of the raw material, the producer, the sales channels and/or the customers. In the case of the stakeholders involved, the CSC assessment methods reviewed in the literature are mostly oriented towards producers (23), followed by raw material suppliers (19), consumers (13), sales channels (12) and finally all stakeholders (7). (Figure 2.3).

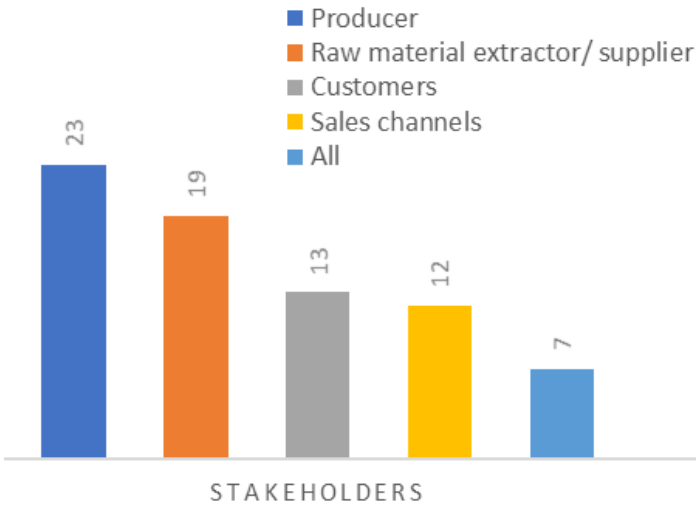


Figure 2.3. Number of appearances of stakeholders involved in the literature review.

In addressing the stakeholders involved in the literature review, it was found that most of the literature is focused on methods such as Life Cycle Assessment (Fregonara et al., 2017; Laso et al., 2018; Pauliuk, 2018; Scheepens et al., 2016) and Material Flow Analysis (Braun et al., 2018; El Wali et al., 2021; Lèbre et al., 2017; Pauliuk, 2018), which does not allow for a full understanding and usefulness of the methods regarding stakeholder's roles and interactions.

2.4.2.5. R-principle covered

These principles correspond to the processes that allow loop closures. According to the R-principles covered in the literature, 19 publications consider the recycling process, such is the case of the longevity and circularity indicators developed for the analysis of the flow of gold in the life cycle of mobile phones, which take into consideration the recycling process to recirculate the material in the production process (Figge et al., 2018). Followed by the reuse process with 11 publications. Subsequently, the reduce process with 7 publications, which, although it is not a loop closure, is taken into consideration, as it is based on the efficient use of resources and is mentioned in the principles of the CE in section 2.1. Remanufacture with 4 publications, refurbishment and loop closure in general (without specifying the process) with 3 publications each one. And recover and repair with 1 publication each one. (Figure 2.4).

with regard to the R-principles, it was observed that their definition varies according to each author, and that there is no agreement in the literature as to the limits of each of these principles. For example, the concepts of remanufacturing and refurbishment (Favi et al., 2017; Garza-Reyes et al., 2018; Rossi et al., 2020b; WBCSD, 2021) may present similar characteristics that make their use vary according to each author. On the other hand, the term reuse is implemented generically to refer only to the closing of loops in general in one of the publications (Di Maio et al., 2017). In addition, the term reduce has a special connotation in these principles, because although it does not represent a loop closure, it is a fundamental principle in the concept of CE.

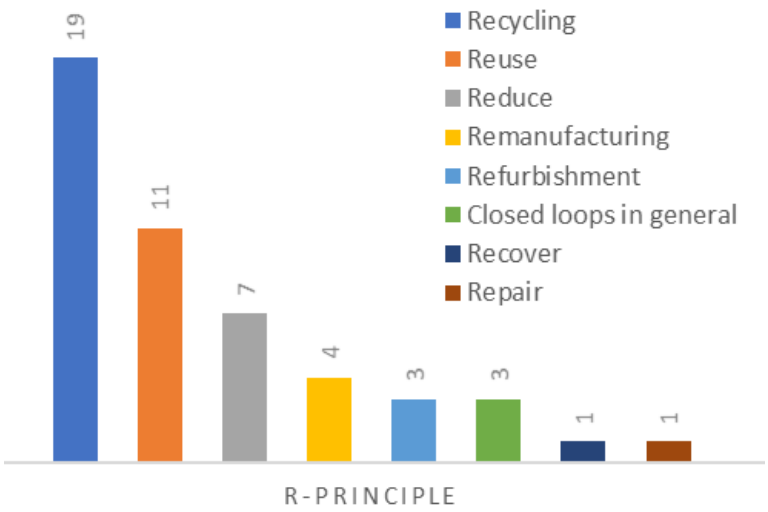


Figure 2.4. Number of appearances of R-principles covered in the literature review.

2.5. Discussion and Conclusions

Our article presents a review of the literature on the evaluation of the sustainable performance of CSCs, in which the understanding of CSCs is developed through the analysis of 25 publications that present different methods and indicators for this purpose.

In the development of the literature review presented above, it was observed that according to the unit of analysis, the sustainable dimensions are studied in greater or lesser proportion. For example, with respect to the indicators oriented towards materials or products, they presented a strong tendency to measure the environmental and economic dimensions, where the environmental part was partially measured, especially through the efficiency of resources and their subsequently recirculation into the SC, taking into account concepts such as circularity and longevity (Figge et al., 2018; Mesa et al., 2018; Zore et al., 2018). Furthermore, this same unit of analysis was found to be strongly focused on the use of indicators for product design (perspective) and end-of-life disposal methods, which are oriented towards suppliers and producers (Favi et al., 2017; Figge et al., 2018; Fregonara et al., 2017; Mesa et al., 2018).

On the other hand, it was observed that most of the publications are oriented to the evaluation of a single firm, with emphasis on the producer as the main stakeholder, with a strong orientation towards the measurement of environmental and economic performance, where only 4 articles considered the 3 sustainable dimensions (Azevedo

et al., 2017; Rossi et al., 2020a; Veleva et al., 2017; Zore et al., 2018). With respect to R-principles, publications related to a single firm consider a greater diversity of R-principles with respect to the other units of analysis (Garza-Reyes et al., 2018; Rossi et al., 2020a).

The dyadic type relationship was found in only one publication, in which post-industrial plastic waste is studied to obtain various products through the quality and purity of the waste used as raw material. This case study, through scenarios, shows the different interactions between the supplier and the producer, with a purely environmental approach, considering only the principle of recycling (Huysman et al., 2017).

With respect to SC as a unit of analysis, it was observed that the four publications (Di Maio et al., 2017; El Wali et al., 2021; Pauliuk, 2018; Yang et al., 2021) base their evaluation proposals on a global vision of SC, mostly based on Life Cycle Assessment and Material Flow Analysis methods, which leads to a focus on processes and product life phases and not on the study of stakeholders and their interactions. Under this unit of analysis, more consideration was given to the systems and their impact on the three sustainable dimensions (El Wali et al., 2021; Yang et al., 2021). The R-principles were treated in a more general way, in which only recycling, reuse, and reduction are generically mentioned.

As mentioned above, this article is part of a thesis work, which aims to study the assessment approaches of sustainable performance in CSC, grouping economic, management and industrial engineering aspects. Therefore, this literature review served as a starting point for the analysis of the sustainable performance of CSCs which is then expected to be further developed on the perspectives and analysis of stakeholder interactions.

2.6. Acknowledgements

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3. Article 2: The Collaborative Ecosystem in the Circular Economy Context: Electrical and Electronic Equipment Value Chain.

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Abstract

Circular Economy (CE) is economic model that decouples economic growth from resource use and waste generation to support sustainable development. It has significant potential in the Electrical and Electronic Equipment (EEE) value chain (VC) due to scarcity and value of the materials that these products contain. Collaboration is needed for successful CE transition, but there is little practical guidance. This paper aims to explore the collaborative ecosystem of the EEE VC in CE and identify key factors that facilitate the collaboration and an enabling ecosystem using a case study of an EEE retailer in Portugal.

Keywords: Collaboration; Ecosystem; Circular Economy.

3.1. Introduction

Circular Economy (CE) is an alternative model that supports sustainable development by decoupling economic growth from resource use and waste generation (Geissdoerfer et al., 2017). In supply chains, CE can be applied to replace the End of Life (EoL) disposal of products and materials by redesigning products, business models and processes (Bressanelli et al., 2021).

The application of CE into the Electrical and Electronic Equipment (EEE) value chain (VC) has a significant potential due to the scarcity and value of the materials that these products contain (Bressanelli et al., 2021; Shittu et al., 2021). However, EEE is a problematic and under-collected stream (Mansuy et al., 2020) due to the involvement of all stakeholders throughout the VC to ensure the product return in the EoL.

Studies of CE transition emphasize the need for multi-stakeholder collaboration, but only few offer practical guidance to stakeholders for engaging in such collaborative processes (Hazen et al., 2020; Saccani et al., 2023; Wielopolski and Bulthuis, 2023). Suggesting that there may be elements of the collaboration that would facilitate the transition to more performing circular models, which have not yet been studied.

Moreover, the notion of the "ecosystem" emerges, as an important concept in understanding how linear models can be transformed into circular ones (Staicu and Pop, 2018). The ecosystem approach allows a consideration of complex constellations of actors, technologies, and institutions that are bound together via loosely coupled interdependencies and co-evolutionary patterns (Aarikka-Stenroos et al., 2021).

This paper aims to provide an understanding of the collaborative ecosystem regarding the VC of EEE in CE and explore the key factors that facilitate this collaboration and an enabling ecosystem through a case study based on an EEE retailer and its ecosystem in Portugal.

3.2. Theoretical background

3.2.1. Facilitators of Collaboration in Circular Economy

Collaboration in CE is a very important matter to be explored since it has received limited attention. Representing a key element with a critical impact in the transition to a circular model (Farooque et al., 2019; Saccani et al., 2023). literature defines collaboration as the process by which individuals or organizations share resources and skills to solve problems and achieve one or more goals. Additionally, collaboration within a relationship can be characterized by varying levels of maturity. When referring to the level of collaboration involves team members communicating effectively, achieving shared understanding, and adapting their tasks, behaviours, and resources to produce high-quality outcomes (Boughzala and De Vreede, 2015).

The literature reports five main facilitating factors of collaboration between stakeholders in CE. The first factor is open, effective and sufficient communication, in which knowledge, information, and key data is exchanged in an opportune manner among the stakeholders (Alghababsheh and Gallear, 2020; Baas, 2008; Boughzala and De Vreede, 2015; Wu et al., 2014; Yan and Dooley, 2014). The problem solving capacity, referring to the ability to solve problems and manage conflicts that may arise throughout the relationship was also reported (Alghababsheh and Gallear, 2020; Boughzala and De Vreede, 2015; Wu et al., 2014). Then, the effective planning, based on the achievement of common objectives and thus the success of the project within defined time and resource requirements is identified by Yan and Dooley, 2014. A general atmosphere of cooperation and mutual support is also considered as facilitator (Jia et al., 2020; Yan and Dooley, 2014). Last factor is the interest in building long-term relationships with the other stakeholders (Wong and Cheung, 2005; Wu et al., 2014).

3.2.2. Facilitators of Circular Economy Ecosystems

When talking about stakeholders collaboration in CE, some authors expose the importance of a favorable ecosystem to enhance the development of the system and at the same time to obtain sustainable benefits (Zhang et al., 2013). In the same vein, literature highlight the need for an enabling ecosystem that allows exchange, cooperation and growth of all the stakeholders (Aarikka-Stenroos et al., 2021; Kapsalis et al., 2019; Paavilainen et al., 2021; Saccani et al., 2023). In this respect, some authors have identified diverse facilitating factors related to CE ecosystem described below.

The first one is the capacity of the ecosystem to provide support and tools to promote the innovation (Aarikka-Stenroos et al., 2021; Alghababsheh and Gallear, 2020; Hansen and Schmitt, 2021). Second, is the need of consumer awareness that comprises trust in the company and its stakeholders to provide them with the appropriate products and services (Masi et al., 2017). Then, the local authorities act as facilitators that promote the creation and application of regulations and financial supports that foster sustainable development (Masi et al., 2017; Tura et al., 2019; Wielopolski and Bulthuis, 2023). The associations and networks related to the territory, industry and/or sustainable development that promote cooperation to achieve common goals (Scheepens et al., 2016; Sudusinghe and Seuring, 2022; Veleva and Bodkin,

2018). Finally, the proximity, as a multidimensional element that integrates geographic and location factors, organizational structures, technologies and perceptions that are compatible between partners (Dallasega and Sarkis, 2018).

3.2.3. EEE Ecosystem in Europe

Waste from electric and electronic equipment (WEEE) is a major environmental issue in Europe, as EEE is one of the fastest-growing waste streams worldwide (Favot et al., 2022). In Europe, the EU's WEEE Directive was introduced in 2003 and requires producers to take responsibility for the disposal of their products at the end of their life. The directive also sets targets for the collection, reuse, and recycling of WEEE. (European Parliament and the Council, 2012). This directive presents the objectives of a minimum collection rate of 65% of EEE put on the market, calculated on the basis of: a) the total weight of WEEE collected and b) the average weight of EEE put on the market in the three preceding years; or 85% of WEEE generated on the territory of that member state. Subsequently, this directive has been transposed and adapted to each of the member states according to their legislation.

Likewise, the role of extended producer responsibility (EPR) as a policy approach that holds producers responsible for the disposal of their products at the end of their life, is a key point addressed in the literature on this particular subject. Cahill, Grimes and Wilson, (2011) explore the implementation and the role of local authorities across Europe regarding EPR for packaging wastes and WEEE. The authors explain that the national collection and treatment systems significantly change in design, in terms of influence of pre-existing policy and systems, methods of achieving producer compliance, fee structures, targets, waste stream prioritization and local authority involvement. In the same vein, Corsini, Rizzi and Frey (2017) expose as principal elements: the need for stronger coordination of EPR and waste policies in order to achieve satisfactory levels of WEEE collection, the need of a clear delineation of the responsibilities into the supply chain and the importance of clearing houses as evolution drivers of the sector by ensuring surveillance and fair distribution of resources among competing collective schemes. Showing that the role of the different actors, as well as the coordination and collaboration among them, is a crucial element in the improvement of this VC.

In other ways, Favot et al.(2022) in their work about regulation and competition in the EPR models in the WEEE sector in Europe, present four main models of EPR in Europe: a) State Fund (eco-tax) Model (with/without single executing Agency), producers must pay a fee or a tax to a designated waste management fund; b) Single Organization Model, there is a unique compliance organization controlled and financed by the industry sector; c) Competing Organization Model (with/without coordination center or with eco-tax back-up), the compliance organizations (PROs) assume the take-back obligation of producers; and d) Other models with producer funding, a variety of models which are underpinned by producer financing. These four models illustrate that according to each European state's needs and interpretation of the WEEE directives, different WEEE management systems are implemented.

Moreover, other authors have studied the benefits, barriers, enablers and levers of the EEE sector in CE in Europe. For example, Rizos and Bryhn (2022) present a framework of barriers and enablers to the implementation of circular business models, classifying these into 6 categories: policy, economics and finance, supply chain, technology, consumers and society, and internal company organization. While, Bressanelli et al. (2021) show a framework of three layers: a) enablers: conditions and contextual factors that facilitate the implementation of CE levers (exogenous nature); b) levers: tools and practices to support the implementation of CE in companies (endogenous nature) and c) potential benefits, advantages that may be obtained from the adoption of CE enablers and levers under the triple bottom line perspective of sustainability (environmental, economic and social dimensions). Which highlights that in the WEEE management ecosystem there are internal and external factors that intervene in the performance of the WEEE management system.

In the specific case of Portugal, European statistics show that although Portugal has increased its collection rates compared to previous years, it has not yet reached the target set by the European WEEE directive in 2020 (Eurostat, 2020). In the literature, some authors have analyzed the behavior of consumers when taking back products at the EoL in Portugal, showing that “the market for the recovery of waste of electrical and electronic equipment is still in its infancy”(p.1079) (Botelho et al., 2016). In the same vain, Martinho et al. (2017) explore the consumer behavior with respect to the consumption and recycling of smartphones and tablets in Portugal. In this work,

authors suggest “to increase collection and recycling rates, environmental awareness campaigns are needed to increase consumers’ knowledge of existing collection and recycling programs” (p.147). Thus, showing that although the WEEE management system is in place and has increased its collection and recycling rates of WEEE in the last years in Portugal, there is still room for improvement in terms of enhancing efficiency, improving consumer participation, and addressing the challenges posed by the ecosystem in the integration and cooperation of all the actors in the VC.

3.3. Methodology

The research design adopted for this exploratory case study is a cross-sectional field study. This allows the collection of data from different individuals of the ecosystem in the same period of time to develop an initial understanding of the phenomenon (Gibbert et al., 2010; Lillis and Mundy, 2005). The unit of analysis was the main stakeholders integrated in an EEE CE ecosystem. The selected case study was the ecosystem surrounding a large EEE retailer in Portugal focusing on the management of EEE at the EoL. Because it is the key process in which the application of CE strategies is evidenced and the intervention and collaboration of different stakeholders is necessary for the appropriate collection and treatment of EEE at the EoL.

To achieve data saturation in this study, multiple techniques were implemented, including the collection of data from various sources. The data collection process encompassed conducting interviews, reviewing relevant documents, and making observations. First, a documentary analysis was carried out, which included a review of European and local laws and regulations. This review also comprised the analysis of internal and external reports of the stakeholders involved in relation to the collection and treatment of WEEE. In addition, direct observations of the phenomenon were made through visits to some of the retailer's stores, and by participating in internal stakeholder meetings related to the subject under study.

Then, we have conducted semi-structured interviews with three stakeholders involved in the EoL management of EEE (Table 3.1) to identify the key factors that facilitate their collaboration. In this ecosystem, EEE at the EoL are delivered to Company A at their points of sale by consumers or are collected by Company A transporters at the time of delivery of new appliances to consumers' households. Then, these devices are transported to the warehouses of Company B, where they are weighed and reported

in the monthly collection statistics. Subsequently, Company B is responsible for the sorting and the auctioning of materials to recyclers throughout the Iberian Peninsula. Accordingly, we can find four main actors in this specific relationship of the VC, which are: consumers, Company A, transporters and Company B. At the same time, in this ecosystem we find external actors outside of the VC, such as Company C and local authorities that influence these relationships.

Table 3.1. Stakeholders interviewed

Company	Description	Interviewee's position
A	EEE retailer	Head of the Sustainable Development Department
		Sustainability Specialists A
		Sustainability Specialists B
B	WEEE management entity	General Director
		Head of Iberia and South America
C	Portuguese retailer association	Environmental and Sustainability Affairs Coordinator

These interviews were conducted between October 2022 and March 2023, in approximately one hour each, and were carried out in some moments in person and in others by video calls. The interviews were organised into four steps. The first corresponded to a presentation of the organization, its functions and its role in the ecosystem. The second consisted of describing its ecosystem and identifying its key stakeholders. The third was based on the description of the collaboration and the identification of the key elements that facilitate the relationships with stakeholders. And finally, the identification of the challenges in the management of WEEE in Portugal and the possible evolution of the ecosystem.

Interviews were conducted in Portuguese. These interviews were later transcribed and translated into English. A cross analysis was then made between the different sources of information. Finally, the data analysis was mainly conducted through NVivo tool based our both theoretical frameworks of facilitators.

3.4. Results and Discussion

3.4.1. Collaboration into the Portuguese WEEE ecosystem

Through the interviews, it was observed that several of the facilitating factors of collaboration described in the literature review are present in the case study relationships. On the one hand, all participants expressed the importance of open, effective and sufficient communication. The Head of the Sustainable Development Department of Company A expressed: *"In this time of transition to more sustainable models, we need to be more transparent and share more information about our performance and impact regarding environment and society".* However, this element seems to be a point of improvement in these relationships, as the data regarding the collection of EEE and its subsequent treatment is not congruent among all stakeholders and sometimes this information is not reported in the stipulated timeframes. The Sustainability Specialists A of Company A, emphasized: *"at the moment we do not have full traceability of the products at the time of collection and treatment in the EoL, the exchange of information is not fluid with the stakeholders and in some cases does not match with our internal data and estimations".* This generates difficulties in data management and decision making in this matter, which at the same time affects the effective planning capacity and the achievement of their common goal based on the legal requirements on WEEE collection rates.

On the other hand, there is a cooperative atmosphere among the three stakeholders interviewed. This was evidenced by their willingness to create spaces for dialogue among the stakeholders to improve their performance regarding the legal requirements on WEEE collection rates. Environmental and Sustainability Affairs Coordinator of Company C expressed: *"We offer spaces for continuous dialogue and serve as a point of convergence between different stakeholders in the ecosystem to improve our general performance in this area".*

Likewise, the three stakeholders stated that in the past they have worked together to overcome common difficulties, as in the case of packaging management. This can also be associated with the stakeholders' capability to solve problems together. Finally, it is observed that long-term relationships are established between the three stakeholders, which are expected to be maintained and improved within the ecosystem.

From the interviews it could be observed that the facilitator most mentioned by the participants in relation to collaboration was open, effective and sufficient

communication, followed by long-term relationships and cooperative atmosphere, while problem-solving capacity and effective planning were less addressed.

3.4.2. Portugal WEEE Ecosystem

With respect to the ecosystem facilitators previously defined in the literature, their effect on these relationships was evidenced. For the particular case of this section, it is important to note that the retailer offers two types of EEE. On the one hand, there are the products of large international brands, and on the other hand, there are own-brand products, in which the retailer is involved in the entire VC of the products, from their design.

The first determinant is innovation. In this context, its effect is observed in two dimensions according to the type of product. On the one hand, it is evidenced through the retailer's relations and some initiatives that are being carried out in the region to improve the traceability of products at the EoL, from the consumer's home to the WEEE management entity. The General Director of Company B explained *"together with Company C we have been developing new solutions, with the integration of electronic and tracking devices for product traceability to ensure complete visibility throughout the VC"*. On the other hand, it is observed through the application of eco-design strategies in the conception of own-brand products. The Head of the Sustainable Development Department of Company A explained *"we are continuously working on making our internal brands more and more sustainable, based on their life cycle analysis and trying to innovate from their conception to offer products with less negative impacts".* This suggests that as the retailer has greater scope over its own brands, it applies CE strategies at earlier stages of product life, while when products are sourced from external brands, the focus moves to EoL management. This also highlights proximity as a determinant element, suggesting that the closer the stakeholders are in terms of location, technology and organization, the stronger the collaboration between them will be.

In addition, interviews showed that consumer awareness is a key point to address. According to several studies that have been conducted internally by Company A, the sustainability specialists B highlighted *“most consumers are not willing to make more responsible decisions in terms of sustainability unless they receive a direct incentive in return, this is why in the past we have focused our collection strategies on gamification-based activities.”.*

Subsequently, all the interviewees highlighted the importance of the role of local authorities for the application of European directives and the existence of local mechanisms for surveillance and control of EEE management at the EoL. As the last facilitating factor of the ecosystem, there are the local associations and networks. Which were highlighted as key elements, because through them the stakeholders interviewed have been able to generate local initiatives to improve their impact on the community, collaboration and performance.

From the interviews it could be observed that the facilitator of an enabling ecosystem unanimously mentioned was the key role of local authorities in governing the national WEEE management system, as well as the development of consumer awareness and innovation as a facilitator in the transition to CE. This was followed by the role of local networks and associations as a point of convergence and dialogue between actors. The least mentioned facilitators were proximity.

3.4.3. Challenges and perspectives for WEEE management in CE

As main challenge the interviewees exposed the need to improve the transparency and traceability of WEEE flows, which are essential to ensure that the system operates efficiently and effectively. Moreover, participants highlighted the fact that the EU targets set by the EU directive do not consider local markets conditions, nor intrinsic characteristics of the products (e.g. lifespan). Also emphasizing that the laws of each EU member country are different, so the transmission of these community directives into local legislation is a challenge. The General Director of Company B emphasized that *"it is necessary adapt European and local laws to the market needs of each country and the intrinsic characteristics of each product category. Besides, each country in the EU has different WEEE management systems."*

As another challenge, the limitations derived from local laws regarding EEE ownership at the EoL were exposed. This limits some of the actors to apply earlier CE strategies such as the classification and reuse of products before moving on to recycling. The Head of the Sustainable Development Department of Company A emphasized that *"we cannot perform any kind of classification for the purpose of reuse the products we collect, due to property limitations stipulated in our local laws".* On the other hand, difficulties were observed in openly communicating performance indicators and CE initiatives in this area, due to the difficulty of obtaining transparent information from the entire VC and

the impact it can have on the reputation of stakeholders. And as a final challenge, the difficulty for actors to establish a long-term strategy consistent with evolving legislation and the collective needs of all stakeholders of the ecosystem.

According to the interviews carried out, it was also possible to know some of the perspectives of the organizations with respect to the evolution of CE in the EEE VC. From the retailers' point of view, there was great interest in developing their own branded products that are increasingly sustainable. There was also great interest in the development of second-hand markets for high-value electronic products such as cell phones and tablets. With respect to the management entity and the retailers' association, there was great interest in local participation for the development of policies more adjusted to local needs, integrating all the stakeholders of the territory. Collaboration and cohesion among all stakeholders were also highlighted as key elements for a more sustainable transition.

Based on the results presented previously, we found there is a strong relationship between the challenges of applying CE in EEE management and the facilitators associated with collaboration and an enabling ecosystem (Table 3.2). With respect to challenge 1, it is associated with the establishment of effective communication; the ability of stakeholders to develop an innovative mechanism that allows full traceability of products and proximity, as they need to build organizational and technological compatibility that will allow a continuous flow of information. In relation to challenges 2 and 3, a cooperative atmosphere between stakeholders (companies, local organizations, policy makers and consumers) would facilitate the adaptation of local legislation, also facilitated by the proximity, as well as the transmission of local needs to European instances. With respect to challenge 4, we have as facilitators an adequate communication that allows the collection of data across the entire VC; in addition, this could be seen as an influencer in generating consumer awareness. Finally, Challenge 5 can be overcome through effective communication and planning, in which the objectives and needs of all stakeholders (companies, governments, associations and local networks) are aligned to develop a common strategy in a cooperative atmosphere. This could be facilitated through long-term fostered relationships. As a common facilitator we have the ability to engage stakeholders in problem solving and conflict management.

Table 3.2. Challenges and facilitators of the EEE ecosystem in Portugal

	Challenges \ Facilitators	Collaboration					Enabling ecosystem				
		Effective communication	Problem solving capacity	Effective planning	Cooperative atmosphere	Long term relationships	Innovation	Consumers awareness	Local authorities	Networks and associations	Proximity
1	Transparency and traceability of WEEE flows	X	X				X				X
2	Legislation adapted to local markets conditions and intrinsic characteristics of the products		X		X			X	X	X	X
3	local laws about EEE ownership at the EoL		X		X			X	X	X	X
4	Openly communicating performance indicators and CE initiatives	X	X					X			
5	Difficulty for actors to establish a long-term strategy	X	X	X	X	X			X	X	

3.5. Conclusion

The research findings described in this article provide an important contribution to both theoretical and managerial implications. First, we bridge the research gap identifying the facilitators that shape the collaboration and an enabling ecosystem in the context of CE. Subsequently, these factors were further analyzed and confirmed through a cross-sectional study based on a case study of an EEE retailer and its ecosystem in Portugal, which allowed the enrichment of research in this area. In addition, the crossover between the challenges of the transition to a circular model and the facilitators of the collaboration and the ecosystem, allowed to identify which facilitators

are best suited to each of the challenges. Finally, the identification of these facilitators and challenges and their relationships could be a support in the decision-making process in ecosystems that pursue a circular transition. As well as a guide in the design and implementation of sustainable policies in this area.

Despite the importance of our results, this analysis has some limitations. Although we had access to valuable data through the EEE case study in Portugal, we were only able to interview some of the actors in this ecosystem. This limited the access to a global view, considering all the interactions and points of view of the stakeholders. Moreover, our results might shed some light on the study of the collaboration and the ecosystem in this sector and its impact on the transition towards more sustainable models. However, it is planned to continue in the medium term with the study of these facilitators and challenges in other European countries with different configurations of WEEE management systems.

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4. Article 3: Exploring determinants of Collaboration in Circular Supply Chains: A Social Exchange Theory Perspective.

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Abstract

In the global shift towards the circular economy, supply chain management is the critical action unit for implementing and succeeding circular systems. Literature continuously highlights the importance of collaborative relationships between supply chain partners in transitioning from linear to circular systems; nevertheless, there is a lack of discussion on implementing and enhancing collaborations through actions in circular supply chains to improve sustainable performance. This paper aims to identify the factors that determine collaboration within circular supply chains and their influence on sustainable performance through the perspective of the Social Exchange Theory. Employing a systematic literature review (64 papers) and a multiple case study (10 firms), this work identifies the elements that make up social relationships, collaboration, and sustainable performance in circular supply chains and analyzes their relationships, presenting the results through a conceptual model. This paper contributes to the emerging field of circular supply chain management literature, providing managers and policymakers with actionable insights to promote collaboration within their circular supply chains, thus bridging theory and practice and advancing the understanding of circular economy dynamics in supply chain management.

Key words: Circular Supply Chain; Collaboration; Sustainable Performance; Social Exchange Theory.

4.1. Introduction

Circular Economy (CE) is a new economic model based on rethinking production and consumption patterns, involving strategies to recirculate existing materials to maximize their use and regenerate natural systems. All this is done to expand the value of the resources to overcome environmental challenges and promote sustainable development (EMF-Ellen MacArthur Foundation, 2013; Korhonen et al., 2018). CE is a multidisciplinary area that involves supply chain, economic sciences, engineering, innovation, environmental sciences, social sciences, and politics. That is why the application of CE needs to adapt the conventional linear systems (take-make-dispose) at different levels that involve all stakeholders to deploy a strategy that truly supports sustainable development (Asgari and Asgari, 2021). In this respect, Supply Chain Management (SCM) is the key unit of action for the implementation and success of CE (Hazen et al., 2020; Lahane et al., 2020).

Interest in CE has increased in recent years, as well as the study of the sustainable performance of Circular Supply Chains (CSC) (Farooque et al., 2019). This literature continuously highlights the importance of collaborative relationships between partners in transitioning from linear to circular systems (Hazen et al., 2020). Recent studies reveal the need for more inter-firm collaboration as one of the principal barriers to the implementation of CE (Hart et al., 2019). Specifically in the context of Circular Supply Chain Management (CSCM), Saccani et al, (2023) present the need for a close collaboration and information exchange among the Supply Chain (SC) as an essential challenge in this context. Nevertheless, there needs to be more discussion on implementing and enhancing collaborations through actions in CSCs to improve sustainable performance (Sudusinghe and Seuring, 2022).

In the traditional literature on SCM, collaboration and its effects on performance are constantly discussed, as well as theories and methods to implement concrete actions to improve collaboration and consequently enhance SC performance (Boughzala and De Vreede, 2015). Recent research has also highlighted collaborative social relationships as potential enablers in knowledge sharing among SC partners in new product development (Merminod et al., 2022) or in creating digital servitization ecosystems (Dalenogare et al., 2023). Base on that, the Social Exchange Theory (SET) has become an essential theoretical perspective to understand better why SC

partners collaborate and how their relationship dynamics change over time by exploring the social structure that defines their collaboration (Can Saglam et al., 2022; Davis-Sramek et al., 2022). SET focuses on the social interactions between actors that are interdependent and contingent on their actions, generating obligations between them and resulting in rewards for both sides (Cropanzano and Mitchell, 2005). In this vein, SET helps explain the base of mutual agreement to collaborate among partners to meet SC performance (Tanskanen, 2015). This theory comprises four pillars (trust, commitment, reciprocity, and power) based on psychological and economic reinforcement, outlining the social exchange system in analyzing its behavioral components and considering how these four social elements help establish and preserve collaboration (Wu et al., 2014).

From the perspective of the CSCM, some authors repeatedly mention individual elements of the SET as influencers of collaboration in CSCs. Such is the case of power (González-Sánchez et al., 2020; Kirchherr et al., 2018; Masi et al., 2017), commitment (Cherrafi et al., 2016; Kapsalis et al., 2019; Liu et al., 2018; Paavilainen et al., 2021; Yadav et al., 2020), trust (Allais, 2015; Bressanelli et al., 2019; Masi et al., 2017; Paavilainen et al., 2021; Tobin and Zaman, 2022), or reciprocity (Can Saglam et al., 2022; Davlembayeva et al., 2021; Gervasi et al., 2022; Jones and Tobin, 2018). However, these elements of SET have been studied separately in academic literature and there is to date no comprehensive mapping of their effect on sustainable performance of CSC as a clear basis for managerial and research actions.

Therefore, this paper aims to identify the factors that determine collaboration within CSC through the lens of SET and their influence on the sustainable performance of CSC. To address the research objective, we conducted a qualitative study based on a systematic literature review and a multiple case study with 10 European companies to highlight academic contributions and contrast them with field data to explore the factors and how collaboration generates beneficial outcomes regarding sustainable performance. Subsequently, these factors are synthesized in a conceptual model, providing significant theoretical contributions to academia and guiding practitioners in decision-making when collaboration concerns their CSCs.

4.2. Theoretical background

4.2.1. The Circular Supply Chains concepts and Circular Economy Strategies

In the SCM literature, numerous concepts, such as sustainable supply chain, green supply chain, environmental supply chain, and closed-loop supply chain, have been introduced to specify the integration of sustainability in SCM. However, none have systematically integrated circular thinking (Farooque et al., 2019). Moreover, De Angelis et al. (2018) expose that CSC embodies CE principles within supply chains. In this respect, the term CSC was used in literature to link CE with SCM (De Angelis et al., 2018; Farooque et al., 2019; Hernandez Marquina et al., 2022), and some definitions have been proposed.

In this study, we adopt the definition proposed by Farooque et al. (2019) in their recent structured literature review; they defined CSCM as “the integration of circular thinking into the management of the supply chain and its surrounding industrial and natural ecosystems. It systematically restores technical materials and regenerates biological materials toward a zero-waste vision through system-wide innovation in business models and supply chain functions from product/service design to end-of-life and waste management, involving all stakeholders in a product/service lifecycle, including parts/product manufacturers, service providers, consumers, and users” (p.884).

In the context of CSC, the R-principles, or R-imperatives, are presented as decisive elements in establishing a transformative vision in CE (Reike et al., 2018). These R-imperatives correspond to the strategies by which value is retained in CE, helping to preserve resources and extending the life cycle of products (Sudusinghe and Seuring, 2022). Gaustad et al. (2018) explain in their work on CE strategies that the R-Principles were initially based on three pillars: reduce, reuse, and recycle. However, these principles have continued to evolve, and new terms such as rethinking, redesign, refurbishment, remanufacturing, repair, etc., have gradually been added to explain all the possibilities in which resources can be recirculated and reintegrated into the value chain (Salvador et al., 2021)

Geissdoerfer et al. (2020), in their work about circular business models, presented an overview and synthesis of the definition of circular business model based on the

integration of the R-Principles into the SC. Figure 4.1 shows an adaptation of this definition, in which a conventional SC is presented in the mainstream, composed of design, production, distribution, use, and disposal processes. The reversed arrows at the top of Figure 4.1 represent the circularity through the R-Principles (reuse, repair, life extension, remanufacturing, refurbishment, recycling, rethink and redesign). Although the CE strategies of life extension during the use phase and rethinking and redesign during the design phase do not constitute material recirculation per se, they are elements that consolidate a CE system. At the top, we have the input of materials and energy to the system, which can occur at any of the CSC stages, as well as the output of waste and emissions at the bottom, which, through the implementation of the CE strategies, are expected to decrease. This scheme was subsequently used to classify the circular strategies applied by the companies that participated in the multiple case study in section 4.5.1.

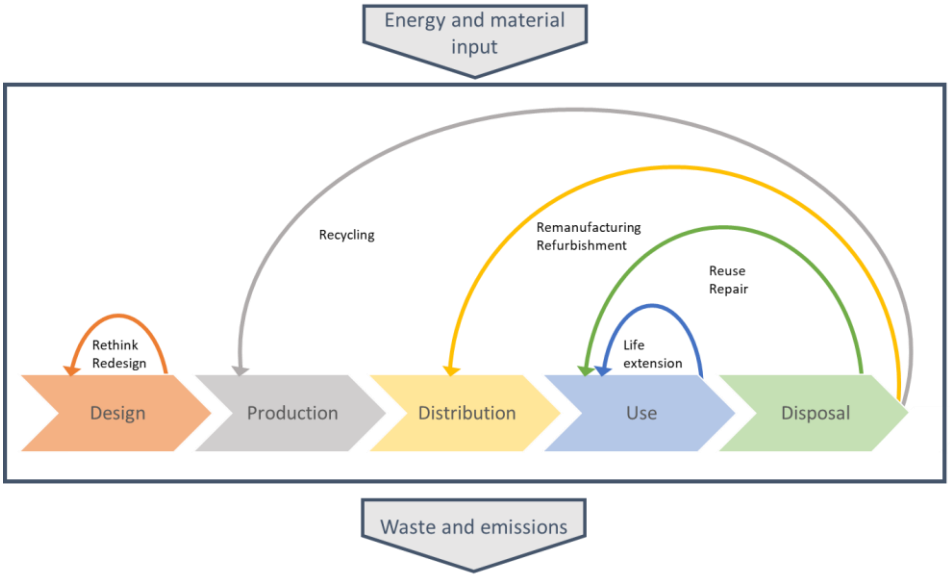


Figure 4.1. Circular Economy Strategies adapted from Geissdoerfer et al. (2020)

4.2.2. Sustainable Performance

The sustainable performance of CSC literature shows that there are partial and total evaluation methods regarding sustainable dimensions (society, environment, and economics), and these dimensions may have different weightings in terms of their importance (Hernandez Marquina et al., 2022; Walker et al., 2021b) while the social dimension is the most neglected. (Corona et al., 2019; Kristensen and Mosgaard, 2020).

According to the evaluation of the sustainable performance of CSCs, literature highlights a great diversity of measurement methods and indicators of circular systems in terms of their scope, scale, input elements, and units of measurement, which make it challenging to obtain standardized data, to replicate and, therefore, to share information with other stakeholders in the value chain (Corona et al., 2019; Hernandez Marquina et al., 2022; Kristensen and Mosgaard, 2020; Roos Lindgreen et al., 2020; Walker et al., 2021a).

Based on the literature on sustainable SC performance, most authors state as main pillars the social, environmental, and economic dimensions (Azevedo et al., 2017; Faulkner and Badurdeen, 2014; Hernandez Marquina et al., 2022; Walker et al., 2021b; Wu et al., 2020). However, in the literature, we can find a fourth dimension associated with the performance of the products and services offered by the SC, denominated non-economic dimension (Wu et al., 2014). In the specific case of this paper, the following elements were selected from the literature to define each sustainable dimension. As a social dimension, we present three main levels based on the work developed by Andrews et al. (2006) on the stakeholder's categorization: a) the workers within the SC; b) the final customers/consumers of the products/services offered by the SC; and c) the society and local communities that belongs to the external environment surrounding the SC. The environmental dimension is composed of: a) emissions, b) resource consumption, c) impact on biodiversity, and d) investment for environmental protection and remediation, based on a simplification of the strategic indicators proposed by Allais (2015) for the measurement of natural capital and the variable proposed by Hussain and Malik (2020) to define SC environmental performance. As economic elements, we consider: a) return on investments, b) sales growth, and c) cost reduction. And finally, as non-economic performance: a) customer relationships, b) capability to react to market changes and c) product/service performance. Both economic and non-economic dimensions are based on the variables presented by Wu et al. (2014) for SC performance measurement.

4.2.3. Collaboration Quality within CSCs

Some authors highlight that CSC collaboration has received very little attention in CSCM and represents a significant knowledge gap with a critical impact on the transition to a circular model (Farooque et al., 2019; Saccani et al., 2023). In addition,

Wielopolski and Bulthuis (2022) and Saccani et al. (2023) emphasize that circular transformation processes need a multi-stakeholder collaboration structure, but only a few offer practical guidance to stakeholders for engaging in such collaborative processes.

In the literature, Boughzala and De Vreede (2015) defines collaboration “as a process in which two or more agents (individuals or organizations) share resources and skills to solve problems so that they can jointly achieve one or more goals”(p.133). When referring to CSC, the literature shows that the ability to collaborate with different stakeholders in both reverse logistics and forward logistics is a crucial element in the success of the SC (Hazen et al., 2020). In the same way, Andrews et al. (2006) explain that “the organization must go beyond its facility boundaries” and be willing to expand its scope of collaboration and communication to all stakeholders in the value chain” (p.29).

The effectiveness of the collaboration can be found in the literature behind the quality and maturity concepts. Varying levels of maturity can characterize collaboration within a relationship. This level of maturity is defined by team members communicating effectively, achieving shared understanding, and adapting their tasks, behaviors, and resources to produce high-quality outcomes (Boughzala and De Vreede, 2015). Similarly, Yan and Dooley (2014) defined buyer–supplier collaboration quality as “the extent to which buyer and supplier groups synergistically exploit shared resources while minimizing wastes through interacting during project planning and execution”(p.61).

When talking about stakeholders’ collaboration, some authors expose the importance of an enabling ecosystem to enhance the development of the SC and, at the same time, to obtain sustainable benefits (Zhang et al., 2013). In their study, Staicu and Pop (2018) applied to CE stakeholders’ dynamics in the textile and apparel sector in Romania, showing that poor interactions among the stakeholders determine a weak circular ecosystem. Wielopolski and Bulthuis (2022), in their study on collaborative ecosystems to accelerate the adoption of CE innovations in the construction sector, exposed that “the deployment of sustainable innovations necessitates a deepening of collaboration between stakeholders with highly diverse cultures, ways of working, business models, and priorities.” Moreover, the difficulties of putting this ecosystem

into practice are based on the fact that "…the versatility of the ecosystem with varying regulatory frameworks, economic interests, historical value logics, and overall conservatism posing significant challenges in finding mutual value opportunities and overcoming barriers for the adoption of true innovations" (p.4).

4.2.4. Social Exchange Theory

In SCM literature, SET is a sociological and psychological theory explaining the social relationships between partners within a SC (Wong and Cheung, 2005). This theory composes a series of basic psychological and economic reinforcement principles outlining the social exchange system in analyzing its behavioral components, including trust, commitment, reciprocity, and power (Wu et al., 2014). Consequently, SET has become a vital theory to understand better why SC partners collaborate and how their relationship dynamics change over time (Can Saglam et al., 2022).

On the other hand, in the context of CE literature, several authors mention separate components of SET, such as power/interdependence (González-Sánchez et al., 2020; Kirchherr et al., 2018; Masi et al., 2017), commitment/engagement (Cherrafi et al., 2016; Kapsalis et al., 2019; Liu et al., 2018; Paavilainen et al., 2021; Yadav et al., 2020), trust (Allais, 2015; Bressanelli et al., 2019; Masi et al., 2017; Paavilainen et al., 2021; Tobin and Zaman, 2022), or reciprocity/justice (Can Saglam et al., 2022; Davlembayeva et al., 2021; Gervasi et al., 2022; Jones and Tobin, 2018) as influencing factors of CSC collaboration. However, without considering all these components as a group of interrelated factors that can influence the collaboration between partners of the CSC. Such is the case of Paavilainen et al. (2021); in their study about Inter-organizational collaboration in CE ecosystems, the authors present a framework defining four types of value creation (associational, interactional, transactional, and associational) through the evaluation of 3 attributes (trust, joint interest and ability to collaborate) based on stakeholder theory, which is intrinsically related to the SET concepts of trust and commitment. In the same vein, Baas (2008) exposes that "experiences in cleaner production and industrial ecology projects show that an open, reflective and ongoing dialogue must be designed to develop trust, transparency, and confidence to ensure real involvement of diverse stakeholders in charting the future of their organizations and regions as part of the transition to sustainable societies"(p.139).

From the commitment perspective, Saccani et al. (2023) synthesized the challenges for circular supply chains, and they present as a cultural issue the internal resistance to change and the limited awareness and commitment to the adoption of more circular initiatives inside of the supply chain, from both top management and employees. Wielopolski and Bulthuis (2022), in their study about the collaborative ecosystem as a catalyst to accelerate the adoption of CE Innovations in the construction sector, explain that “the ecosystem needs to make sure that it addresses all relevant stakeholders on a global scale, brings them together, motivates them, and enables cross-disciplinary innovation projects”(p.11) with the commitment as a pillar to define a strategy to achieve exponential scalability of circular economy innovations.

Following the same line of thought, Tobin and Zaman (2022), in their study about regional cooperation in waste management in Australia, explain that “social capital is among the most crucial (but frequently overlooked) ingredient needed to sustain Australian mechanisms for regional cooperation”(p.29), showing as the most prized social capital qualities: reciprocity, transparency, trust, and a shared sense of identity.

Moreover, the authors also expose that the role of organizations in balancing the ecosystem in the CE inter-organizational grid “is badly affected by the regional segmentation of regulatory directives, educational background, funds’ budgeting, and traditional peculiarities applied at developed and developing economies, as well as the inherent subjectivity in accounting environmental and economic aspects in a common basis, especially considering the uneven influential power of stakeholders and the conflict of interests in sharing the common good of environment under monetary appreciation”(p.22) (Kapsalis et al., 2019). This work emphasizes the inequality of power and its negative influence on constructing a CE ecosystem.

4.2.5. Conceptual model

In light of our theoretical background, we have selected four principal constructs, and we draw an initial conceptual model to understand how SC collaboration achieves sustainable performance in the CE context (Figure 4.2). Stemmed from the literature review, we investigate how to measure the quality of collaboration and the pillars of SET in the context of CSC. Then, through the literature and the multiple case study, we explore how the different constructs of the initial model are associated with each other.

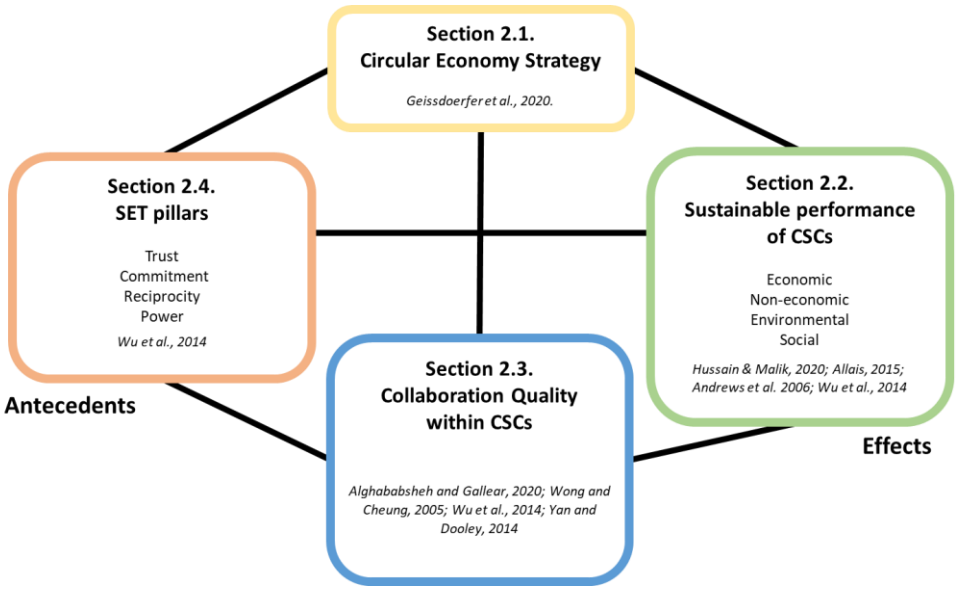


Figure 4.2. Initial conceptual model of CSCs collaboration

4.3. Methodology

To frame and assess the collaboration behaviors among stakeholders and their impact on the sustainable performance of CSCs, a stepwise approach combining a systematic literature review (64 papers) and a multiple case study (10 firms), followed by a cross-checking and an analysis of the data is applied (Figure 4.3). The purpose of this study was twofold: first, to illustrate the use of the proposed model guiding firms in a comprehensive way to improve the quality of the collaboration within their CSC. Second, to suggest which factors of the model should be prioritized from the practitioner's perspective and which research topics should be addressed in the future for scholars.

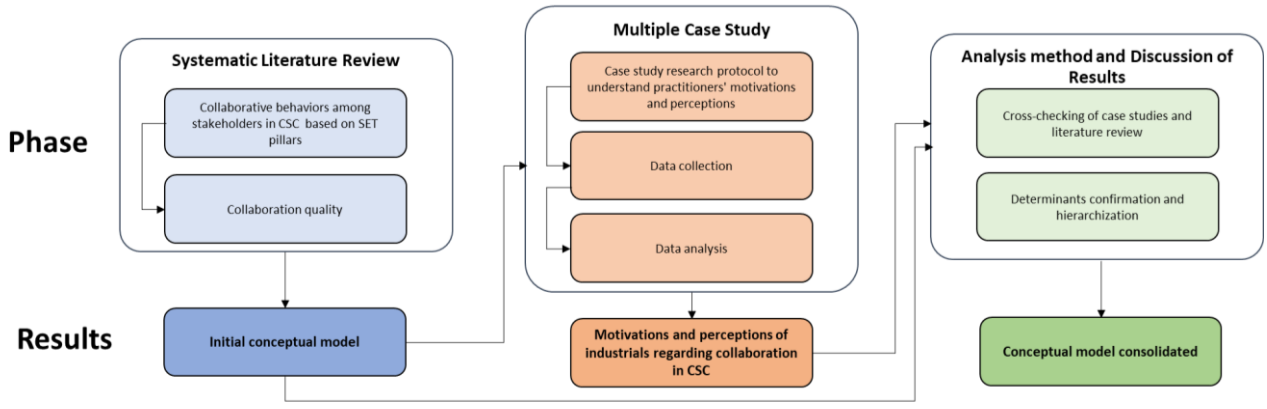


Figure 4.3. Research method process of the study

4.3.1. Systematic Literature review

For the first stage of this work, a systematic literature review was carried out between March and December 2022, considering academic literature composed of peer-review articles, proceeding papers, and theses. For this, the search was focused on publications about collaboration between stakeholders in CE contexts, highlighting the pillars of SET and their potential impact on the sustainable performance of the CSC. Searching for academic literature was carried out through Science Direct, Web of Science, and Google Scholar. This search was narrowed down to publications available in the last 20 years. At first, 153 articles were obtained and filtered based on eliminating duplicates and their relevance to the present work. Then, 15 publications were integrated from the references of the previously selected articles and six from expert recommendations. This resulted in a total of 64 selected publications. Figure 4.4 shows this process. Based on this literature review, an initial conceptual model was formulated.

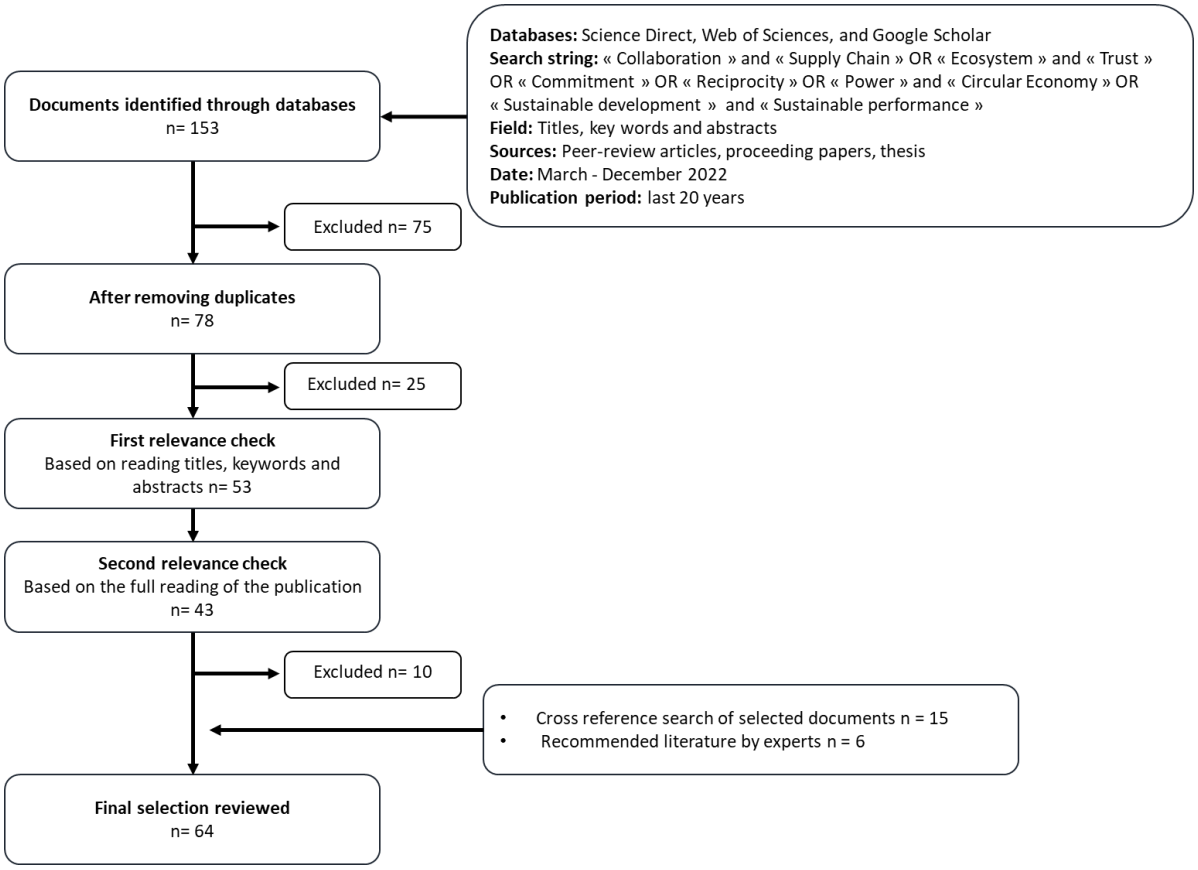


Figure 4.4. Systematic literature review process (adapted from Santa-Maria et al. (2021)

4.3.2. Multiple case study

4.3.2.1. Cases selection

In order to understand practitioners' motivations and perceptions regarding stakeholders' collaboration and its influence on the sustainable performance of CSC, a multiple case study was led to collect qualitative data. The research sample selection was based on identifying 10 European companies in which CE and sustainable development strategies are already being implemented. To increase the validity of results and avoids biases, the case studies selected represent a mix of different industries (including fashion, waste treatment and disposal, construction, industrial maintenance, retailers, and consulting), companies' size (small, medium, and large) and European countries (France, Spain, Romania, and Portugal). Table 4.1 shows the general characteristics of the ten companies participating in this research.

Table 4.1. Basic information of the sample

Company	Interviewee's position	Company's size (number of employees)	industry	location	Geographical perimeter	Circular economy strategy	Customer Profile	Offer	Sustainable practices integration
1	Company founder and CEO	25	Fashion - Design, manufacturing and commercialization of garments	Spain	Continental, Europe	All the stages of the value chain	B2B and B2C	Products	From its origin
2	Founder of the company	50	Fashion – support on design and manufacturing of garments	Romania	Continental, Europe	Rethink and redesign	B2B	Services focused on solutions	Gradual
3	Business Development Manager	2	Non-hazardous waste treatment and disposal	France	Local, Region Auvergne Rhone Alpes	Use, reuse, repair, collection and recycling	B2B	Services focused on solutions	From its origin
4	Founder of the company	4	Construction suppliers	France	Local, Region Auvergne Rhone Alpes, Bourgogne and Lyon	Use, reuse, and repair	B2B	Services focused on solutions	From its origin
5	supply chain manager	40	Construction suppliers	France	National	Use, reuse, and repair	B2B	Services focused on solutions	From its origin
6	Company founder and CEO	5	Garment repair-Outdoor equipment	France	National	Reuse and repair	B2B and B2C	Services focused on solutions	From its origin
7	Company founder and CEO	16	Industrial maintenance - commercialization of spare parts	France	International	Reuse	B2B	Services focused on solutions	From its origin
8	Consultant	10	Consulting and training - in functionality economy strategies	France	National	All the stages of the value chain	B2B	Services focused on solutions	From its origin
9	Director of sustainability and circular economy projects	36607	Food retailing	Portugal	National	All the stages of the value chain	B2C	Products	Gradual
10	Head of store concept and sustainability	5000	Electronics and home appliances retailing	Portugal	National	All the stages of the value chain	B2C	Products	Gradual

4.3.2.2. Data collection

Semi-structured interviews were conducted in approximately 60 minutes and were carried out in some cases face-to-face (n=3) and others through video calls (n=7). An interview guide (see Appendix 1) was developed and structured into four parts. The first was focused on the company's presentation, the basis of its business model and the circular economy principles applied. The second corresponded to identifying the critical stakeholders and the supply chain stages. The third was to detect the necessary

factors to collaborate with their stakeholders. Finally, we discussed how these factors impact the sustainable performance of their supply chain. To obtain saturation, as suggested by Kallio et al. (2016) to conduct a qualitative study, we use other sources of data, such as websites and internal documentation (non-financial reports, certifications, contractual relationships with stakeholders), to identify the main elements involved in stakeholder collaboration in CE contexts.

4.3.2.3. Data analysis

The interviews were conducted in 4 languages (French, English, Portuguese, and Spanish). During their execution, they were recorded and later transcribed and translated into English. Subsequently, the data collected was synthesized and organized according to the topics addressed in each question and then proceeded to the cross-analysis with the findings from the literature review.

4.3.3. Analysis method and discussion of results

The insights from the systematic literature review and the 10 case studies were cross-checked. At this stage, iterative discussions took place between the authors to analyze how the findings from the case studies and the literature illustrate the determinants of the collaboration and its effect on the sustainable performance of CSC. Lastly, these results were presented and discussed in 2 online workshops (one hour each) with 5 participants from companies 4,6,7,9,10. In these workshops, the results of the multiple case studies were discussed, as well as the participants' perspectives regarding collaboration and performance, similarities and differences according to their industries, countries, and business models, future opportunities in this context, and finally, the consolidation of the conceptual model.

4.4. Literature review results

This section presents the key elements in the literature that determine stakeholder collaboration based on SET pillars and collaboration quality. First, we present an analysis of each pillar of the SET (trust, commitment, reciprocity, and power) and their respective manifest variables. Second, the definition and manifest variables of collaboration quality are exposed.

4.4.1. Social Exchange Theory

4.4.1.1. Trust

In the literature, trust is defined as "a firm's expectation that their partners will perform a particular action to benefit their interests irrespective of their ability to monitor or control their partners" (Wu et al., 2014, p.125). In turn, Wong and Cheung (2005) established that trust between stakeholders is structured in 4 dimensions, which correspond to a) Partner performance, based on the perception of the work competencies of the stakeholders; b) Partner permeability, related to communication and information flow between stakeholders; c) Relational bonding, which corresponds to the compatibility and strength of the relationship between partners; and d) the system on which trust is founded, which is based on results, conflict resolution and reputation of the partners.

The literature also presents the importance of trust between stakeholders, such as the case of Mastos et al. (2021), who explain that manufacturing enterprises have consistently recognized the importance of good relations and identified the need for trusted supplier relationships. Moreover, Nee et al. (2013) explain that when sustainable strategies are correctly performed, they generate better relations with the stakeholders, promoting fidelity, acceptance, and trust. In the same vein, Chertow (2000) explains that based on mutual recognition and trust, firms and other partners exchange knowledge and broaden the definition of sustainability on which they act. In addition, Masi et al. (2017), state that trust is vital to enable the transition from conventional industrial parks to eco-industrial parks, in which local authorities can act as facilitators. On the other hand, Wang et al. (2020) present the lack of common interest and mutual trust as an inter-organizational barrier in managing CSC for fast fashion. Table 4.2 shows a general view of trust as a latent variable and its manifest variables, according to the literature.

Table 4.2. Description of manifest variables of Trust

Manifest variables	Description	Literature source
Rights protection and promises kept	Fulfilling the commitments made in the relationship and protecting the rights of all stakeholders in the relationship fosters a mutual trust.	(Paavilainen et al., 2021; Wu et al., 2014)

Honesty	Always say the truth, even when problems occur, creates an environment of trust in the relationship with stakeholders.	(Baas, 2008; Wu et al., 2014)
Collective welfare awareness	In order to have a relationship of trust, it is necessary that all stakeholders are aware and work for the well-being of all those involved.	(Tobin and Zaman, 2022; Wang et al., 2020; Wu et al., 2014)
Reputation based on performance	Companies with higher reputation are more trustworthy as they do not want to lose their valuable asset. In this case it can be associated with performance in the different sustainable dimensions (social, environmental and economic), and applied trough certifications and labelling.	(Allais, 2015; Bressanelli et al., 2019; Masi et al., 2017; Wong and Cheung, 2005; Zhang et al., 2013)
Openness and transparency	Open and frequent communication and maintaining open-door policies to each other results from willingness of partners to create transparency in relationship.	(Chertow, 2000; Nee et al., 2013; Tobin and Zaman, 2022; Wong and Cheung, 2005)

4.4.1.2. Commitment

In the literature, Wu et al., (2014) define commitment as "a partner's exchange belief that an ongoing relationship with another is so important as to warrant maximal efforts at maintaining it, that is, the committed party believes that the relationship endures indefinitely" (p.125). Concerning CE models, authors expose the necessity of a management commitment in firms to transform their business model for a more efficient, circular, and low-carbon economy that spans across and beyond its value chain (Liu et al., 2018; Veleva et al., 2017; Yadav et al., 2020). In addition, Cherrafi et al. (2016) explain that the commitment to minimize environmental impact may improve a firm's brand image, positively influencing market performance.

According to Veleva et al. (2017), developing a "zero waste" strategy is challenging, as it requires engaging various stakeholders across the supply chain, including innovative actors such as designers and product/service entrepreneurs who can provide critical services and solutions. Where Wu et al. (2014) state that any future transaction among supply chain partners requires a commitment by two parties to achieve their common supply chain goals. Table 4.3 shows an overview of commitment as a latent variable and its different manifest variables, according to the literature.

Table 4.3. Description of manifest variables of Commitment

Manifest variables	Description	Literature source
Willingness to sacrifice	To be able to give up some kind of immediate benefit to maintain the relationship with stakeholders in order to grow together and achieve common objectives.	(Liu et al., 2018; Paavilainen et al., 2021; Wu et al., 2014)
Willingness to make an effort within the relationship	Ensure maximum effort to continue the engagement with other stakeholders.	(Kapsalis et al., 2019; Wu et al., 2014; Yadav et al., 2020)
Share a common vision	Share a common vision and objectives with other stakeholders according to sustainable dimensions (social, economic and environmental).	(Cherrafi et al., 2016; Kapsalis et al., 2019; Veleva et al., 2017)

4.4.1.3. Reciprocity

Wu et al. (2014) exposed, "SET contends that social relationships are formed and maintained because participants offer reciprocal benefits to one another over time" (p.125). "Reciprocity is the exchange of goods and services to attain some kind of symmetry and mutual benefit"(Jones and Tobin, 2018, p.70). In addition, reciprocity facilitates the interdependence of people in communities, thus fostering collaborative relations, collective well-being, and social inclusion (Davlembayeva et al., 2021). According to the literature, table 4.4 shows a general view of reciprocity as a latent variable and its manifest variables.

Table 4.4. Description of manifest variables of Reciprocity

Manifest variables	Description	Literature source
Fair policies	The norms and rules governing the relationship between stakeholders are perceived as just. Mostly represented in contractual relationships.	(Jones and Tobin, 2018; Wu et al., 2014)
Fair benefits and rewards	Mutual exchanges that partners perceive as fair and beneficial.	(Can Saglam et al., 2022; Davlembayeva et al., 2021; Gervasi et al., 2022; Jones and Tobin, 2018)
Fair treatment	Stakeholders are dealing with each other in a fair and mutually fair manner.	(Jones and Tobin, 2018; Wu et al., 2014)

4.4.1.4. Power

According to Wu et al. (2014), “power refers to the relative dependence between exchange members, where power gained by one member can influence the decisions and behaviors of other members”(p.126). Moreover, González-Sánchez et al. (2020), in their work on the main dimensions of the building of CSC, explain: “Powerful institutions have an option of implementing policies which boost organizations and the population to adopt a practice. The environment of the circular economy is governed by new rules and customs that revolutionize social, cultural, and political models” (p.8).

On the other hand, Leigh and Li (2015) explains that the development of Industrial Symbiosis interactions between the stakeholders of the SC also depends on the enabling context of social, informational, technological, economic, and political factors, where the power of influence is mainly determined by agents such as governments, businesses, and coordinating entities. Masi et al. (2017) states that one impactful barrier that is likely to prevent the circular transitions from taking place is the need for agreement across SCs, finding that even if SMEs are willing to adopt new business models, their low power in their supply network prevents them from convincing important partners to collaborate. According to the literature, table 4.5 shows an overview of power as a latent variable and its manifest variables.

Table 4.5. Description of manifest variables of Power

Manifest variables	Description	Literature source
Interdependency symmetry	All the stakeholders have the same power to influence each other in decision, R&D, sale, production, and distribution.	(Masi et al., 2017; Wu et al., 2014)
Soft power	To bring about change by attracting others through values and practices that shape their attitudes and preferences.	(González-Sánchez et al., 2020; Kirchherr et al., 2018; Leigh and Li, 2015)
Hard power	To force change through technical, regulatory and/or economic means.	(González-Sánchez et al., 2020; Kirchherr et al., 2018; Leigh and Li, 2015)

4.4.2. Quality of the collaboration

Quality of the collaboration can be first depicted as the maturity degree of the different mechanisms in which collaboration is manifested in the relationship. Boughzala and De Vreede (2015) define “collaboration maturity as a team’s current maximum

capability to collaborate (i.e., people) where team members effectively communicate (i.e., process), reach a shared understanding (i.e., information), and adjust their tasks (i.e., management and process), behaviors (i.e., people), and means (i.e., technology and information) to produce high-quality outcomes" (p.133).

Recurrent studies in the literature evaluate the quality of collaboration and its maturity. Such is the case of Boughzala and De Vreede (2015), through developing and applying a collaboration maturity model to assess the quality of collaboration in teams. In turn, Yan and Dooley (2014) studied the quality of collaboration in the buyer-supplier relationship to develop new product projects. Following this same order of ideas, there are also studies on social capital in the buyer-supplier relationship, in which it is observed how elements of collaboration affect the performance of the relationship (Alghababsheh and Gallear, 2020). On the other hand, studies are beginning to emerge based on literature reviews on CSCs in which collaboration appears as a critical element in the development of circular models (Jia et al., 2020), showing a direct relationship between CSC collaboration and sustainable performance (Sudusinghe and Seuring, 2022).Table 4.6 groups the manifest variables that integrate the quality of the collaboration according to the literature.

Table 4.6. Description of manifest variables of Quality of Collaboration

Manifest variables	Description	Literature source
Open, effective and sufficient communication	Ability to have an open, transparent and efficient dialogue, in which knowledge, information, etc. is exchanged in an opportune manner among the stakeholders.	(Alghababsheh and Gallear, 2020; Baas, 2008; Boughzala and De Vreede, 2015; Wu et al., 2014; Yan and Dooley, 2014)
Problem solving capacity	Ability of the different stakeholders to solve problems and manage conflicts that may arise throughout the relationship.	(Alghababsheh and Gallear, 2020; Boughzala and De Vreede, 2015; Wu et al., 2014)
Effective planning	Achieve the common objectives and thus the success of the project within defined time and resource requirements.	(Yan and Dooley, 2014)
Cooperation	The general atmosphere of the relationship is cooperative and mutual support is evident.	(Jia et al., 2020; Yan and Dooley, 2014)

Long term relationships	Stakeholders demonstrate a strong interest and commitment to building long-term relationships.	(Wong and Cheung, 2005; Wu et al., 2014)

4.5. Multiple case study results

This section presents a cross-analysis of the case studies and identifies the key elements that determine stakeholder collaboration and its impact on the sustainable performance of CSCs. First, we present an overview of the business models by discussing the customer profile and the product/service/solution offered. Second, the different CE strategies applied in each case are analyzed. Afterward, an analysis of each pillar of the SET (trust, commitment, reciprocity, and power) is presented. Finally, a synthesis of the effects of collaboration on the sustainable performance of CSCs is shown.

4.5.1. Business Model Overview and CE strategies

From the sample of 10 companies (Table 4.1), we found only two companies focused on a B2C (Business-to-consumer) model (9, 10), two on mixed B2B (Business-to-business) and B2C models (1,6), and six firms on B2B (2,3,4,5,7,8), showing that the customer profile was diverse, with a greater focus on B2B models. Figure 4.5 shows the companies positioned according to the CE strategies and R-principles they are involved in. According to this, four companies apply strategies that comprise all stages of the value chain (1,8,9,10). While only one is focused on earlier stages, such as rethink and redesign (2). The second half of the group of companies is focused on later stages such as use, reuse, and repair (4,5,6,7) and use, reuse, repair, and recycling (3).

Concerning the offer, we found that only three companies are based on the supply of products (1, 9, 10). In contrast, the other seven offer services focused on solutions in key stages for implementing circularity in supply chains such as use, reuse, and repair (3,4,5,6,7) and recycling (3), rethink and redesign (2), and only one of them (8) integrates all stages of the SC. Regarding the business model strategy, we can find two approaches. The first corresponds to companies with long trajectories gradually trying to transition towards more circular and sustainable models (2,9,10). The second corresponds to relatively young companies, in which the integration of sustainable and circular strategies is part of their identity and is rigorously applied from the beginning (1,3,4,5,6,7,8,9).

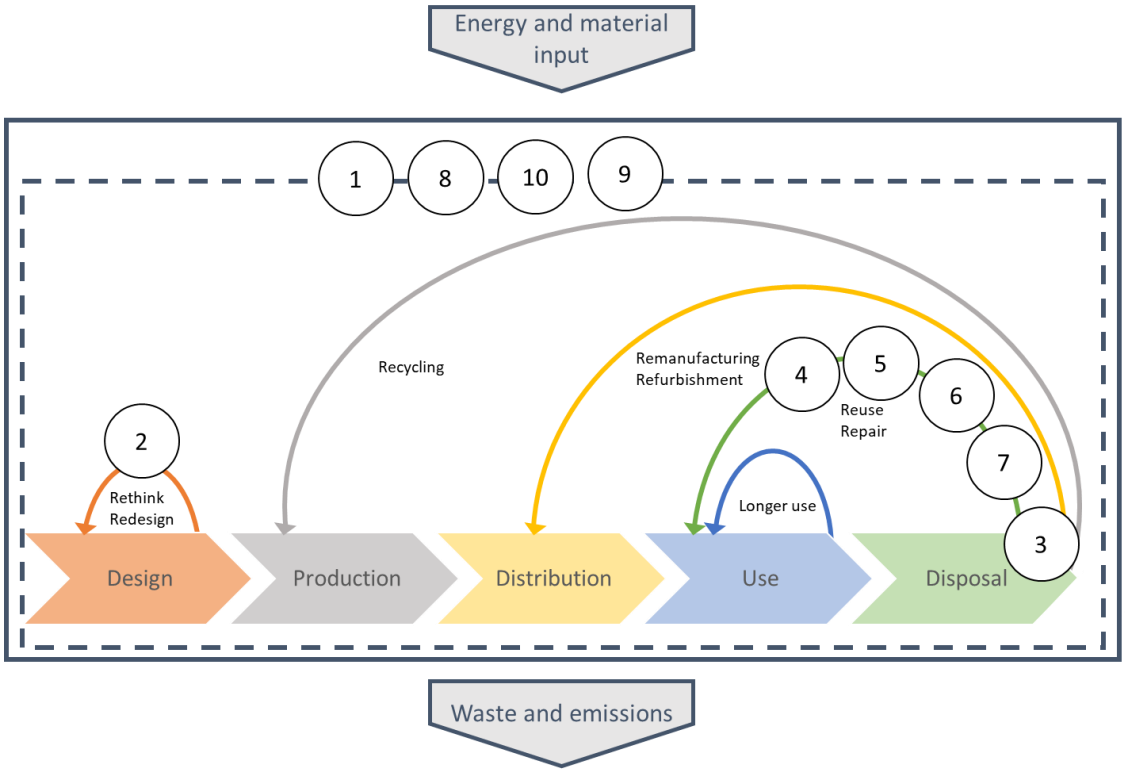


Figure 4.5. Circular strategies applied according with each company

4.5.2. Social Exchange theory

4.5.2.1. Trust

The interviews show that trust with stakeholders is the most critical pillar in developing collaborative relationships. Open and transparent communication, which in some cases is bound by a contractual affiliation, was highlighted as a fundamental factor by all interviewees. On the other hand, the interviews showed that some companies, especially those related to the fashion industry (1,2), select their suppliers according to their performance and reputation in all sustainable dimensions, sometimes based on certifications and ecolabelling. The CEO of Company 1 stated:

"We are very committed to sustainable development, and we have the B Corp certification to prove it… we continuously audit our suppliers to ensure the best sustainable performance in our value chain".

Likewise, the founder of Company 2 exposed:

"We conduct a deep study when establishing a relationship with a new stakeholder, so we apply a series of evaluations based on sustainable performance to ensure this relationship".

In addition, some of the companies reported that trust based on open and effective communication influences customer loyalty (2,6). Moreover, the founder of Company 6 explained:

"We have the Gore-Tex and SympaTex certifications to ensure the performance and quality of the repairs we make; this encourages big brands to rely on our services to manage their repairs and warranties regarding outdoor garments and equipment."

Similarly, companies 4, 5, and 7 ensure that their guarantees allow their customers to develop trust in their services.

4.5.2.2. Commitment

From the information gathered in the interviews, the concept of commitment for the companies is closely related to their sustainable policy and sharing common goals. It was also observed that commitment seems to be a determinant for long-term relationships (1,2,4,6,8,9).

The CEO of Company 1 expressed:

"In this collaborative model, the commitment of all stakeholders and sharing the same values and visions is necessary to achieve a real impact… it is also necessary the development of long-term relationships due to the great effort invested at the beginning of the partnership, derived from the documentation, evaluations, and audits led to prove that they are compatible with our circular model".

Likewise, the founder of company 2 explained that:

"The joint work towards common goals should be based on the identification of uniqueness and value of the competencies and skills of each stakeholder."

4.5.2.3. Reciprocity

According to the interviews conducted, the representative of Company 9 stated that:

"reciprocity with our stakeholders is based on our contractual relationships with them.... We normally try to establish standardized relationships with all our suppliers as a means of fair treatment.".

On the other hand, the CEO of Company 7 explained that:

"the direct competitors we have are spare parts brokers, which base their prices on speculation; for this, we have a policy of fair prices for our products. To define these prices, we consider several factors that allow us to offer competitive, transparent and just prices".

In the case of Company 4, its founder explains that:

"our business model is based on cooperation with our suppliers of goods and services. Reciprocity is essential in our relationship, as it helps us learn and generate solutions collectively".

In the same vein, the CEO of Company 2 explained:

"it is vital to have a symmetrical and fair relationship with our stakeholders, based on fair benefits and rewards, founded on the added value and skills each stakeholder brings to the relationship."

4.5.2.4. Power

Concerning the information gathered through the interviews, significant heterogeneity was noted with the concept of power and its interpretation, showing that a relationship has different mechanisms and intensities of power. On the one hand, companies such as Firm 1 state that they have a very symmetrical power relationship with their stakeholders, even when these stakeholders are larger in size and trajectory. In this regard, the founder of Company 1 stated:

"Although we are a small company compared to some of our suppliers, with us, they feel that they have the opportunity to innovate and apply new processes and strategies when developing textiles... this means that power is distributed symmetrically because, in this case, it is associated with our ability to innovate together".

Likewise, companies 2,4,5, and 8 mentioned that power is closely related to the added value and solutions that partners bring to the relationship.

On the other hand, Company 2 detailed that:

"It is important that in our ecosystem we all have a symmetrical distribution of power, and normally this is associated with the size of the company… sometimes we have been contacted by large firms in Europe for the design and manufacture of garments, but in the course of negotiations it is challenging to be faithful to our sustainable principles when these companies have such rigid processes and so wide range, which is why we prefer to work with small and medium-sized companies".

Following the same order of ideas, companies 3 and 6 stated that their main clients are large companies with significant influence over them. Usually, these companies have very rigid processes that do not allow sustainability strategies to go further in their relationship.

The representative of Company 8 stated that:

"the basis of any relationship is cooperation, and for this, we carried out dialogue activities with all stakeholders regardless of their size or power, providing free environments for exchange and innovation."

On the other hand, company 9 expressed that they, being a large company in the Portuguese territory, have influenced their suppliers and other smaller stakeholders to apply more sustainable strategies in offering their products, which has allowed them to innovate and grow together. In the case of companies 4, 5, and 7, the power between stakeholders does not significantly influence the development of relationships. However, they mention the importance of legislative mechanisms that encourage sustainable supply in the construction and industrial maintenance industry.

4.5.3. Quality of Collaboration

Through the interviews, we found that all the participants mentioned transparent and effective communication and building long-term relationships as fundamental elements of collaboration. The founder of Company 2 expressed that:

"open communication accompanied with a fair and right contract clarifies the relationship."

In turn, companies 3 and 6 expressed that their reach in the relationship and collaboration with their clients is affected by the need of effective communication channels; this may be due to the need for more interest in further integrating CE strategies and misalignment in their common goals.

On the other hand, Company 8 stated:

"as fundamental elements in working with stakeholders, cooperation is a key part which is based on the commitment of the different parties to achieve the common objectives and thus the success of the project... clear and effective exchange is fundamental, as well as the ability to solve problems and manage conflicts".

Figure 4.6 shows the frequency of appearance of the manifest variables of each pillar of the SET and the collaboration quality based on the information collected by the case studies.

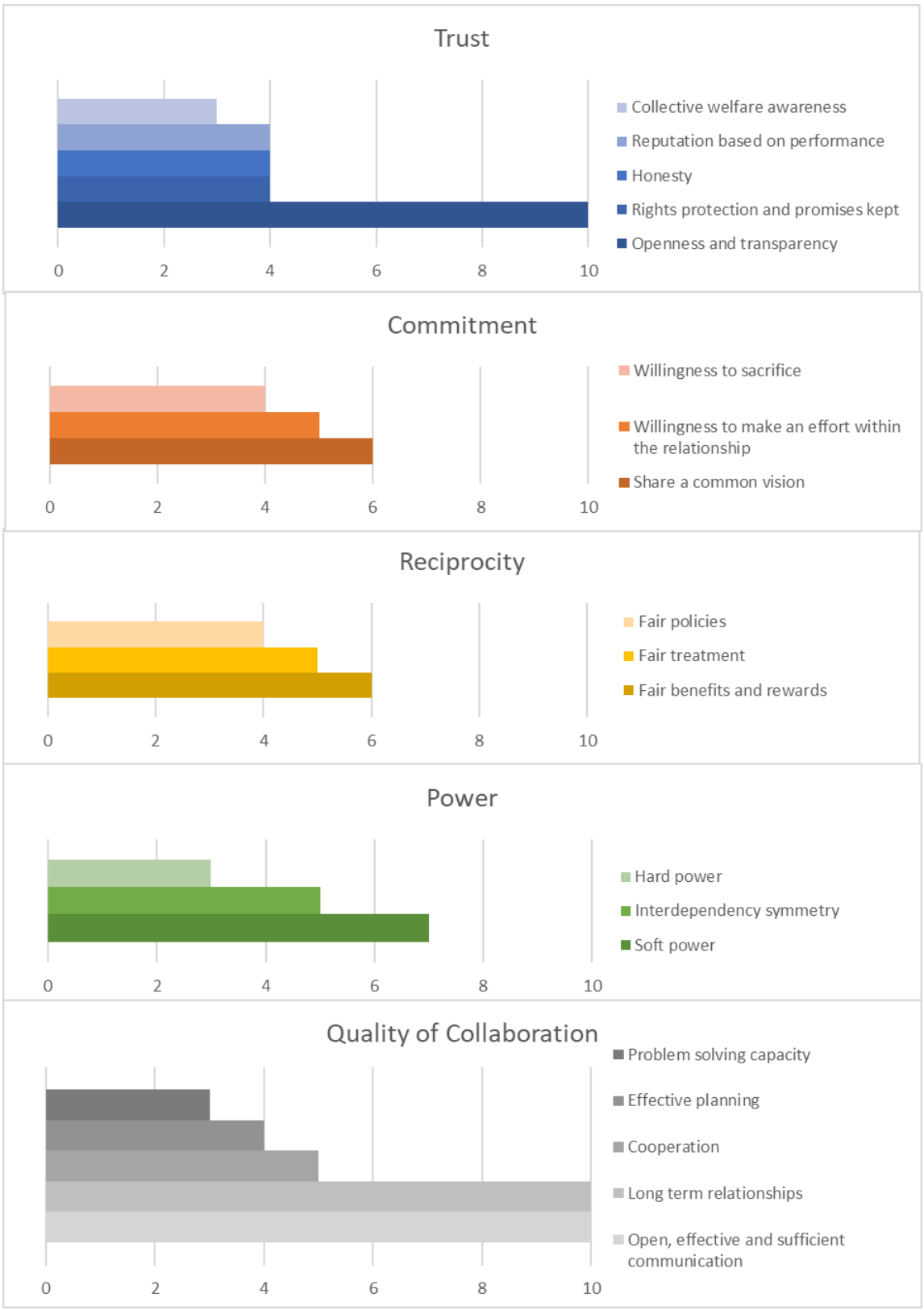


Figure 4.6. Frequency of occurrence of manifest variables according to each SET pillar and Collaboration quality

4.5.4. Effects of collaboration on the sustainable performance of CSCs

Concerning sustainable performance, it was observed that there is a great diversity in how the performance is defined, its indicators, and the maturity of each company regarding its assessment methods. Likewise, it was also observed that the sustainability dimensions and evaluation methods vary in importance depending on the focus of their business model and CE strategies. Regarding sustainable performance, the CEO of Company 1 expressed:

"When comparing the design of a business in circular economy with one in a linear system, it is necessary to understand that at the beginning, you have more constraints -regarding all sustainable dimensions, and not only the economic dimension- that will shape your business and that in the long term will make it more resilient."

Emphasizing this as an advantage that circular business has over linear business.

Following the same order of ideas, the consultant of Company 8 pointed out:

"Our model is based on developing four dimensions of efficiency: economy, solution performance, environmental and social."

From the environmental dimension, companies with business models based on the use/reuse/repair stages show a greater interest in evaluation methods focused on material flow, logistics, and the comparison of reuse products vs. new products (4,5,6,7). Companies involved in the entire value chain or at the beginning of it have more entrenched concepts of responsible procurement and eco-design for the development of sustainable products (1,2,8,9,10). In turn, companies associated with fashion (1,2) showed more maturity in their evaluation methods considering all the sustainable dimensions. Most of the companies expressed that they are building their performance assessment methods, which has been a big challenge for their business (2,3,4,5,6,7). Furthermore, in some cases, they expressed that (company 7):

"when the diversity of products is vast, it is difficult to apply current assessment methods such as Life Cycle Assessment."

On the other hand, the founder of Company 3 expressed:

"we have some difficulties measuring our environmental impact since our clients do not share with us the information necessary to create the adequate metrics; we based our indicators on theoretical approximations which could not be verified."

Showing that a low level of collaboration in terms of communication can have a significant impact on CSC performance measurement and results.

Concerning economic and non-economic performance, several participants emphasized the importance of offering a performing product. The representative of Company 7 explained:

"In a circular business model (based on reuse), we must make sure to offer a product with at least the same quality and attributes as a new product or one coming from a linear system for the same price."

In the same vein, the CEO of Company 1 emphasized the importance of the differentiating elements of the product beyond its circularity:

"We ensure the uniqueness of our product through its durable and innovative characteristics in the design of textiles, so they repel stains and bad odors and do not wrinkle, and at the same time, we ensure that it is a sustainability-friendly product throughout its life cycle… this also means that our products are more expensive than those produced in linear systems".

Likewise, the company's CEO 1 expressed:

"For us, it is key to constantly collaborate and exchange information with our suppliers in developing our innovative textiles and materials, which directly impacts the final product's performance."

Regarding the social dimension, all companies greatly emphasize their relationship with their workers, their clients, and their interaction with society and local communities. However, it was perceived that the information of the companies associated with this dimension is qualitative, which makes it challenging to study and subsequent quantification and comparison.

In addition, companies expressed the difficulty of finding partners who share the same ideals and objectives of sustainability (1,2,3,4,5,6,7); this is observed through elements comprising trust and commitment. In this regard, the CEO of Company 2 said:

"finding the right partners, with whom we can share objectives and goals is fundamental, and we have seen this reflected in the performance of our company, not only economically, but also socially and environmentally speaking."

Companies that are focused on use, reuse, and repair strategies (4,5,6,7) expressed great concern about managing uncertainty and heterogeneity in their procurement and this negatively impacts the reliability of their services and the trust of their customers. Having a direct impact on both economic and non-economic performance. The founder of Company 4 explained:

"At the moment, we have great difficulties with logistics; the uncertainty in the supply of materials from reuse sometimes makes us not so efficient in terms of time and costs concerning a conventional supplier."

In turn, the CEO of company 7 expressed as a challenge, but at the same time as an opportunity to expand their business, the role they have as facilitators in procuring spare parts to make links between different industries that generally would not be related; this reflects an improvement in the environmental performance of customers who are buying reused parts, and at the same time positively affecting their consumption patterns. On the other hand, the influence on economic performance is observed since spare parts are provided at fairer prices. Moreover, there is a positive influence on non-economic performance as the company guarantees the performance of the reused product.

Otherwise, representatives of companies 2, 3, and 6 expressed the difficulty of working with large companies as a challenge due to their large and rigid structures that make it difficult to adapt their processes to more circular and resilient systems. While companies 9 and 10 express this situation as an opportunity in which they have influenced and accompanied the sustainable transition of their suppliers, this has been reflected in the overall performance of the entire SC positively.

The representative of Company 8 emphasized the importance of mindset change, explaining that:

"our current economic model is rigid and is based on infinite growth, which is incompatible with the finite resources that we have at our disposal,"

in turn, he highlighted the importance of cooperation as a critical element in the transformation toward more sustainable models since:

"the current systems are based on achieving individual profits rather than collective benefits."

Finally, he expressed the importance of working on the credibility and perceptions that the different actors in the territory have among themselves, pointing out as an example the communities' perception towards the sustainable policies developed by the government.

The information obtained above shows a high awareness of the dimensions of sustainability. However, great diversity is observed in the interpretation of sustainable performance and its dimensions according to the CE strategies applied in each case study. Likewise, different maturity levels are observed in the design and implementation of sustainable metrics.

4.6. Discussion

Based on the combined analysis of the literature review and the comparison analysis of the multiple case study, a conceptual model is proposed linking the pillars of SET to collaboration quality and sustainable performance, considering the influence of the CE strategy adopted.

About the pillars of SET, trust was the concept with which the participants were more familiar and more easily visualized in their relationships with other stakeholders. There was a strong emphasis on openness and transparency, unanimously highlighted in all 10 case studies. Likewise, it could be observed through the literature that it is a recurrent concept when dealing with collaboration issues and the barriers and facilitators in the transition in CE under the SCM approach (De Angelis et al., 2018; Mastos et al., 2021; Tura et al., 2019; Wu et al., 2020), commonly related to transparency, which affects collaboration, information sharing, risk management and SC performance (Tobin and Zaman, 2022). On the other hand, from the case studies, trust and sustainable performance could have a determining relationship since some companies select their suppliers according to their performance and reputation in all sustainable dimensions, sometimes based on certifications and ecolabeling. Concerning the circular strategy and R-principles, it was observed that the companies that apply reuse and repair base their trust in ensuring the guarantee of their products through their sales conditions and certifications. While companies that apply rethinking and redesigning, as well as a global approach in all circular strategies, trust is observed in their dealings with suppliers and their evaluation and selection mechanisms based

on reputation and performance, which in turn target establishing long-term relationships.

Following the concept of commitment, it was observed that the most frequently mentioned variable in the case studies was sharing a common vision based on internal policies. Otherwise, a connection was observed between commitment and the establishment of long-term relationships, which suggests a relation between SET and the quality of the collaboration. Regarding the literature, authors expose the necessity of a management commitment in firms to transform their business model for a more efficient, circular, and low-carbon economy across and beyond its value chain (Liu et al., 2018; Veleva et al., 2017; Yadav et al., 2020), and Cherrafi et al. (2016) explain that the commitment to minimize environmental impact may improve a firm's brand image, positively influencing market performance, thus exemplifying a direct relationship between the company's commitment and its performance.

For reciprocity, it was observed that the most recurrent variable mentioned in the case studies and literature (Can Saglam et al., 2022; Davlembayeva et al., 2021; Gervasi et al., 2022; Jones and Tobin, 2018) was fair benefits and rewards, which are observed in the case studies through the establishment of just contractual relationships, which reflect the cooperation between stakeholders. It was also observed that reciprocity is a concept linked with external actors of the CSC, such as communities and clients, and that seems to affect economic performance since it is associated with the offer of products and services with fair prices in the companies that apply reuse and repair. On the other hand, the literature also shows the concept of reciprocity as a facilitator in the interdependence of actors and communities, promoting collaborative relationships, collective well-being, and social inclusion (Davlembayeva et al., 2021). Thus, showing a relationship between reciprocity, quality of collaboration, and social performance.

The concept of power seemed more ambiguous for the interpretation of the interviewees. The definition of power was framed by several nuances, which, according to the company's individual situation, could be seen as a positive or negative factor based on its symmetry. It could also be appreciated that this concept was related to the size and scope of the stakeholders, their capacity for innovation, and the added value that the different partners brought into the relationship. These effects of power on the transition to CE, both positive and negative, are also mentioned in the literature,

where it is not only associated with powerful internal stakeholders but also with external stakeholders of CSC, such as governments (González-Sánchez et al., 2020; Leigh and Li, 2015).

Effective communication and the fostering of long-term relationships were identified as critical elements concerning the quality of collaboration. At the same time, the ability to solve problems and manage conflicts was the least mentioned factor. In addition, some of the companies reported that trust based on open and effective communication influences customer loyalty (non-economic performance), showing that there could be a relationship between SET, quality of collaboration, and performance. Likewise, literature shows a strong relationship between CSC collaboration and sustainable performance (Jia et al., 2020; Sudusinghe and Seuring, 2022).

Lastly, companies have great difficulties in defining their evaluation methods for sustainable performance; this is exemplified in the case study of Company 3, in which the interviewee expressed that they have difficulties in quantifying their environmental performance since their clients do not share with them the necessary information to create these metrics, which in turn is related to the asymmetry of power, since the client is a large company that exercises great power in the relationship and does not seem interested in delving into these issues. On the other hand, although all the companies consider aspects of all the dimensions of sustainability, very few have a symmetrical vision of the environment. Most of them apply strategies aimed at economic and environmental impact, reaffirming the elements found in the literature review, which affirm that the sustainable dimensions may have different weightings in terms of their importance, while the social dimension is the most neglected (Corona et al., 2019; Kristensen and Mosgaard, 2020; Walker et al., 2021b). For economic and non-economic performance, opinions diverged according to the business model. On the one hand, companies that apply reuse as a CE strategy emphasize offering circular products with the same performance as a linear product in terms of price, availability, and attributes. On the other hand, companies focused on earlier stages of the value chain, such as rethink and redesign, emphasized the importance of offering unique and innovative solutions, where the performance of the circular product should be superior to that of the linear product and, therefore should be offered at a higher price,

this suggests that the definition of performance and its evaluation may change according to the circular strategy applied in each business model.

Figure 4.7 shows the conceptual model with the relationships between the elements of SET, collaboration quality, and sustainable performance. This model is presented in 2 stages: first, a macro view with the principal four constructs and their relationships, based on Figure 4.2. Second, a micro view integrating all the manifest variables identified in the literature review and the multiple case study. This conceptual model also shows this study's different links and relationships, represented by the arrows. The continuous arrows represent indirect relationships between the SET pillars and sustainable performance mediated by the quality of the collaboration. In contrast, the dotted arrows represent direct relationships between SET and sustainable performance without the intervention of collaboration quality. In addition, it can be observed that some of the manifest variables (*) do not have links because they were identified in this study as essential elements in the definition of the constructs; however, a direct relationship between them could not be identified.

4.7. Conclusions

This study provides a comprehensive overview of the factors that determine collaboration within CSCs through the lens of SET and their influence on the sustainable performance of CSCs. With this aim, the different variables and their relationships were articulated through their manifest elements and presented in a conceptual model. All this through the crossing of the literature with a multiple case study of 10 European companies. These results represent a valuable resource for this emerging field of literature and practitioners and policymakers regarding CE transition.

As a main theoretical implication, these results explore the relationship between collaborative behaviors and the success of CSCs under a sustainable performance approach, thus enriching the academic discussion on implementing and enhancing collaborations through actions in CSCs to improve sustainable performance. Even though this study provides a global picture of the interaction of the constructs (macro level), it also shows in a precise way the interaction of the different elements that compose each construct (micro level). Regarding SET elements, Trust was the pillar most highlighted in the literature and the case studies, with a strong emphasis on openness and transparency. On the other hand, the

elements of commitment, reciprocity, and power were less emphasized, which could be due to the ambiguity of the concepts and their interpretation. Effective communication and the fostering of long-term relationships were identified as the most essential elements concerning the quality of collaboration. At the same time, the ability to solve problems and manage conflicts was the least mentioned factor.

Regarding practical implications, this work can guide managers and policymakers in their decision-making on selecting appropriate collaborative practices to boost the sustainable performance of CSCs. This paper offers new insights for the transition to CE models since we provide the means for managers and practitioners to identify what they need in terms of collaboration and social behaviors with stakeholders to achieve a competitive advantage in all dimensions of sustainable development (social, environmental, and economic).

The results should nevertheless be carefully interpreted in light of the following limitations. The first limitation concerns the generalizability of our results. We provide rich insights into CSC collaboration and its impact on sustainable performance and an understanding of the definition of a successful CSC collaboration. However, due to its exploratory nature and the limited size of the multiple case study, more than these results are needed to validate the conceptual model fully. As a further limitation, not all of the CE strategies, R-principles, or all of the actors in these CSCs are addressed in the case studies, which provides a partial view of these elements in the collaborative aspects of CSCs. However, these limitations could be addressed through a quantitative study (e.g., surveys), which could provide more robust results by testing the real impact of the variables that make up the collaboration on the sustainable performance of CSCs, considering all CSC stakeholders and all the strategies that comprise the CE.

4.8. Acknowledgments

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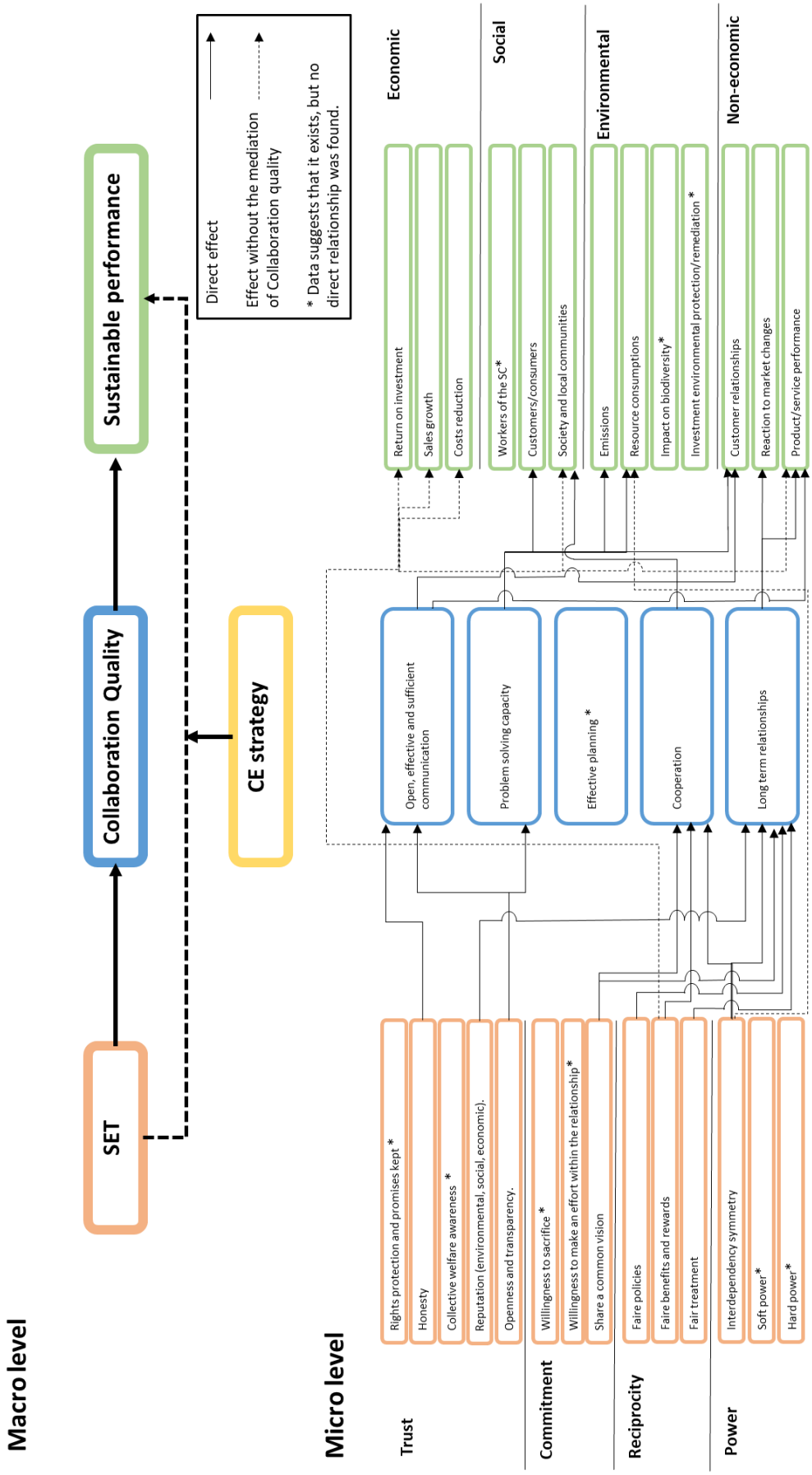


Figure 4.7. Conceptual model of the determinants of collaboration in a CE context and their relationships

Appendix 1

I Introduction

1. Personal presentation of the interviewer(s).
2. Presentation of the research and its objectives.
3. Interview introduction (objective, time frame, permission to record).

II Development of the interview

1. Personal presentation of the interviewee(s)
2. Company presentation
   - 2.1. What are the main characteristics of your business model and your value proposition?
   - 2.2. What are the circular economy principles applied in your company?
3. Please describe your supply chain and your key stakeholders.
4. How did you choose the stakeholders of your supply chain?
5. Please describe the contribution of the key stakeholders in your supply chain?
6. Please describe the collaboration with your key stakeholders.
   - 6.1. What are the principal elements that integrate collaboration in your supply chain?
   - 6.2. Do you recognize elements such a trust, commitment, reciprocity and/or power in the collaboration with your key stakeholders?
7. How do you describe the quality of the collaboration with your key stakeholders?
8. Please describe your ecosystem including aids, networks, governmental regulations, external factors, stakeholders and market context.
9. How the sustainable performance is defined in your company?
10. How do you measure sustainable performance?
11. What are the factors that determine this performance?
12. What are the challenges for the implementation of circular economy and the collaboration inside of the supply chain context?

III Conclusions and next steps of the research

5. Article 4: Exploring the effects of Trust in Collaboration and Sustainable Performance of Circular Supply Chains

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Abstract

In the context of the circular economy, the supply chain management emerges as a pivotal driver for the successful adoption of this new economic model. Interest in the study of the sustainable performance of the circular supply chains has grown in recent years, consistently emphasizing the importance of collaborative partnerships in transitioning from a linear to a circular system. Recent studies highlight inter-firm collaboration as one of the principal obstacles to implementing the circular economy. Specifically, within the context of supply chain management, trust and close collaboration among stakeholders present a fundamental challenge in achieving a successful circular economy model. However, there is a need for further discourse on implementing and enhancing collaborations through actions in circular supply chains to boost sustainable performance. This paper aims to demonstrate the effects of trust on the collaboration quality and the sustainable performance of circular supply chains through an empirical study based on Structural Equation Modeling. Regarding the results of this work, firstly, we establish a group of indicators to measure trust, collaboration quality, and the sustainable performance of circular supply chains. Secondly, this study points out that trust is a determinant of collaboration quality and sustainable performance. Thirdly, we expose that the quality of collaboration is not a mediator between trust and sustainable performance. In this respect, the results extend the application of social behaviors and collaboration in the circular supply chain management context. Finally, this study also contributes as guidance for practitioners in establishing collaborative relationships with their stakeholders to improve or transition towards a circular economy.

Key words: Circular Supply Chain Management; Trust; Collaboration; Sustainable performance.

5.1. Introduction

The Circular Economy (CE) represents a novel economic paradigm focused on reevaluating the production and consumption of goods and services. It entails strategies based on reusing existing materials to extend their useful life and regenerating natural ecosystems. The primary objective is to amplify the value of resources, addressing environmental and social challenges, and fostering sustainable development (EMF-Ellen MacArthur Foundation, 2013). Consequently, the implementation of CE requires a change from conventional linear systems (take-make-dispose) at various levels, involving all stakeholders to establish a strategy that genuinely supports sustainable development (Asgari and Asgari, 2021).

In this context, Supply Chain Management (SCM) emerges as the pivotal driver for the successful adoption of CE (Hazen et al., 2020; Lahane et al., 2020). Interest in CE has grown in recent years, as well as the research on the sustainable performance of Circular Supply Chains (CSC) (Farooque et al., 2019), consistently emphasizing the importance of collaborative partnerships in the transition from linear to circular systems (Hazen et al., 2020). Recent studies highlight increased inter-firm collaboration as one of the principal obstacles to implementing Circular Economy (CE) (Hart et al., 2019). Specifically, within the context of Circular Supply Chain Management (CSCM), Saccani et al., (2023) stress the importance of close collaboration and information exchange among Supply Chain (SC) entities as a fundamental challenge. However, there is a need for further discourse on implementing and enhancing collaborations through actions in CSCs to boost sustainable performance (Sudusinghe and Seuring, 2022).

SCM scholars have delved into the significance of social relationships among stakeholders to mitigate conflicts and foster cooperative behaviors. Their studies indicate that the concept of trust holds a central position in discussions concerning the social relationships of stakeholders (Han et al., 2021; Laaksonen et al., 2009; Sodhi and Son, 2009; Wu et al., 2014). The benefits of interfirm trust, contributing to enhanced collaboration performance, have been extensively evaluated using various approaches, whether qualitative or quantitative (Krishnan et al., 2006). Some authors

have even considered trust as a determinant of stakeholders collaboration (Wu et al., 2014).

For example, Laaksonen et al. (2009) propose a financial measurement of interfirm trust, demonstrating that mutual trust between firms can be viewed as a valuable resource for both customer-supplier relationships and entire supply chains. Furthermore, Wong and Cheung (2005) studied the direct positive effects of trust on project partnering success using Structural Equation Modeling (SEM). Additionally, Han et al. (2021) provided empirical evidence of the complementary roles of trust and distrust in supply chain collaboration. Their exploration of how these concepts work together across the supply chain, supported by case analysis, suggests that trust tends to be the primary motive bringing manufacturers and suppliers together at the pre-formation stage of collaboration. This is expected to promote joint benefits, including reduced transaction costs, knowledge exchange, and performance enhancement.

Moreover, other scholars have explored the impact of social relationships, including trust, on the performance of SC, measured mainly in economic terms, such as costs, sales, and revenue and non-economic terms, like market size, product performance, and innovation. For instance, in their study on information sharing and collaborative behaviors enabling Supply Chain (SC) economic and non-economic performance, Wu et al. (2014) examine the relationships among the pillars of social exchange theory (trust, commitment, reciprocity, and power), information sharing, collaboration, and SC performance through empirical research. The study demonstrates that trust is the antecedent with the strongest influence on collaboration and information sharing, and collaboration has the most substantial mediating effect between antecedents and SC performance. Similarly, in a systematic literature review, Alghababsheh and Gallear (2020) investigate social capital theory in buyer-supplier relationships. They explore its antecedents, benefits, risks, and boundary conditions, revealing positive impacts of social capital dimensions on the strategic, financial, operational, innovation, and environmental performance of both buyers and suppliers. Likewise, Benhayoun et al. (2023) demonstrate that in collaborative new product development projects involving suppliers, relational capital positively mediates the relationship between structural capital and project performance, measured in terms of cost, quality, delay, and innovation.

Studies about sustainable development show that an effective dialogue, emphasizing trust and transparency, is vital for engaging diverse stakeholders in shaping the future of organizations and regions in the shift to more sustainable systems (Baas, 2008). In the same vain, Wang et al., (2020), identify the absence of shared interests and mutual trust as a barrier between organizations when it comes to managing CSC, suggesting that the establishment of trusting relationships between stakeholders is a key element affecting the collaboration and the performance of CSCs. Likewise, Paavilainen et al. (2021) in their study on inter-organizational collaboration in CE ecosystems, the authors suggest that trust and the ability to collaborate influence the value creation within the CE ecosystem. Also, Tobin and Zaman (2022) through a case study of regional cooperation in Australia regarding waste management, reveal that social capital, often overlooked, is one of the most crucial elements required to sustain mechanisms for regional cooperation. The most valued qualities of social capital in this context include reciprocity, transparency, trust, and a shared sense of identity.

In conclusion, the role of trust, collaboration and its impact on SC performance has received significant attention in previous research on linear SCs. However, in the context of CSC and sustainable performance, research on this topic is limited. To fill this gap, this paper aims to demonstrate the effects of trust on the quality of collaboration and the sustainable performance of the CSC through a quantitative study based on Structural Equation Modeling (SEM).

This paper is organized as follows. First, the research background is presented, based on the three principal concepts under study, trust, collaboration and sustainable performance in the context of the CSC. Then, the research hypotheses and a conceptual model are exposed (Section 2). In Section 3, the research design is presented. Afterward, the conceptual model is tested through SEM and the results are reported in Section 4. Finally, the discussion of the results (Section 5) and the general conclusions are drawn in Section 6.

The findings of this study offer important contributions to the existing field of research on CSCM. First, by comprehensively reviewing and integrating the literature of linear SCM and CSCM, this work establishes a group of indicators to measure the trust, the collaboration quality and the sustainable performance of CSC. Secondly, it reveals that the quality of the collaboration is not a mediator between trust and sustainable

performance in CSC context. The study points out that trust is a determinant of the collaboration quality and sustainable performance of CSC. In this respect, the results extend the application of social behaviors and collaboration in the CSCM context. Finally, this study also contributes as guidance for practitioners in establishing collaborative relationships with its stakeholders to improve or transition towards CE.

5.2. Research background and hypothesis development

5.2.1. Collaboration Quality within Circular Supply Chains

Due to the multidisciplinary nature of CE and the necessity for the involvement of all stakeholders in its successful implementation (Asgari and Asgari, 2021), SC is presented as the key unit of action in the transition to CE (Hazen et al., 2020; Lahane et al., 2020). In this respect, the literature consistently emphasizes the implication of collaborative partnerships among stakeholders in the shift from linear to circular systems (Hazen et al., 2020). Likewise, the authors point out the absence of a robust collaboration as a challenge in the implementation of CSC (Hart et al., 2019; Saccani et al., 2023).

In SCM collaboration is defined 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) (Simatupang and Sridharan, 2002). Literature indicates that effective collaboration with stakeholders in both reverse logistics and forward logistics is a key component in the success of CSCs (Hazen et al., 2020). Similarly, Andrews et al. (2006) argue that organizations should not confine themselves to their physical bounds, but rather should be open to broadening their scope of collaboration and communication to include all stakeholders involved in the value chain. However, there exists an absence of discourse regarding the implementation and reinforcement of collaborations through concrete efforts inside CSC, with the aim of enhancing sustainable performance (Sudusinghe and Seuring, 2022).

Studies on collaboration show that its effectiveness can be related to concepts like quality and maturity. Such is the case of the work of Boughzala and De Vreede (2015) in which the term collaboration quality is evaluated through a collaboration maturity model. In this work, the authors expose that the level of collaboration maturity is composed by team members communicating effectively, achieving shared

understanding, and adapting their tasks, behaviors, and resources to produce high-quality outcomes. In the same vain, Yan and Dooley (2014), in their work on buyer–supplier collaboration quality in new product development projects, they define the buyer–supplier collaboration quality as “the extent to which buyer and supplier groups synergistically exploit shared resources while minimizing wastes through interacting during project planning and execution”(p. 61). Likewise, Ramanathan and Gunasekaran, (2014), explore the effects of collaborative planning, execution and decision making in the success of SC collaboration and future collaborations; as well as Liao et al. (2017), in their work about Taiwan's networking communication industry, the authors showed that SC collaboration could help to enhance the firm competitive advantage through SC capabilities. This suggests that the collaboration quality is composed of several elements, which according to their level of development or maturity impact the relationships between the different parties involved. These elements are: open, effective and sufficient communication (Alghababsheh and Gallear, 2020; Baas, 2008; Boughzala and De Vreede, 2015; Wu et al., 2014; Yan and Dooley, 2014); problem solving capacity (Alghababsheh and Gallear, 2020; Boughzala and De Vreede, 2015; Wu et al., 2014); effective planning (Yan and Dooley, 2014), long term relationships (Wong and Cheung, 2005; Wu et al., 2014) and power symmetry (Zhang and Cao, 2018).

In accordance with the concept of collaboration discussed above, there are two strands in the literature. The first, suggesting that collaboration could be a mediator between the social relationships of CSC stakeholders and their sustainable performance (Sudusinghe and Seuring, 2022). The second, as a dimension of performance in itself from the definition of collaboration maturity (Boughzala and De Vreede, 2015).

5.2.2. Sustainable Performance of CSC

According to the existing literature on sustainable SC performance, the primary dimensions commonly identified by numerous writers are the social, environmental, and economic aspects (Azevedo et al., 2017; Faulkner and Badurdeen, 2014; Hernandez Marquina et al., 2022; Walker et al., 2021b; Wu et al., 2020). According to the stakeholder classification proposed by Andrews et al., (2006) the social dimension integrates the employees inside the SC; the end customers/consumers of the products/services provided by the SC; and the society and local communities that are

part of the external environment around the SC. According to the indicators proposed by Allais, (2015) for measuring natural capital as well as the variable proposed by Hussain and Malik, (2020) for defining SC environmental performance, the environmental dimension encompasses several key factors, including emissions, resource consumption, impact on biodiversity, and investment in environmental protection and remediation. Regarding the economic dimension, literature suggests as key factors the return on investments; the increase of sales; and the decrease of costs (Wu et al., 2014). Lastly, also literature present a fourth dimension associated with the performance of the products and services offered by the SC, denominated non-economic dimension, this includes: the establishment and maintenance of customer connections, the ability to effectively respond to market changes; and the performance of products or services (Wu et al., 2014).

5.2.3. Trust

Literature presents trust concept as “a firm's expectation that their partners will perform a particular action to benefit their interests irrespective of their ability to monitor or control their partners" (Wu et al., 2014, p.125). The study performed by Paavilainen et al. (2021) about Inter-organizational collaboration in CE ecosystems, highlight the importance of trust, joint interest and ability to collaborate to the value creation based on stakeholder theory. In the same vain, Baas (2008) exposes that “experiences in cleaner production and industrial ecology projects show that an open, reflective and ongoing dialogue must be designed to develop trust, transparency, and confidence to ensure real involvement of diverse stakeholders in charting the future of their organizations and regions as part of the transition to sustainable societies” (p.139). Likely, Mastos et al. (2021) explain that manufacturing enterprises have recognized the importance of good relations and the need for trusted supplier relationships, while Nee et al., (2013) explain that the correct implementation of sustainable strategies generates better relations with the stakeholders, promoting fidelity, acceptance, and trust. Also Chertow, (2000) explains that based on mutual recognition and trust, firms and other partners exchange knowledge and broaden the definition of sustainability on which they act. In contrast, Wang et al. (2020) expose the lack of common interest and mutual trust as an inter-organizational barrier in managing CSC.

In the context of CE, several authors mention trust as an influencing factor of CSC success, reflect on the collaboration quality and the sustainable performance (Allais, 2015; Bressanelli et al., 2019; Masi et al., 2017; Paavilainen et al., 2021; Tobin and Zaman, 2022). Also, literature shows that trust can be a multidimensional concept (Wong and Cheung, 2005), based on an honest, open and transparent communication within the SC (Chertow, 2000; Nee et al., 2013; Tobin and Zaman, 2022; Wong and Cheung, 2005), partners reputation founded on performance (Allais, 2015; Bressanelli et al., 2019; Masi et al., 2017; Wong and Cheung, 2005; Zhang et al., 2013), collective welfare awareness of all the SC stakeholders (Tobin and Zaman, 2022; Wang et al., 2020; Wu et al., 2014) and rights protection and promises kept between SC partners (Paavilainen et al., 2021; Wu et al., 2014).

5.2.4. Hypothesis development

5.2.4.1. Trust, collaboration quality and CSC performance

In literature about SCM regarding linear SC, some academics have already studied the effects of trust on collaboration, such is the case of Wu et al., (2014), in which the authors explore the effects of the Social Exchange Theory pillars on collaboration and information sharing. Furthermore CE literature shows that trust is a recurrent concept when dealing with collaboration issues and the barriers and facilitators in the transition in CE under the SCM approach (De Angelis et al., 2018; Mastos et al., 2021; Tura et al., 2019; Wu et al., 2020), commonly related to transparency, which affects collaboration, information sharing, risk management and SC performance (Tobin and Zaman, 2022). In the same vain, Paavilainen et al. (2021) in their work about inter-organizational collaboration based on five case studies in CE ecosystems in Finland, the authors propose that the stronger and the more mature stakeholder relationships are in terms of the trust, the ability to collaborate and joint interests, the broader the scale of created value. Thus, the literature in both SCM and CSCM suggests that trust is a key determinant of stakeholder collaboration quality. Based on these arguments, the following hypothesis is proposed:

H1: Trust positively affects the collaboration quality of the CSC.

Regarding performance, Wong and Cheung, (2005) studied the effects of trust on the partnership success of projects, based on a multidimensional concept of trust made up by partners performance, partners permeability, relational bonding and system-

based trust. In the same vain, Wu et al., (2014), explore the effects of the Social Exchange Theory pillars (including trust) on SC performance, considering performance as a bidimensional element, made up of financial indicators (return on investment, costs, sales growth, etc.) and non-financial indicators (product performance, customer relations, market reactivity, etc.), this study reveals that trust is the antecedent that has the greatest impact on SC collaboration and in turn shows collaboration as a mediator between trust and SC performance. With respect to sustainability into SCM, Beske and Seuring, (2014) expose that a "high relationship quality and transparency through information flows are important for good SC performance, irrespective of a focus on sustainability" (p.328). In the other hand, United Nations, (2022) recognizes the significant role of transparency (key element in the definition of trust) in achieving the Sustainable Development Goals, particularly those related with inclusive and sustainable economic growth and decent work (SDG 8); resilient and sustainable infrastructures, industrialization and innovation (SDG 9); and sustainable consumption and production patterns (SDG 12). Therefore, the literature indicates that trust could be a determinant of performance, both in the performance of linear SC, based on an economic approach related with the business performance and in a CSC, based on a sustainable approach including the environmental and social performance. Founded on these arguments, the following hypotheses are proposed:

H2: Trust positively affects the business performance of the CSC.

H3: Trust positively affects the environmental-social performance of the CSC.

5.2.4.2. Mediating role of collaboration quality

Wu et al. (2014) in their work about information sharing and collaborative behaviors in enabling SC performance, the authors show that social exchange pillars (including trust) are important to determine information sharing and collaboration and both have a partial mediation effect on SC performance. In the same vain, Cao and Zhang (2011) explore the mediating effects of collaborative advantage between SC collaboration and firm performance. This indicates that in linear SC, collaboration has played a mediating role between trust and SC performance. Regarding CE literature, Hussain and Malik (2020) in their empirical study about organizational enablers for CE in the context of sustainable SCM, the authors show that collaboration within SC networks positively affects environmental performance of the SC. In the same vain, Sudusinghe and

Seuring (2022) explore SC collaboration strategies and their influence on sustainable performance in CE, this work suggests that the SC sustainable performance can be affected by the changes in the SC orientation of the companies involved in collaborative relationships. Based on these arguments, the following hypotheses are proposed:

H4: Collaboration quality mediates the relationship between trust and business performance of the CSC.

H5: Collaboration quality mediates the relationship between trust and environmental-social performance of the CSC.

Figure 5.1 shows the conceptual model to be tested in this paper, which presents the trust construct as an antecedent of sustainable performance, and collaboration quality as a partial mediator between trust and sustainable performance.

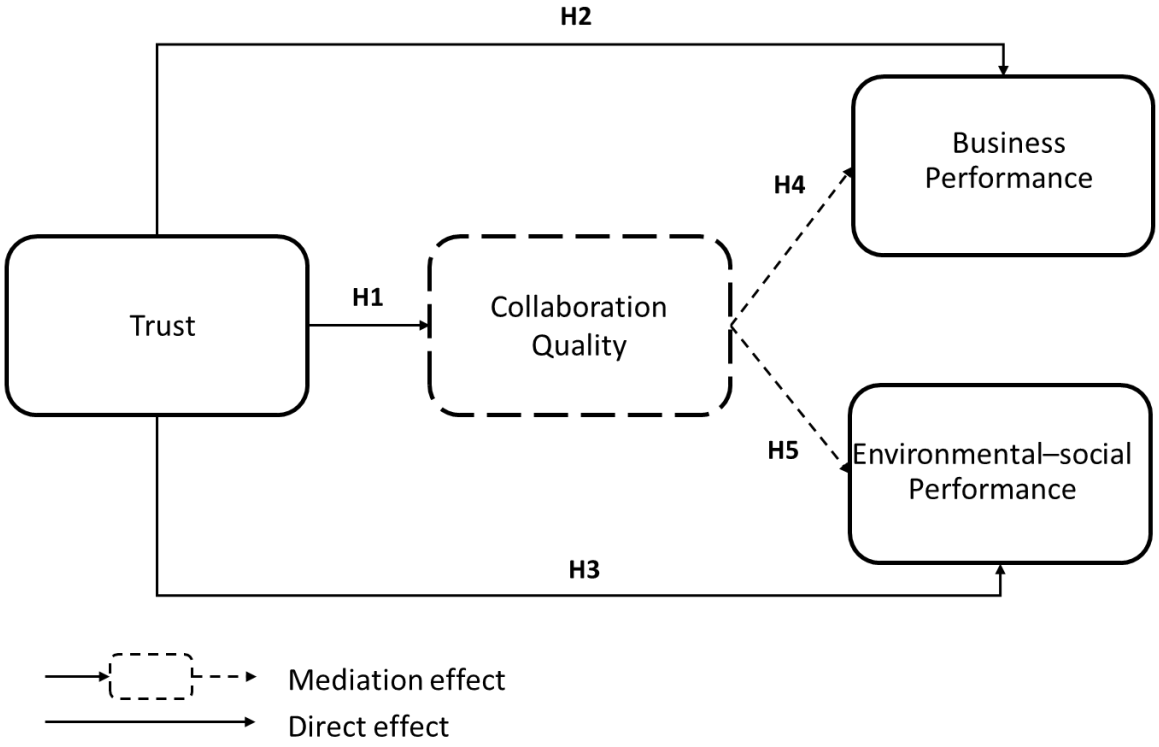


Figure 5.1. Conceptual model

5.3. Research design

A quantitative study was carried out through a questionnaire to collect empirical data and analyze the conceptual model presented in Figure 5.1 through SEM, because it allows the analysis of complex phenomena that involve several variables interacting with each other, since it provides the means to model complex relationships between observed and latent variables (Hoyle, 2012). The structure of the research design is outlined as follows.

5.3.1. Development of the measurement scale

The questionnaire encompasses four sections aimed at comprehensively understanding the company's profile and evaluating its supply chain dynamics. First, in order to validate the content of the constructs and their variables, an extensive literature review was conducted and a potential list of items was compiled. Then, structured interviews were conducted with the help of experts, ten academics and five practitioners from three European companies to check the relevance and clarity of each construct's definition and the wording of question items. Based on the feedback from the experts, redundant and ambiguous items were eliminated or modified, and new items were added when necessary. Accordingly, the final structure of the questionnaire is detailed as follows, sections 1 was based on closed questions with single and/or multiple-choice, and sections 2, 3 and 4 were based on a Likert scale from 1 to 7, with an exit option in case the question did not apply in the particular context of the company.

In the first section, fundamental company information was gathered, including industry type, size in terms of annual revenue and workforce, key partners, business model (B2B and/or B2C), product/service/solution offerings, circular-sustainable strategies applied, and the geographical scope. Simultaneously, respondent characteristics such as work experience, education level, gender, position, and country were considered. Subsequent sections delve into specific aspects. Section 2 focuses on trust construct, employing four manifest variables derived from theoretical models in SCM and literature in CE and sustainable development. The construct was based on models developed by Wong and Cheung (2005) and Wu et al. (2014), emphasizing decision-making in new SC relationships. Section 3 examines collaboration quality construct, incorporating six manifest variables drawn from literature, particularly the works of

Wong and Cheung (2005), Wu et al. (2014), and Yan and Dooley (2014). Questions in this section center on the current collaboration quality within the SC. Lastly, Section 4 assesses the sustainable performance constructs of the SC, differentiating between environmental-social and business dimensions. The environmental-social construct comprises six manifest variables based on the work of Allais (2015) and Hussain and Malik (2020) regarding environmental variables and Andrews et al. (2006) regarding social variables. While the business construct includes four variables based on the work of Wu et al. (2014). Questions in this section explored the present impact of key partners on the company's sustainable performance. Table 5.1 shows the constructs with their respective indicators.

Table 5.1. Constructs and indicators

Construct	Item	Description	Indicator	Adapted from
Trust	TR1	Rights protection and promises kept	We look for partners who will keep their promises and protect our rights	Wong and Cheung (2005) and Wu et al. (2014)
	TR2	Social reputation	The reputation of our partners in terms of their social performance is considered	
	TR3	Economic reputation	The reputation of our partners in terms of their economic performance is considered	
	TR4	Openness and transparency	Partners are open and transparent in the exchange of information	
Collaboration Quality	CQ1	Open, effective, and sufficient communication	Communication between Supply Chain partners and us is open, effective and sufficient.	Wong and Cheung (2005); Wu et al. (2014) and Yan and Dooley (2014).
	CQ2	Problem solving capacity	Supply Chain partners and us work together and help us each other while problems occur	
	CQ3	Effective planning	Task assignments of partners were well planned and all the activities are well scheduled in relation to the timeframe	
	CQ4	Long term relationships	Supply Chain partners collaboration is based on long term relationships	
	CQ5	General collaboration	A high level of collaboration with our partners is fundamental for the development of our supply chain	
	CQ6	Interdependency symmetry	The interdependency among partners is symmetrically distributed i.e., we have the same power to influence each other in decision, R&D, sale, production, and distribution	

Business performance	BP1	Return on investment	Supply Chain partners help us to improve return on investment and/or assets	Wu et al. (2014)
	BP2	Costs reduction	Supply Chain partners help us to reduce costs (Ex. Production, inventory, logistics, etc.)	
	BP3	Customer relationship	Supply Chain partners help us to improve customer relationships	
	BP4	Product performance	Supply Chain partners help us to improve product(s)/ service(s)/ solution(s) performance	
Environmental-social performance	ESP1	Emissions	Supply Chain partners help us to reduce emissions	Allais (2015); Andrews et al. (2006) and Hussain and Malik (2020)
	ESP2	Biodiversity impact	Supply Chain partners help us to reduce the Impact on biodiversity that develops around the company's activities	
	ESP3	Scarce/polluting material consumption	Supply Chain partners help us to reduce the consumption of scarce and/or polluting materials	
	ESP4	Compliance with environmental laws and regulations	All the Supply Chain partners are concerned about compliance with environmental laws and regulations	
	ESP5	Working conditions	Supply Chain partners help us to improve the working conditions of our employees	
	ESP6	Society and local communities	Supply Chain partners help us to Improve the closest society surrounding our organization in territorial terms	

5.3.2. Sample and data collection

In order to carry out this study, it was necessary for the participants to have considerable experience in SCM practices and to take part in the decision-making process when selecting partners. the target of respondents were top managers, including general managers and logistics/purchasing executives. To obtain the necessary sample for this study, it was decided to contract the services provided by Kantar Group, which has the necessary number of panelists for the collection of the international data required for this project. The questionnaire was applied between May and June 2023. Finally, 600 responses were obtained with the same proportion of responses per country, and after applying the corresponding filters based on Minimum Covariance Determinant (MCD) in order to identify outliers and suspect systematic patterns of answer, a total of 390 responses were available for further analysis.

The participants were mostly from the logistics department (87.9%) and had significant experience in circular economy: 1 to 5 years (47.9%) and 6 to 10 years (34.9%). Appendix 1 shows the demographics of the respondents per country. Regarding the companies, most of them belong to the transportation and storage industry (41.3%), manufacturing (16.9%) and wholesale and retail trade (13.3%), generally medium (45.9%) and large-sized (36.4%) companies. Mostly with a business-to-business (B2B) and business-to-consumer (B2C) oriented business model (61.3%). The majority of these companies have a national (43.1%) and local (31.8%) presence in their territory. We tested for differences in responses with respect to country, industry, size, revenue and CE strategy and business model but we did not find any statistically significant differences, appendix 2 shows the principal characteristics of the companies per country.

5.3.3. Data analysis

For the purpose of this study, Structural Equation Modeling (SEM) was applied in order to explore in a quantitative way the interrelationships between the four unobserved latent constructs and its indicators (Hoyle, 2012). Analysis of the data was done using Lavaan package (Rosseel, 2012) from R version 4.3.1 (R Core Team, 2023). First, the indicators that compose the constructs were evaluated through their loadings and correlations. Then, internal reliability was tested using Exploratory Factor Analysis (EFA) to verify whether there was a high internal consistency among the items. Subsequently, the latent constructs relationships were analyzed through Confirmatory Factor Analysis (CFA) in two stages: convergent validity and discriminant validity. Next, the fit of the model was evaluated. Afterwards, the model was tested through the significant path values and mediation analysis. Finally, a complete structural model was developed by eliminating insignificant paths to remove unsupported hypotheses.

5.4. Results

5.4.1. Common method bias and non-response bias

Regarding biases, in the case of this instrument the non-responses bias does not apply, since the responses were obtained in their entirety at one time. On the other hand, the common method bias was calculated through the Variance Inflation Factors (VIF). According to Kock (2015) this value should be less than 3.3, in our case this

value oscillates between 1.091 and 1.982, thus proving the absence of the common method bias.

5.4.2. Measurement model's results

The testing of the measurement model was carried out in two stages. First, the indicators that compose the constructs were evaluated through their loadings and correlations in order to test that the observed variables effectively measure the latent constructs. Table 5.2 shows the inter-correlations among the measured items and descriptive statistics such as mean and standard error (SE). Although numerous variables exhibit statistically significant correlations with one another, none of them demonstrate a strong correlation approaching 0.9 or 1.0. According to the literature presented in section 2, the measured items were grouped under 4 latent variables: Collaboration Quality (CQ) (6 items), Business Performance (BP) (4 items), Environmental-Social Performance (ESP) (6 items) and Trust (TR) (4 items). Then, according to Hair (2009) just factors with loadings bigger than 0.4 should be considered for further analysis. The loadings of this study range from 0.359 to 0.714 (Table 5.3). Although the loading of item ESP6 is outside the limits described in the literature (0.359), we keep it for model fitting purposes.

Table 5.2 Correlations among indicators

Item	Mean	SE	CQ1	CQ2	CQ3	CQ4	CQ5	CQ6	BP1	BP2	BP3	BP4	ESP1	ESP2	ESP3	ESP4	ESP5	ESP6	TR1	TR2	TR3	TR4
CQ1	5.94	0.64																				
CQ2	5.96	0.79	0.13**																			
CQ3	5.96	0.70	0.41***	0.04																		
CQ4	5.97	0.84	0.34***	0.42***	0.31***																	
CQ5	5.98	0.68	0.26***	0.22***	0.33***	0.03																
CQ6	5.95	0.75	0.26***	0.27***	0.39***	0.29***	0.31***															
BP1	5.92	0.70	0.42***	0.23***	0.28***	0.24***	0.3***	0.38***														
BP2	6.04	0.74	0.26***	0.26***	0.28***	0.22***	0.32***	0.37***	0.31***													
BP3	5.96	0.72	0.33***	0.17***	0.19***	0.2***	0.29***	0.27***	0.45***	0.18***												
BP4	5.98	0.72	0.32***	0.17***	0.29***	0.27***	0.32***	0.35***	0.4***	0.41***	0.4***											
ESP1	5.91	0.73	0.32***	0.26***	0.3***	0.21***	0.28***	0.32***	0.4***	0.3***	0.46***	0.44***										
ESP2	5.99	0.72	0.31***	0.29***	0.29***	0.31***	0.31***	0.37***	0.31***	0.33***	0.32***	0.44***	0.47***									
ESP3	5.86	0.71	0.28***	0.2***	0.21***	0.15**	0.29***	0.4***	0.37***	0.29***	0.46***	0.32***	0.41***	0.35***								
ESP4	6.01	0.77	0.26***	0.23***	0.39***	0.3***	0.34***	0.34***	0.3***	0.24***	0.32***	0.34***	0.34***	0.37***	0.35***							
ESP5	5.92	0.73	0.33***	0.19***	0.28***	0.16**	0.2***	0.32***	0.46***	0.24***	0.47***	0.33***	0.46***	0.32***	0.41***	0.29***						
ESP6	5.98	0.80	0.16**	0.35***	0.22***	0.48***	0.14**	0.27***	0.21***	0.25***	0.16**	0.21***	0.16**	0.24***	0.19***	0.22***	0.09					
TR1	5.88	0.68	0.4***	0.25***	0.3***	0.25***	0.28***	0.36***	0.42***	0.26***	0.51***	0.36***	0.46***	0.36***	0.37***	0.37***	0.33***	0.18***				
TR2	5.94	0.76	0.15**	0.35***	0.27***	0.29***	0.28***	0.4***	0.23***	0.33***	0.18***	0.25***	0.21***	0.31***	0.27***	0.28***	0.17***	0.25***	0.25***			
TR3	5.89	0.78	0.3***	0.28***	0.26***	0.3***	0.24***	0.34***	0.44***	0.24***	0.51***	0.38***	0.48***	0.39***	0.51***	0.32***	0.47***	0.21***	0.51***	0.29***		
TR4	5.96	0.80	0.18***	0.27***	0.28***	0.26***	0.27***	0.36***	0.24***	0.27***	0.33***	0.32***	0.31***	0.36***	0.2***	0.31***	0.28***	0.28***	0.34***	0.31***	0.39***	

** Correlation is significant at the 0.01 level (2-tailed)

*** Correlation is significant at the 0.001 level (2-tailed)

Second, reliability and validity were tested in order to assess the consistency, stability and confirm that the instrument measures the intended constructs. Firstly, the EFA was applied with the aim of asses reliability by the criterions of Cronbach's α and Composite Reliability (CR), that according with Hair et al. (2010) values larger than 0.6 are acceptable for an exploratory research. In the particular case of this study, the values of Cronbach's α range between 0.679 and 0.725, and the values of CR range between 0.685 and 0.752, thus showing an adequate reliability. Then, convergent validity and discriminant validity were tested trough CFA. To assess the convergent validity, the Average Variance Extracted (AVE) and the CR were considered. According to Fornell and Larcke (1981) if AVE is less than 0.5, but CR is higher than 0.6, the convergent validity of the construct is still adequate. In this case the AVE values vary between 0.271 and 0.361, while all the CR values are higher than 0.6, showing an appropriate convergent validity. We conducted additional assessments to determine the discriminant validity of the constructs, aiming to determine the extent to which each construct differs from the others. As none of the inter-correlations between the four constructs reached a value of 1.0, we can confidently assert that each construct exhibits distinct characteristics according to Ramanathan and Gunasekaran (2014). We have also used CR to verify the discriminant validity, which is above the recommended minimum mentioned before (0.6). Table 5.3 shows the results obtained in the EFA and CFA.

Table 5.3. Construct reliability and validity analysis

Construct	Item	Description	Loading	AVE	CR	Cronbach's α
Collaboration Quality	CQ1	Open, effective, and sufficient communication	0.542	0.361	0.689	0.685
	CQ2	Problem solving capacity	0.416			
	CQ3	Effective planning	0.527			
	CQ4	Long term relationships	0.479			
	CQ5	General collaboration	0.467			
	CQ6	Interdependency symmetry	0.619			
Trust	TR1	Rights protection and promises kept	0.671	0.271	0.685	0.679
	TR2	Social reputation	0.454			
	TR3	Economic reputation	0.714			
	TR4	Openness and transparency	0.542			
Environmental-Social Performance	ESP1	Emissions	0.662	0.323	0.752	0.687
	ESP2	Biodiversity impact	0.611			
	ESP3	Scarce/polluting material consumption	0.606			

	ESP4	Compliance with environmental laws and regulations	0.549			
	ESP5	Working conditions.	0.588			
	ESP6	Society and local communities	0.359			
Business Performance	BP1	Return on investment	0.637	0.361	0.694	0.725
	BP2	Costs reduction	0.489			
	BP3	Customer relationship	0.645			
	BP4	Product performance	0.629			

5.4.3. Structural model results

To carry out the evaluation of the structural model, a measurement of the fit indices was first carried out to determine the extent to which the proposed model fits the observed data. A good model fit indicates that the model adequately represents the existing relationships in the data (Hoyle, 2012). Then, the path values were evaluated to determine the direct effects (H1, H2 and H3), and finally, the indirect effects H4 and H5) were evaluated through the mediation test ((Baron and Kenny, 1986).

5.4.4. Model's fit

In order to evaluate the model's fit, the following indicators were considered: chi-square ($\chi 2$ (df)) and Goodness-of-Fit Index (GFI) that according to Doll et al. (1994) scores in the 0.80 to 0.89 range have representing reasonable fit; Comparative Fit Index (CFI), in which values between 0.8 and 0.9 indicate acceptable fit (Baumgartner and Homburg, 1996); Standardized Root Mean Squared Residuals (SRMR) that according to Byrne (1994) must be smaller than 0.08; Root Mean Square Error of Approximation (RMSEA) with a value smaller than 0.10 (Hair et al., 2010); and Trucker Lewis index (TLI) that should be a value between 0 and 1 (perfect fit) (Molenaar et al., 2000; Schumacker and Lomax, 2012). The results of the model with respect to the indicators mentioned above are shown in Table 5.4. These results are presented based on 2 competitive sub-models. The first model corresponds to the direct effects composed by H1, H2 and H3 effects. The second model correspond to the direct and mediation effects, considering H1, H2, H3, H4 and H5. These results show an adequate fit of both models, which proves that the conceptual model proposed is consistent with the data collected.

Table 5.4. Fit indices

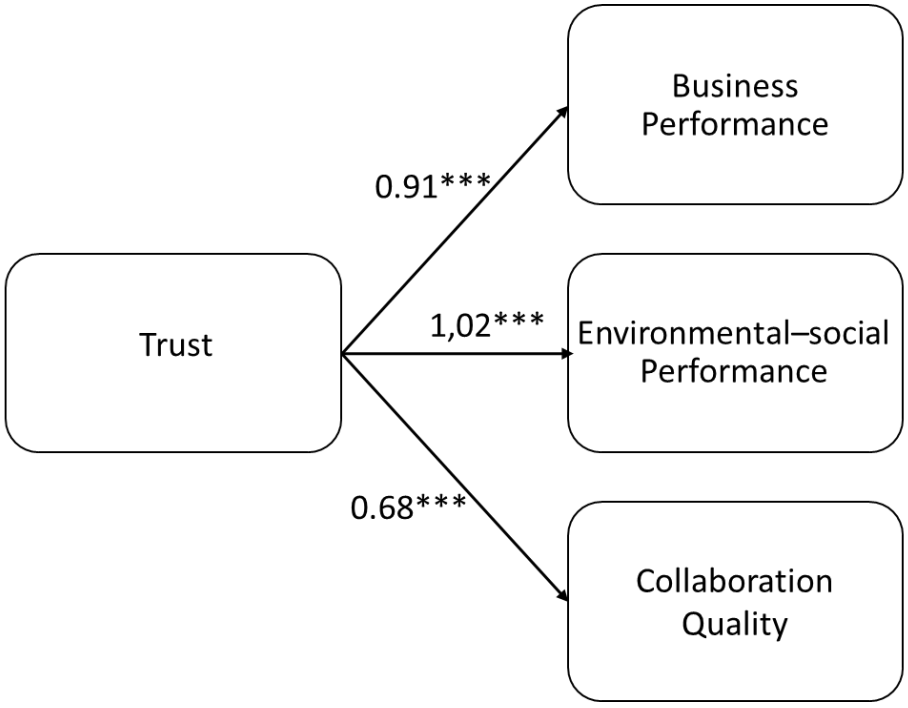
	χ2 (df)	GFI	CFI	SRMR	RMSEA (90% CI)	TLI	
Structural model (direct)	590.90(164)	0.86	0.83	0.07	0.08(0.07-0.09)		0.80
Structural model (mediation)	590.90(164)	0.86	0.83	0.07	0.08(0.07-0.09)		0.80

With respect to the model of direct effects, the path coefficient between the construct trust and collaboration quality has a significant value (0.68, $p < 0.001$), showing that trust between stakeholders in CSC has a positive significant impact on the collaboration quality between them. This prove the H1 with trust as an antecedent of collaboration quality. Regarding the effects of trust in business performance, the value of the path coefficient (0.91, $p < 0.001$) demonstrates a significant impact, proving that trust between stakeholders has a positive and significant effect on the business performance of the CSC, thus supports H2. In the same vain, the value of the path coefficient between trust and environmental-social performance (1.02, $p < 0.001$) demonstrates that trust has a significant and positive impact on the environmental-social performance, consequently supporting H3.

5.4.5. Mediation effects of collaboration quality

Regarding the mediation effects, the method suggested by Baron and Kenny (1986) based on 3 steps was applied. First step consists in testing the direct effects of the predictor variable (trust) on the mediator (collaboration quality). This corresponds to the previous test of H1, showing that trust has a positive significant effect on the collaboration quality (0.68, $p < 0.001$). In Second step the impact of the predictor variable (trust) on both dimensions of CSC performance is tested to stablish whether there is an effect to be mediated. This corresponds to the previous test of H2 and H3, showing that trust has a positive and significant effect on the business performance (0.91, $p < 0.001$) and a positive and significant effect on the environmental-social performance (1.02, $p < 0.001$). In the Third Step the indirect effects through a regression of the performance dimensions simultaneously on the mediator (collaboration quality) and on the predictor (trust) are examined. The mediation test is successful if the collaboration quality has a significant effect on the performance dimension and the significance of the link between trust and the dependent variable (performance) is reduced (Partial mediation) or no longer occurs (Full mediation). In the specific case of this study, collaboration does not have a significant effect on none

of the performance dimensions, therefore the quality of collaboration does not have an effect in mediating trust and business performance, nor social-environmental performance. Thus, rejecting hypotheses H4 and H5. Figure 5.2 shows the structural model with the path coefficients of the direct effects. Table 5.5 summarizes the results of the hypothesis tests, showing that only H1, H2 and H3, corresponding to the direct effects, were validated.



***significant at $p < 0.001$

Figure 5.2. Structural model with path coefficients of direct effects.

Table 5.5. hypothesis testing

Relationship between constructs		*p*-value	Supported or not
H1	Trust → Collaboration quality	0,000	Supported
H2	Trust → Business performance	0,001	Supported
H3	Trust → Environmental-social performance	0,000	Supported
H4	Trust →Collaboration quality → Business performance	0.203	Not supported
H5	Trust →Collaboration quality → Environmental-social performance	0.089	Not supported

5.5. Discussion

Based on the literature review about linear SCM and CSCM and the empirical analysis, this model shows the construct of trust as antecedent of the collaboration quality, the

business performance and the environmental-social performance, demonstrating the significant and positive influence that trust has on the tree constructs. Regarding the direct effects of trust, these results prove that it has a positive and determinant effect on both dimensions of performance and on the quality of collaboration. This reinforces elements found in the literature on CSC which suggest these direct effects (Allais, 2015; Bressanelli et al., 2019; Masi et al., 2017; Paavilainen et al., 2021; Tobin and Zaman, 2022).

However, the quality of the collaboration between partners in CSC does not influence either the business performance or the environmental-social performance of the CSC. This reveals that collaboration quality does not act as a mediator between trust and CSC performance, in contrast to studies in linear SC that prove these mediation effects (Cao and Zhang, 2011; Wu et al., 2014; Yan and Dooley, 2014). When comparing these studies in linear SC with our own, we can find notable differences with respect to the intrinsic characteristics of the sample. Two of these studies are conducted in the US (Cao and Zhang, 2011; Yan and Dooley, 2014) and another one in Taiwan (Wu et al., 2014), while our study is developed in Canada, France and Portugal. On the other hand, with respect to the industry, the linear studies focused mainly on manufacturers and their relationships with key suppliers, as well as buyer-supplier relationships in new product development projects. In our case, the industries considered are manufacturers, wholesalers, retailers, logistics and storage companies; moreover, in our specific case the interactions with all SC actors are considered from a CE perspective. Another difference is the definition of the variables and the constructs, which, although in general terms are very close, some variables differ among the models presented by the several authors.

Furthermore, in the literature on CSC, we can find two strands. On the one hand, some authors suggest that the quality of collaboration can act as a mediator between trust and sustainable performance (Hussain and Malik, 2020; Sudusinghe and Seuring, 2022). On the other hand, others suggest that there is a direct effect between trust and sustainable performance (Beske and Seuring, 2014; Jens K. Roehrich, Stefan U. Hoejmose, 2017; Rinaldi et al., 2022). However, from these results, we can infer that trust acts directly on the sustainable performance and quality of the collaboration of the CSC.

The results of this work suggest a shifting of collaboration quality from mediator to an element that could be part of the sustainable performance concept itself in the context of CSCs. This sustainable performance vision could be based on the integration of the concepts of efficacy as well as efficiency, as suggested by Bstieler (2006), Le Dain et al. (2011), and Wong and Cheung (2005) in their evaluation of the performance of new product development collaborations, as well as Simatupang and Sridharan (2005), Singh and Power (2009) and Sodhi and Son (2009) in the context of linear SC. Regarding this sustainable performance vision that's integrates the business performance, the environmental-social performance and the collaboration quality, we have sustainable performance as a principle of efficacy, which integrates the social, environmental and economic development of the CSC, i.e. the achievement of the objectives based on sustainability. On the other hand, we have the collaboration quality as an efficiency principle, in which the relationships between CSC partners are effective with respect to communication, problem-solving capacity, planning, long-term relationships, overall collaboration and interdependence symmetry. Figure 5.3 shows the final integration of all the elements that make up CSC performance.

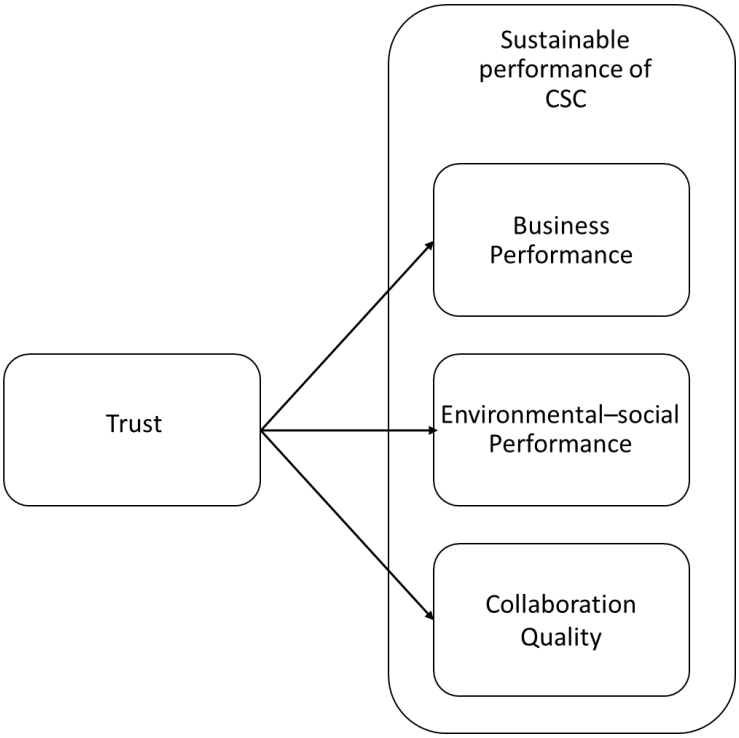


Figure 5.3. Final model

5.6. Conclusion

This work provides a comprehensive understanding of the effects of trust on the collaboration quality and the sustainable performance of the CSC, through a quantitative study based on empirical research. With this aim, the four constructs and their relationships were articulated through their manifest elements based on the literature and tested through a questionnaire applied to 390 companies in France, Portugal and Canada. These results represent a valuable resource for this emerging field of literature and practitioners and policymakers regarding stakeholders' relationships in a context of CE.

Regarding theoretical implications, the results of this study have the potential to enrich the existing body of research on collaboration in the context of CSCM. Primarily, by conducting a thorough review and synthesis of the literature encompassing both linear SCM and CSCM, this study establishes a set of indicators for assessing the collaborative behaviors and sustainable performance within CSC. Notably, it highlights the pivotal role of trust as a determining factor in the quality of collaboration and sustainable performance in CSC. Through empirical research, the study precisely examines the direct impact of trust on collaboration quality and sustainable performance, as well as the mediating role of collaboration quality between trust and sustainable performance, specifically within CE context. The findings highlight the crucial role of social relationships among stakeholders in facilitating the adoption and consolidation of CE practices. Consequently, these results broaden the application of social behaviors and collaboration principles and their relationship with sustainable performance.

In terms of practical implications, this study serves as a valuable resource for managers and policymakers, offering guidance in the strategic selection of collaborative practices to enhance the sustainable performance of the CSC. These results introduce new perspectives on the shift towards CE models by providing managers and practitioners with the tools to develop trusting and collaborative relationships with stakeholders into the CSC in order to achieve a fully sustainable development.

Although the results obtained represent a valuable resource for the literature and the applied field, they should be interpreted carefully considering some limitations. The

limitations of this study may also be the direction for future research. While we provide a rich insight into trust and its influence on the quality of collaboration and its sustainable performance, some external factors that could influence these relationships are not addressed, such as the ecosystem, the social-political context and the dynamic environment. On the other hand, social relations theories such as social exchange theory and social capital consider other important elements in SC relationships, not only trust and collaboration, but also power, commitment, reciprocity, and stakeholder associations. Future research may explore the effects of these other elements of social exchange and the CSC ecosystem on sustainable performance.

5.7. Acknowledgments

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Appendix 1

Descriptive statistics of individuals

	Canada (N=127)	France (N=131)	Portugal (N=132)	Total (N=390)
Work experience				
Less than a year	2 (1.6%)	0 (0.0%)	0 (0.0%)	2 (0.5%)
1 to 5 years	20 (15.7%)	30 (22.9%)	35 (26.5%)	85 (21.8%)
6 to 10 years	77 (60.6%)	68 (51.9%)	63 (47.7%)	208 (53.3%)
More than 10 years	28 (22.0%)	33 (25.2%)	34 (25.8%)	95 (24.4%)
Work experience in CE				
Less than a year	6 (4.7%)	4 (3.1%)	2 (1.5%)	12 (3.1%)
1 to 5 years	62 (48.8%)	63 (48.1%)	62 (47.0%)	187 (47.9%)
6 to 10 years	42 (33.1%)	49 (37.4%)	45 (34.1%)	136 (34.9%)
More than 10 years	17 (13.4%)	15 (11.5%)	23 (17.4%)	55 (14.1%)
Education level				
Less than 3 years	1 (0.8%)	2 (1.5%)	5 (3.8%)	8 (2.1%)
3 to 5 years	46 (36.2%)	59 (45.0%)	56 (42.4%)	161 (41.3%)
More than 5 years	80 (63.0%)	70 (53.4%)	71 (53.8%)	221 (56.7%)
Gender				
Woman	16 (12.6%)	24 (18.3%)	20 (15.2%)	60 (15.4%)
Man	111 (87.4%)	106 (80.9%)	112 (84.8%)	329 (84.4%)
Decline to state	0 (0.0%)	1 (0.8%)	0 (0.0%)	1 (0.3%)
Age				
25 - 34	16 (12.6%)	13 (9.9%)	23 (17.4%)	52 (13.3%)
35 - 44	73 (57.5%)	74 (56.5%)	74 (56.1%)	221 (56.7%)
45 - 54	36 (28.3%)	42 (32.1%)	33 (25.0%)	111 (28.5%)
Other	2 (1.6%)	2 (1.5%)	2 (1.5%)	6 (1.5%)
Department				
Logistics	113 (89.0%)	127 (96.9%)	103 (78.0%)	343 (87.9%)
Other	14 (11.0%)	4 (3.1%)	29 (22.0%)	47 (12.1%)

Appendix 2

Descriptive statistics of firm characteristics

	Canada (N=127)	France (N=131)	Portugal (N=132)	Total (N=390)
Industry type				
Manufacturing	18 (14.2%)	27 (20.6%)	21 (15.9%)	66 (16.9%)
Wholesale and Retail Trade	17 (13.4%)	14 (10.7%)	21 (15.9%)	52 (13.3%)
Transportation and Storage	53 (41.7%)	58 (44.3%)	50 (37.9%)	161 (41.3%)
Other	39 (30.7%)	32 (24.4%)	40 (30.3%)	111 (28.5%)
Firm's output				
Product	28 (22.0%)	35 (26.7%)	22 (16.7%)	85 (21.8%)
Service	18 (14.2%)	16 (12.2%)	17 (12.9%)	51 (13.1%)
Product-Service	61 (48.0%)	63 (48.1%)	71 (53.8%)	195 (50.0%)
Other	20 (15.7%)	17 (13.0%)	22 (16.7%)	59 (15.1%)
Business model				
B2B	28 (22.0%)	26 (19.8%)	28 (21.2%)	82 (21.0%)
B2C	28 (22.0%)	20 (15.3%)	21 (15.9%)	69 (17.7%)
Both	71 (55.9%)	85 (64.9%)	83 (62.9%)	239 (61.3%)
CE importance				
Mean (SD)	6.260 (0.620)	6.191 (0.556)	6.235 (0.578)	6.228 (0.584)
Range	4.000 - 7.000	5.000 - 7.000	5.000 - 7.000	4.000 - 7.000
CE strategies (MC)				
Production and supply	111 (87.4%)	114 (87.0%)	114 (86.4%)	339 (86.9%)
Consumer demand and behaviour	114 (89.8%)	96 (73.3%)	111 (84.1%)	321 (82.3%)
Waste management	89 (70.1%)	89 (67.9%)	96 (72.7%)	274 (70.3%)
Company size				
Under 10	0 (0.0%)	4 (3.1%)	1 (0.8%)	5 (1.3%)
From 10 to 49	19 (15.0%)	23 (17.6%)	22 (16.7%)	64 (16.4%)
From 50 to 249	64 (50.4%)	51 (38.9%)	64 (48.5%)	179 (45.9%)
250 and more	44 (34.6%)	53 (40.5%)	45 (34.1%)	142 (36.4%)
Balance turnover				
€ 2 m or under	2 (1.6%)	1 (0.8%)	3 (2.3%)	6 (1.5%)
From € 2.1 m to € 10 m	35 (27.6%)	31 (23.7%)	32 (24.2%)	98 (25.1%)
From € 10.1 m to € 42.9 m	63 (49.6%)	56 (42.7%)	52 (39.4%)	171 (43.8%)
€ 43 m or over	27 (21.3%)	43 (32.8%)	45 (34.1%)	115 (29.5%)
Geographical perimeter				
Local	47 (37.0%)	44 (33.6%)	33 (25.0%)	124 (31.8%)
National	60 (47.2%)	61 (46.6%)	47 (35.6%)	168 (43.1%)
Continental	11 (8.7%)	11 (8.4%)	25 (18.9%)	47 (12.1%)
Worldwide	9 (7.1%)	15 (11.5%)	27 (20.5%)	51 (13.1%)
Key partners (MC)				
Raw material extractors	38 (29.9%)	39 (29.8%)	43 (32.6%)	120 (30.8%)
Manufacturer	69 (54.3%)	53 (40.5%)	77 (58.3%)	199 (51.0%)
Logistics	84 (66.1%)	92 (70.2%)	93 (70.5%)	269 (69.0%)
Loop closers	37 (29.1%)	34 (26.0%)	26 (19.7%)	97 (24.9%)
Retailers	67 (52.8%)	55 (42.0%)	67 (50.8%)	189 (48.5%)

6. Final results and discussions

This section presents a synthesis and contrast of the results of Chapters 2, 3, 4 and 5. Firstly, Chapters 2 defines the sustainable performance of CSC. Secondly, Chapter 3, explores the concept of collaborative ecosystem in CSCs. Thirdly, Chapter 4 presents a conceptual model, based on the exploration of the SET, collaboration, and its influence on CSCs sustainable performance from a qualitative perspective. And Finally, in Chapter 5 this conceptual model is partially tested through a quantitative approach.

6.1. Sustainable Performance of CSCs

With respect to the definition of sustainable performance, it could be observed that it is intimately linked to terms such as achieving the circular transition (Farooque et al., 2019), success of CE implementation (Sudusinghe and Seuring, 2022), being competitive in terms of sustainability (Allais and Gobert, 2016) and the achievement of the sustainable development goals of the United Nations (United Nations, 2015). However, this makes its definition open to different interpretations and different scopes. In the literature (Chapter 2) and practice (Chapter 4), It was noted that the definition of sustainable performance is a challenge due to the great variety of definitions and measurement methods. It was also found that sustainability dimensions and evaluation methods vary in importance depending on the focus and maturity of the business model and CE strategies. This makes it difficult to obtain standardized and replicable data to be transmitted across all CSC stakeholders.

In this research, through chapters 2, 4 and 5, a common definition of sustainable performance was obtained, considering all the dimensions (economic, environmental and social) that this definition implies. Firstly, Chapter 2 allowed to develop a state of the art around this definition, then chapter 4 permitted to define the key indicators based on economic, environmental, social and non-economic performance. Finally, Chapter 5 shows a refined list of these indicators and subsequently quantifies the effects of trust on the collaboration and the sustainable performance of CSCs.

Figure 6.1. shows the evolution of the concept of sustainable performance from Chapter 4 (right side) to Chapter 5 (left side). In this evolution it can be noticed that the

four main dimensions of sustainable performance were regrouped into two categories, corresponding to environmental-social performance and business performance. This refinement of the indicators was carried out in two stages during the development of Chapter 5. Firstly, during the questionnaire development, indicators adjustments were made during the pre-tests with experts and industry professionals, and subsequently, during the statistical analysis for the construct's validation. In the final version of these indicators (right side figure 6.1), it can be observed that for environmental-social performance, 2 social performance indicators and 4 environmental performance indicators were retained. Out of the 3 original social performance indicators list, the second indicator was eliminated during construct validation. On the other hand, out of the 4 environmental performance indicators, 2 of them were reformulated during the discussion with experts and industry professionals, namely, "scarce/polluting material consumption" and "compliance with environmental laws and regulations". Regarding economic and non-economic performances, these were consolidated into a single construct referred to as "business performance". The refinement of these indicators took place during the construct validation process in Chapter 5.

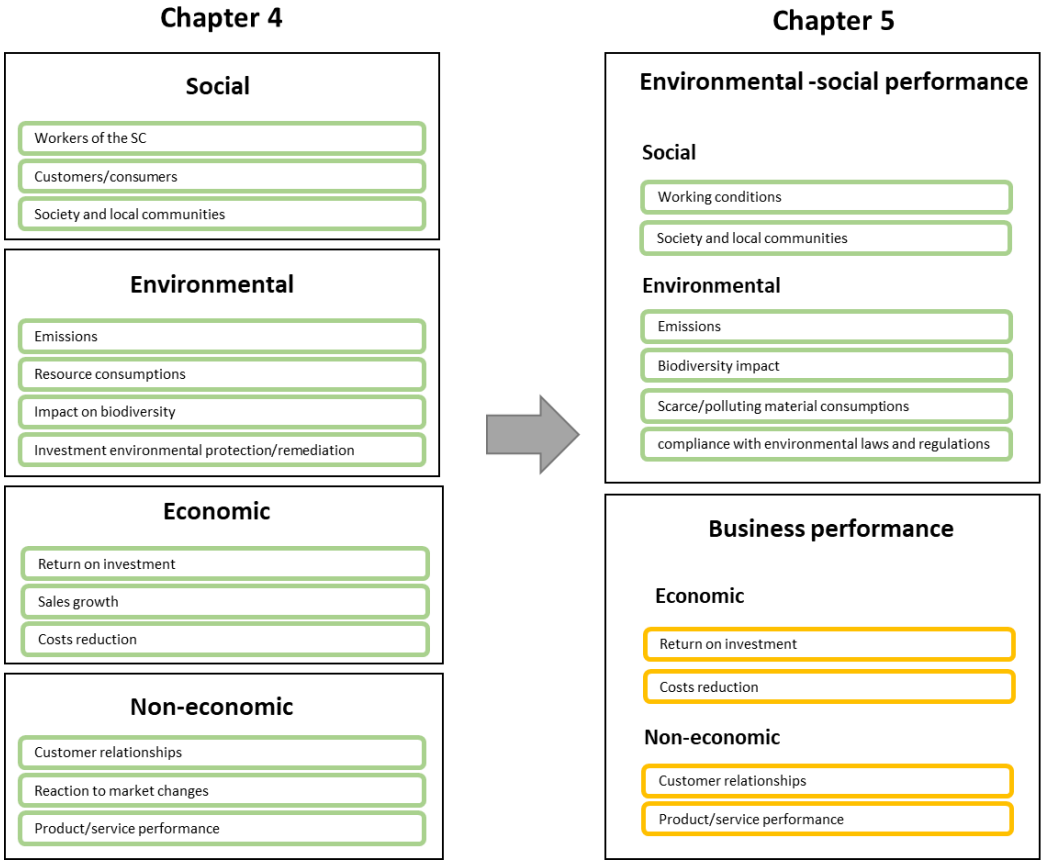


Figure 6.1. Evolution of the sustainable performance definition and indicators

6.2. Collaborative ecosystem in CSCs

Regarding collaboration, it was observed that it is a term discussed both in linear SCM literature and in circular SCM literature. However, the relationship between collaboration and SC performance is more developed in linear systems (Boughzala and De Vreede, 2015; Wu et al., 2014). While scholars in CE emphasize the need for further discussions on the implementation of collaboration in CSC to enhance sustainable performance (Saccani et al., 2023; Sudusinghe and Seuring, 2022).

Firstly, the collaboration concept was addressed in Chapter 3 with the study of collaborative ecosystems in the CE context. This chapter explored collaborative ecosystems in the transition to CE through a cross-sectional case study in the EEE industry in Portugal. These results showed the importance of collaboration among stakeholders in the EEE ecosystem to achieve the transition towards the CE. Participants in this case study emphasized the importance of open, sufficient and effective communication, as well as fostering long-term relationships and working cooperatively with other ecosystem players. Furthermore, this study shed light on the importance of external SC actors such as consumers, and the importance of developing a collective awareness towards sustainability transition; governments and policy makers, as facilitators and sources of change; and local organizations as generators of dialogue and collective initiatives in the region. Moreover, Chapter 3 allowed linking these key elements of the collaborative ecosystem with specific challenges of the case study, such as product traceability, the adaptation of European laws into local legislation, and the difficulty of establishing open and effective communication, as well as the establishment of a long-term collective strategy. Thus, offering a first approach on how collaborative strategies can facilitate the transition to the CE.

In the SCM literature, we found that collaboration can exhibit varying levels of maturity or development (Boughzala and De Vreede, 2015), which can impact its quality (Yan and Dooley, 2014) and potentially transform it into a competitive advantage (Cao and Zhang, 2011) for the SC. According to this, this research approached the collaboration quality as a multidisciplinary element. In Chapter 4, the indicators that make up the

collaboration quality concept were identified. Subsequently, these indicators were analyzed quantitatively in Chapter 5. Figure 6.2 illustrates the evolution of this concept between Chapter 4 and Chapter 5. Initially, in Chapter 4, the quality of collaboration was defined based on 5 indicators, which changed to 6 in Chapter 5. During the questionnaire development, the indicator "cooperation" was modified to "general collaboration" during tests conducted with experts and industry professionals. On the other hand, indicator 6, "Interdependency Symmetry," was added during the statistical analysis for the validation of constructs, supported by the study conducted by Zhang and Cao (2018), in which power symmetry integrates the concept of collaboration.

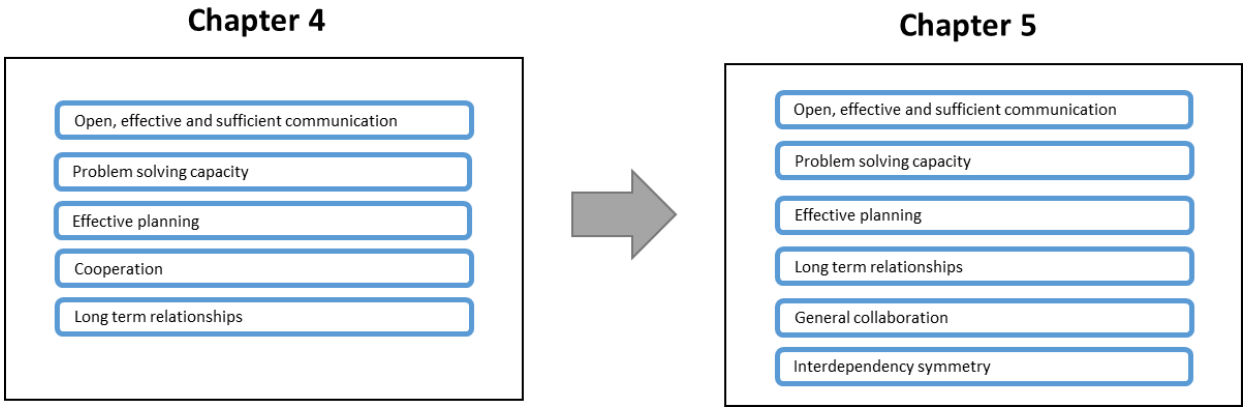


Figure 6.2. Evolution of the collaboration quality definition and indicators

6.3. Social behaviors within CSCs

Concerning the social behaviors among CSC stakeholders, this research took as a starting point the SET. This theory, based on 4 pillars (trust, commitment, reciprocity and power) was introduced in this work in chapter 4, in which through the literature review and multiple case studies it was possible to define the indicators that compose each of the pillars. In Chapter 4, we also defined the effects that these elements could have on the collaboration quality and sustainable performance of the CSC, considering the perspectives and motivations of industrialists, which would later be quantified in Chapter 5.

In the construction of the concepts and indicators of these four pillars in Chapter 4, it was observed that the trust pillar was much more addressed in the literature and understood in the industrial environment, compared to the pillars of reciprocity, commitment and power, especially when talking about the importance of having an

open and transparent dialogue between stakeholders and their reputation in all dimensions of sustainable performance. This emphasis on trust was later confirmed in Chapter 5, in which, during the statistical analysis for the confirmation of the constructs, it was evidenced that trust was the only SET pillar that could be validated for its subsequent integration in the final quantitative model.

Figure 6.3 depicts the evolution of the definition of trust between Chapter 4 and Chapter 5. Initially, the reputation indicator was subdivided into three sub-indicators, corresponding to each sustainability dimension during the questionnaire review with experts and industry professionals. Subsequently, "honesty" and "collective welfare awareness" indicators were removed during the construct validation in the quantitative analysis.

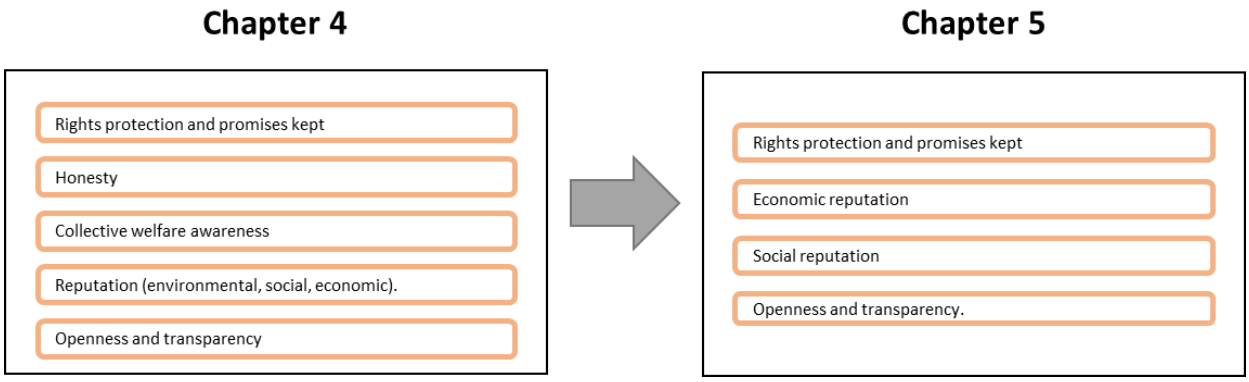


Figure 6.3. Evolution of Trust definition and indicators

6.4. Effects and Determinants of Collaboration, Social Behaviors and Sustainable Performance

The relationships and effects between social behaviors, collaboration quality, and the performance of CSCs were analyzed. First, qualitatively in Chapter 4 and second, quantitatively in Chapter 5. Chapter 4 presented a conceptual model as its main outcome, which is divided into two levels (micro and macro), encompassing the results obtained from literature review and multiple case studies. From the macro level, this model illustrates that the SET serves as an antecedent to the sustainable performance of CSCs, with the quality of collaboration acting as a partial mediator. This macro-level model also suggests that the SET may have a direct effect on sustainable performance with a moderating effect from CE strategies.

Subsequently, in Chapter 5, this model was partially evaluated, considering trust as the only element of SET. This quantitative analysis revealed that collaboration quality does not act as a mediator between trust and CSC performance, in contrast to studies in linear SC developed by Wu et al. (2014), Cao and Zhang (2011) and Yan and Dooley (2014). In these results, trust has a significant positive effect on both performance dimensions and collaboration quality, suggesting that the latter could be considered as a dimension of performance.

These results show that CSC performance success would be based on two criteria, efficacy and efficiency. On the one hand, we have sustainable performance as a principle of efficacy, which integrates the social, environmental and economic development of the CSC, i.e. the achievement of the objectives based on sustainability. On the other hand, we have the collaboration quality as an efficiency principle, in which the relationships between CSC partners are effective with respect to communication, problem-solving capacity, planning, long-term relationships, overall collaboration and interdependence symmetry. This success therefore integrates performance criteria of efficacy as well as efficiency, as suggested by (Bstieler, 2006; Le Dain et al., 2011; Wong and Cheung, 2005) in their evaluation of the performance of new product development collaborations as well as (Simatupang and Sridharan, 2005; Singh and Power, 2009; Sodhi and Son, 2009) in the context of linear SC. Figure 6.4. shows the final integration of all the elements that make up CSC performance success based on efficacy and efficiency.

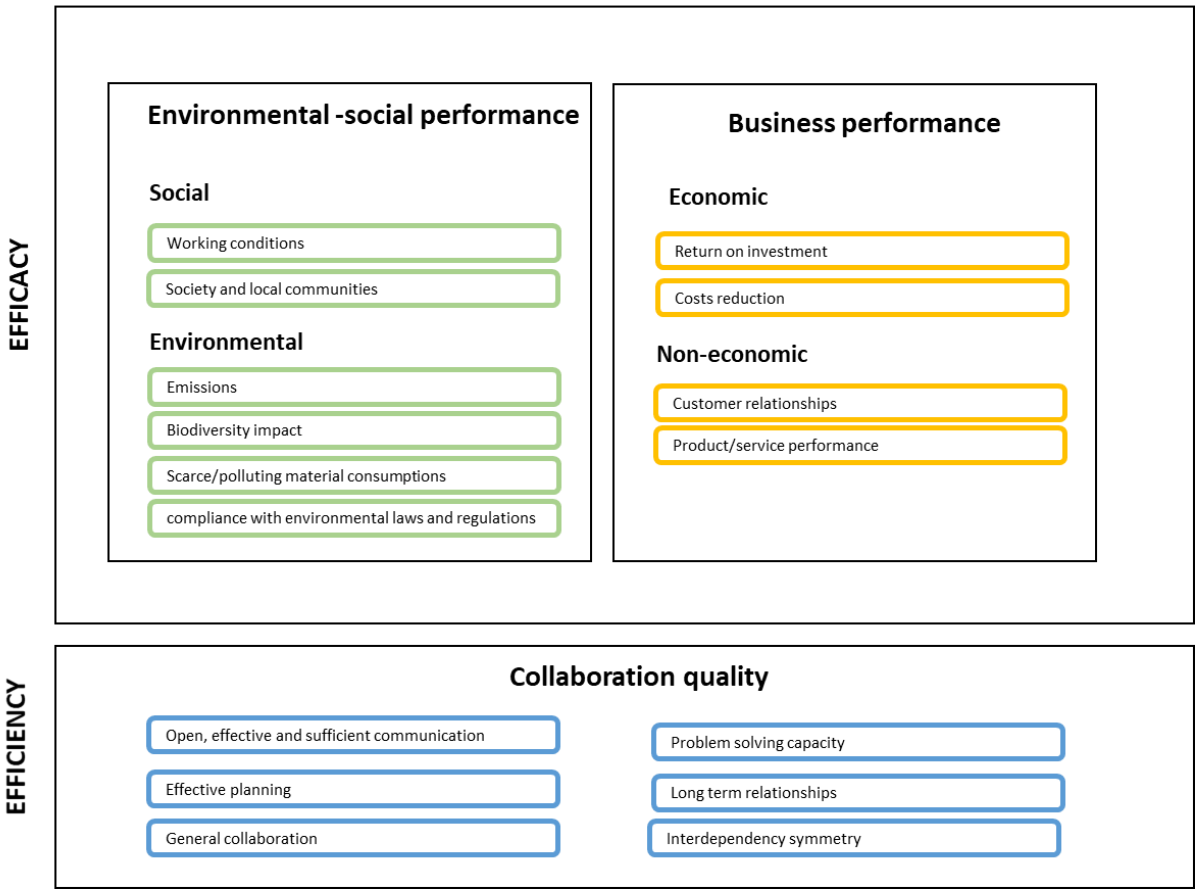


Figure 6.4. CSC performance success based on efficacy and efficiency.

Furthermore, the quantitative model also examined differences in responses based on the CE strategies (an element presented as a moderator in Chapter 4), but no statistically significant differences were found. Figure 6.5 illustrates the evolution of the macro-level conceptual model based on the results from Chapters 4 and 5. It is important to emphasize that this quantitative model represents a partial measurement of the effects of SET on collaboration quality and sustainable performance since only the trust construct is considered.

Figure 6.6 presents the final proposed model based on the quantitative results from Chapter 5. In this model, trust is presented as an antecedent to sustainable performance and collaboration quality, along with the final indicators associated with each construct (micro-level). In this final model, it can be observed that trust has a positive and significant effect on all three constructs.

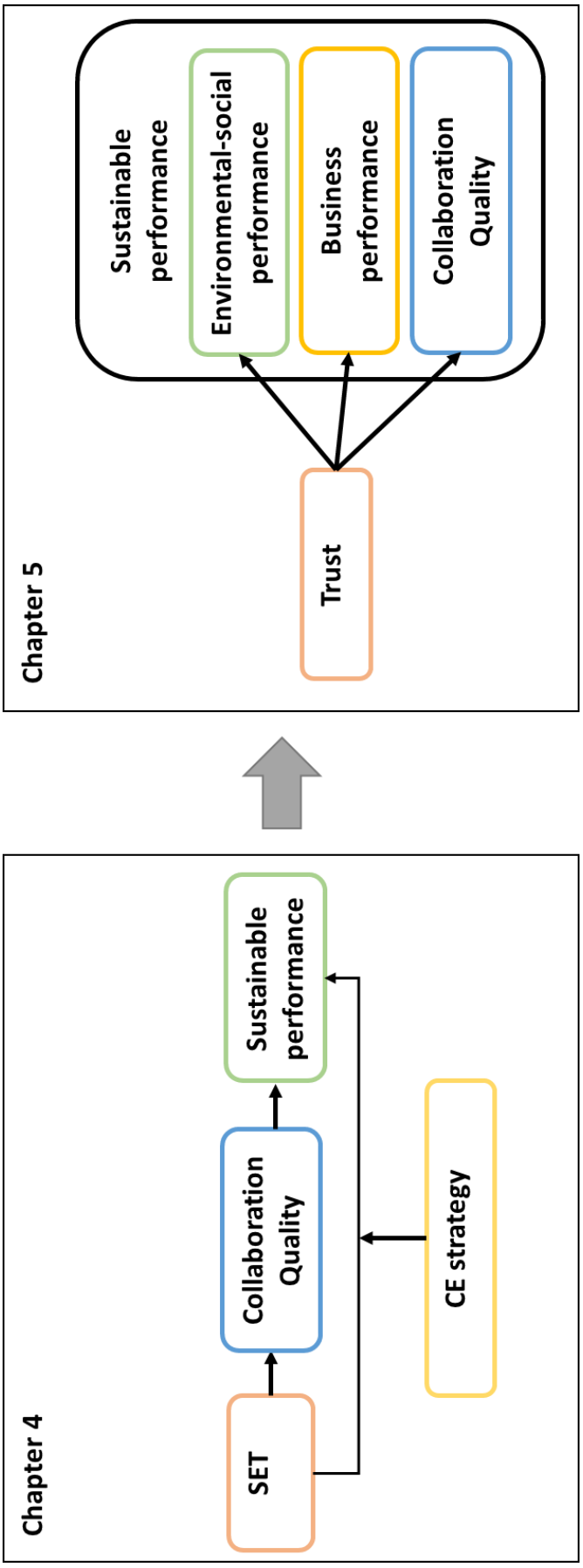


Figure 6.5. Evolution of the conceptual model

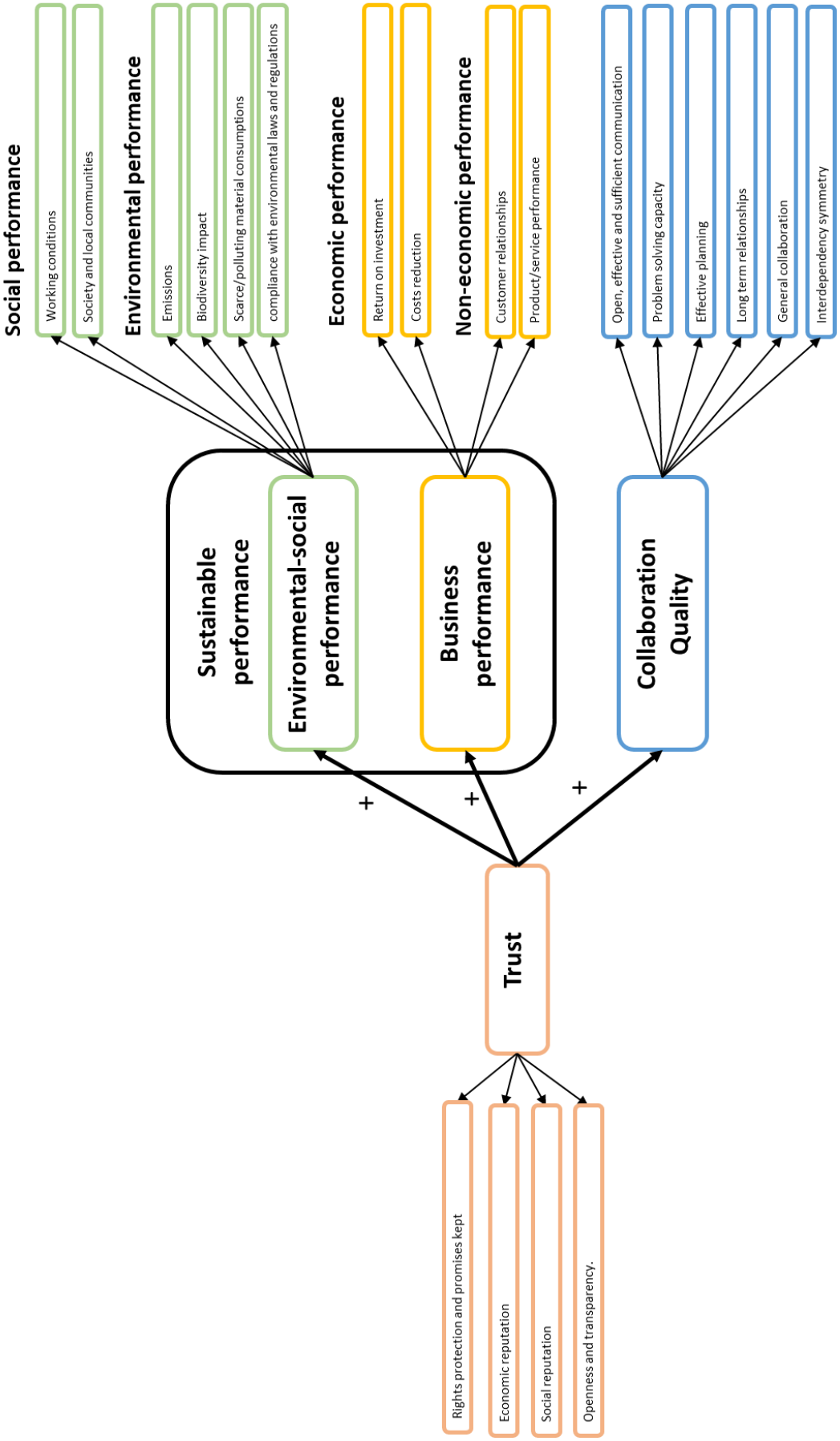


Figure 6.6. Final model proposition of trust and its influence on collaboration and sustainable performance

7. Conclusions

This section presents the thesis' theoretical and practical contributions and the opportunities for future research. This work explores the role of social behaviors in CSC and its influence on collaboration and sustainable performance. To carry out this research, the elements that make up the sustainable performance of CSC and collaboration were defined. Subsequently, the determinants of collaboration and social behaviors among stakeholders of the CSC were identified through the perspective of SET. Finally, the impact of these determinants on the sustainable performance of CSC was defined and subsequently quantified. In the early stages of our research, a conceptual model encompassing all dimensions of the SET was initially proposed (Chapter 4). However, as the analysis progressed, the primary focus shifted towards the examination of the effects of a single pillar, corresponding to trust (Chapter 5). By concentrating on trust as a fundamental element, valuable insights were gained into its impact on collaboration quality and sustainable performance in the context of the research.

Our final findings highlight the significant and positive impact of trust, specifically rooted in pillars such as rights protection and promise-keeping, the establishment of a solid economic and social reputation, and the fostering of openness and transparency among stakeholders. This suggests that trust is a key element in enhancing CE transition, specifically regarding sustainable performance and the collaboration quality within CSCs. These findings provide a valuable resource in this emerging field of literature, clarifying the effects of social behaviors on the collaboration and the sustainable performance of CSCs as well as the deployment of collaborative strategies to enhance sustainable performance in the practical field regarding industrialists and policy makers.

7.1. Theoretical contributions

The research makes significant theoretical contributions in the field of CSCM by enriching the concept of sustainable performance. While sustainability has been a focal point in SCM (Davis-Sramek et al., 2022), this research extends the understanding by encompassing all three dimensions of sustainability: social, environmental, and economic. By considering these dimensions comprehensively, the research lays the

foundation for a more holistic and nuanced perspective on sustainable performance in CSCM.

Furthermore, the study explores into the theoretical foundations of collaboration in the context of CSCM and its positive effects on enhancing sustainable performance. By exploring the mechanisms and dynamics of collaboration within CSCs, the research advances existing theoretical discussions. It sheds light on the intricacies of collaborative relationships among SC partners and how these collaborations can be leveraged to achieve sustainability goals. This insight contributes to a deeper understanding of the theoretical foundations of collaboration in SCM, particularly within the context of CE.

In addition to these contributions, the research enriches social behavior theories, specifically SET in a CE context. This expansion of SET within this context provides valuable insights into the social dynamics of CSCM. It enhances the understanding of stakeholder behaviors and interactions, contributing to a more comprehensive theoretical framework for managing relationships and exchanges in CSCs, which is vital for advancing sustainable practices and outcomes.

Finally, as another theoretical contribution, we find that collaboration is not a mediator between trust and the sustainable performance of the CSC, but is an element that integrates the sustainable performance of the CSC, which is also determined by trust. Therefore, these findings contradict the results presented in the linear SCM literature, in which collaboration is presented as a mediator between trust and SC performance.

7.2. Practical contributions

This work could serve as support for businesses, organizations and governments seeking to boost the sustainable development in their ecosystem, offering guidance in the decision-making process regarding the implementation of collaborative strategies, As well as in the design and implementation of sustainable policies.

First, by enriching the concept of sustainable performance in CSCM and considering all dimensions of sustainability (social, environmental, and economic), businesses could develop a more complete approach to sustainability. This practical insight might allow companies to create strategies that address multiple dimensions simultaneously,

promoting more responsible and sustainable SC practices. It could help organizations align their operational goals with sustainability targets, improving their overall performance, positively impacting the economy, the society and the environment.

The study's exploration of collaboration within CSCs and its positive effects on sustainable performance provides real-world guidance for SC practitioners. Businesses might implement collaborative strategies that enhance their sustainability efforts. This may involve forming partnerships, sharing resources, and jointly pursuing sustainable initiatives with SC partners. By leveraging these insights, organizations could build stronger and more resilient SC networks that contribute to reduced waste, enhanced resource efficiency, and increased economic and environmental benefits.

Lastly, the research contribution based on the study of social behaviors in the context of the CSC, particularly the SET, has practical implications for stakeholder management. Companies might use this understanding to develop more effective stakeholder engagement strategies, ensuring that stakeholders are aligned with the organization's sustainability goals and expectations. This, in turn, can lead to improved stakeholder relationships, which are critical for the successful implementation of sustainability practices. By fostering trust and mutually beneficial exchanges with stakeholders, businesses can gain their support and cooperation in achieving sustainability objectives, thus enhancing the practicality of CSCM.

7.3. Opportunities for future research

Future research in the field of CSCM ought to delve more profoundly into the ecosystem perspective and the external environment of SCs from a collaborative perspective. This includes a more comprehensive analysis of political, economic, technological, and social factors, as outlined in Chapter 3. For instance, researchers could explore the evolving awareness of consumers in the context of CE and the role of governments in shaping policy and regulations related to CSC on a collaborative ecosystem. Understanding how these collaborative external dynamics impact CSCM is crucial for developing strategies that can adapt to ever-changing environments and for preparing businesses to operate effectively in a world with increasing sustainability expectations.

Another approach for future research could be based on the application of longitudinal studies to analyze collaboration from a dynamic perspective. These studies could examine how collaborative relationships within CSCs evolve over time, considering elements such as adaptation to change and the involvement of all the key partners. This approach allows for a more in-depth understanding of the motivations and changing perspectives of the stakeholders. Understanding the dynamics of collaboration over time is essential for building sustainable and resilient CSC networks that continuously adapt to new challenges and opportunities.

This research can serve as a starting point for the development of more advanced practical guidance tailored for businesses and practitioners. Future research can take these insights and expand on the effects of collaboration and collective behaviors outlined in the thesis. These practical guidelines can be designed to help organizations navigate the complexities of sustainability, collaboration, and social behaviors within the SC. An integral aspect of this guidance should be the integration of collaborative strategies that not only enhance sustainability but also ensure the collective welfare of all stakeholders within the CSC. By promoting the well-being of all involved parties, these practical recommendations can significantly contribute to the successful implementation of CSC practices, fostering positive environmental, social, and economic outcomes. This collective welfare perspective will be crucial in transitioning to circular systems that are not only sustainable but also equitable and socially responsible.

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Résumé étendu

1. Introduction

L'économie circulaire est un modèle économique qui cherche à changer la façon dont les biens et les services sont produits, consommés et disposés. Elle repose sur l'idée de remplacer le modèle linéaire traditionnel par un système circulaire dans lequel les ressources sont utilisées le plus longtemps possible et leur valeur est maximisée (EMF-Ellen MacArthur Foundation, 2013). L'économie circulaire ne se limite pas aux aspects environnementaux, mais présente également d'importantes opportunités économiques et sociales, telles que la création d'emplois, la promotion de l'innovation et la réduction des coûts à long terme, qui sont étroitement liées au concept de développement durable (Korhonen et al., 2018). Selon Niang et al. (2020), l'économie circulaire est associée à une forme renouvelée d'opérationnalisation du concept de soutenabilité ou de développement territorial durable, qui mérite une adaptation locale des principes du développement durable, basée sur l'articulation entre les domaines économique, social et environnemental, élargie à la gouvernance locale et à la recherche d'externalités positives. Sur cette base, cette étude se concentre sur le concept de développement soutenable.

Le développement soutenable est fondé sur l'équilibre de 3 dimensions principales (économique, sociale et environnementale) (Walker et al., 2021b), cependant, l'attention portée à ces dimensions est actuellement partielle, laissant généralement de côté la dimension sociale (Corona et al., 2019; Kristensen and Mosgaard, 2020).

La littérature soutient que la supply chain est l'unité d'action clé en ce qui concerne la mise en œuvre et la réussite de l'économie circulaire et qu'elle constitue la base pour conduire les changements nécessaires (Hazen et al., 2020). En effet, l’application de l'économie circulaire doit adapter les systèmes économiques conventionnels à différents niveaux en impliquant toutes les parties prenantes pour déployer une stratégie qui soutient véritablement le développement soutenable (Asgari and Asgari, 2021).

Plusieurs auteurs ont montré le besoin d'une collaboration solide entre les parties prenantes au sein de la supply chain pour parvenir à des modèles circulaires (Hazen et al., 2020). De même, l'engagement de partenaires au-delà des frontières de la supply chain a été reconnu comme essentiel pour la mise en œuvre de l'économie circulaire (Sudusinghe and Seuring, 2022). Les études sur le changement progressif vers l'économie circulaire soulignent le besoin d'une collaboration multipartite (Saccani et al., 2023; Sudusinghe and Seuring, 2022). Toutefois, peu d'études donnent un aperçu de la manière dont la collaboration entre les parties

prenantes peuvent influencer la performance soutenable d'une supply chain circulaire, et peu d'entre elles offrent des conseils pratiques aux parties prenantes pour qu'elles s'engagent dans de tels processus de collaboration (Hazen et al., 2020; Saccani et al., 2023; Wielopolski and Bulthuis, 2023). Notamment les éléments de la collaboration qui faciliteraient la transition vers des modèles circulaires plus performants n'ont pas encore été étudiés.

Dans le domaine du management de la supply chain conventionnelle, la théorie de l'échange social est une théorie qui a été souvent mobiliser pour expliquer les relations entre les individus au sein de la supply chain (Wong and Cheung, 2005). Le principal mérite de cette théorie est de mettre en exergue l'incapacité de l'approche strictement économique pour analyser les relations d'échanges et propose un cadre d'analyse étendu pour observer les différentes manifestations de l'échange notamment sociales. Les manifestations de cet échange social mobilisées dans la littérature sont la confiance, l'engagement, la réciprocité et le pouvoir (Wu et al., 2014). Par conséquent, la théorie de l'échange social a gagné en pertinence en permettant de mieux comprendre la collaboration entre les partenaires d'une supply chain et la manière dont la dynamique de leurs relations évolue au fil du temps (Can Saglam et al., 2022).

Parallèlement, dans la littérature sur l'économie circulaire, plusieurs auteurs ont mentionné individuellement différents éléments de la théorie de l'échange social, tels que le pouvoir (González-Sánchez et al., 2020; Kapsalis et al., 2019; Kirchherr et al., 2018; Leigh and Li, 2015; Masi et al., 2017), l'engagement (Kapsalis et al., 2019; Liu et al., 2018; Paavilainen et al., 2021; Saccani et al., 2023; Tobin and Zaman, 2022; Veleva and Bodkin, 2018; Wielopolski and Bulthuis, 2023; Yadav et al., 2020), la confiance (Allais, 2015; Beske and Seuring, 2014; Carter and Rogers, 2008; Masi et al., 2017; Paavilainen et al., 2021; Tobin and Zaman, 2022), et la réciprocité (Can Saglam et al., 2022; Davlembayeva et al., 2021; Jones and Tobin, 2018; Tobin and Zaman, 2022), en tant qu'éléments influençant la collaboration entre les partenaires des supply chains circulaires. Toutefois, ils n'ont pas considéré l'ensemble de ces éléments comme un groupe de facteurs interdépendants qui peuvent influencer conjointement la collaboration entre les partenaires et, à leur tour, avoir un effet sur la performance soutenable de la supply chain.

2. Questions de recherche et méthodes

En considérant le rôle de la collaboration dans la supply chain circulaire et son influence sur la performance soutenable à travers la perspective de la théorie de l'échange social, la présente thèse aborde les questions de recherche suivantes :

I. Qu'est-ce que la performance soutenable dans le contexte de la supply chain circulaire ?
II. Qu'est-ce qu'un écosystème collaboratif dans le contexte de la supply chain circulaire ?
III. Quels sont les déterminants de la collaboration dans une supply chain circulaire ?
IV. Comment ces déterminants influencent-ils la performance soutenable de la supply chain circulaire ?

Pour répondre à l'objectif de cette étude de *"construire un modèle qui explique comment la collaboration des acteurs au sein d'une supply chain circulaire influence leur performance soutenable* ", cette thèse adopte une approche mixte qui intègre des analyses qualitatives et quantitatives à différentes phases de la recherche. En adoptant une telle approche, nous cherchons une complémentarité entre les points forts de chaque méthode au regard de leurs limites, ce qui permet d'obtenir une vision plus complète et holistique du phénomène étudié (Driscoll et al., 2007; Lund, 2012). Afin d'obtenir une saturation des données, la validation croisée de différentes sources de données et la compréhension du contexte par le biais de multiples études de cas sont appliquées à plusieurs étapes de cette recherche (Gustafsson, 2017).

3. Structure de la thèse

Ce travail de recherche est structuré en quatre étapes. Chacune des étapes correspond à un des objectifs de la thèse et donne lieu à un article soumis à une évaluation par des pairs. Les relations entre les articles, les questions de recherche, les objectifs et les méthodes sont présentées dans le Table 1.

Table 1. *Structure de la thèse par articles*

Articles	Question de recherche	Objectifs de recherche	Méthodes
1	Qu'est-ce que la performance soutenable dans le contexte de la supply chain circulaire ?	Définition de la performance durable dans le contexte de la supply chain circulaire, en tenant compte des trois dimensions de la soutenabilité.	Analyse systématique de la littérature
2	Qu'est-ce qu'un écosystème collaboratif dans le contexte de la supply chain circulaire ?	Définition des écosystèmes collaboratifs dans le contexte de la supply chain circulaire	Analyse de la littérature et étude de cas transversale

3	Quels sont les déterminants de la collaboration dans une supply chain circulaire ?	Identification des déterminants de la collaboration entre les parties prenantes dans les supply chains circulaires à travers la théorie de l'échange social	Étude qualitative : Analyse systématique de la littérature et 10 études de cas
4	Comment ces déterminants influencent-ils la performance soutenable de la supply chain circulaire ?	Déterminer l'impact des déterminants de la collaboration sur la performance soutenable des supply chains circulaires	Étude quantitative : enquête et analyse statistique par modélisation des équations structurelles

La Figure 1 montre comment ces articles sont liés les uns aux autres, couvrant les différents domaines de recherche de la thèse. Cette figure correspond au modèle conceptuel sur lequel repose cette thèse, composé de 4 construits, correspondant à des variables indépendantes, telles que la théorie de l'échange social et les stratégies d'économie circulaire, et à des variables dépendantes, correspondant à la collaboration des parties prenantes de la supply chain circulaire et à la performance soutenable. L'article 1 décrit les variables dépendantes à travers une revue systématique de la littérature sur la performance soutenable. L'article 2 présente la collaboration dans l'écosystème de la supply chain circulaire au moyen d'une étude de cas. L'article 3 se concentre sur la définition des variables indépendantes telles que les piliers de la théorie de l'échange social et les stratégies d'économie circulaire, puis décrit les interactions possibles entre les quatre concepts à l'aide d'une analyse documentaire et de dix études de cas afin de présenter un premier modèle conceptuel. Enfin, dans l'article 4, ce modèle théorique est évalué par une analyse quantitative basée sur une étude empirique.

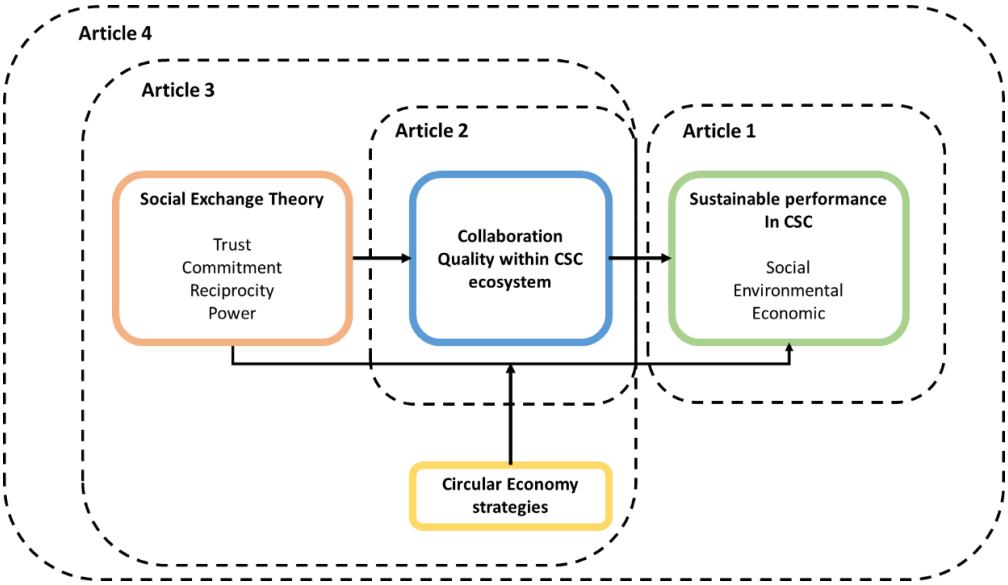


Figure 1. Relation entre les articles de la thèse

Article 1. " Sustainable performance of circular supply chains: A literature review".

Article présenté dans "29th CIRP Life Cycle Engineering Conference. Leuven 4-6 April 2022".

Cet article vise à comprendre le concept de performance soutenable des supply chains circulaires et à analyser les différentes méthodes de mesure existant dans la littérature. Grâce à une revue systématique de la littérature, 23 articles académiques et 2 rapports de littérature grise correspondant à des indicateurs et des méthodes d'évaluation de la performance soutenable des CSC ont été examinés, en considérant les 3 dimensions de la soutenabilité (sociale, économique et environnementale). Les articles sélectionnés ont été étudiés en fonction de l'unité d'analyse évaluée, des dimensions de durabilité couvertes, des parties prenantes impliquées et des stratégies d'économie circulaire abordés. Les résultats de cet article ont permis de définir les dimensions soutenables de la performance et de classer les indicateurs et les méthodes d'évaluation en fonction des dimensions correspondantes de la soutenabilité, qui sont ensuite utilisées pour les articles 3 et 4.

Article 2. *"The Collaborative Ecosystem in the Circular Economy Context: Electrical and Electronic Equipment Value Chain".*

Article présenté dans "30th EurOMA Conference. Leuven 3-5 July 2023".

Cet article explore l'écosystème collaboratif de la chaîne de valeur des équipements électriques et électroniques dans le contexte de l'économie circulaire et identifie les facteurs clés qui facilitent écosystème collaboratif à l'aide d'une étude de cas transversale d'un distributeur des équipements électriques et électroniques au Portugal. Ce travail identifie les éléments qui composent la collaboration et un écosystème favorable dans la littérature de l'économie circulaire. Ensuite, à travers l'étude de cas, les motivations derrière ces éléments sont étudiées, ainsi que la relation avec les défis de cette industrie dans la transition vers l'économie circulaire. Les résultats de cet article sont ensuite utilisés pour les articles 3 et 4.

Article 3. *"Exploring determinants of Collaboration in Circular Supply Chains: A Social Exchange Theory Perspective".*

Article soumis dans le journal "Sustainable Production and Consumption".

Cet article vise à présenter l'ensemble des déterminants de la collaboration dans les supply chains circulaires sous la perspective de la théorie de l'échange social, et leur influence sur la performance soutenable de la supply chain circulaire, sur la base d'un modèle conceptuel construit à partir d'une revue systématique de la littérature et de 10 études de cas des entreprises européennes. Tout d'abord, les résultats de l'analyse documentaire sont présentés afin de définir les variables qui constituent les piliers de la théorie de l'échange social

(confiance, engagement, réciprocité et pouvoir) et la qualité de la collaboration. Puis ces données sont confrontées avec 10 études de cas d'entreprises qui appliquent des stratégies dans le domaine de l'économie circulaire. Ensuite, les effets de la collaboration sur la performance soutenable des supply chains circulaires sont démontrés de manière qualitative et enfin un modèle théorique est proposé qui met en évidence les effets de la théorie de l'échange social et de la qualité de la collaboration sur la performance soutenable des supply chains circulaires. Le modèle théorique résultant de cet article est ensuite utilisé pour l'analyse quantitative de l'article 4.

Article 4. "*Exploring the effects of Trust in Collaboration and Sustainable Performance of Circular Supply Chains"*

Article soumis au journal **"***International Journal of Production Economics"*

Cet article vise à préciser l'impact des déterminants de la confiance et de la collaboration sur la performance soutenable des supply chains circulaires. Pour cet article, nous adoptons le modèle théorique proposé dans l'article 3 dans une approche partielle, en nous concentrant uniquement sur les effets de la confiance sur la qualité de la collaboration et la performance soutenable de la supply chain circulaire. Grâce à une enquête menée auprès de 390 industriels du Canada, de France et du Portugal, le modèle a été testé à l'aide de la modélisation par équations structurelles. Cet article prouve l'effet positif et significatif de la confiance sur la performance et la qualité de la collaboration des supply chains circulaires. Cela valide partiellement notre modèle initial et prouve que les comportements sociaux des supply chains circulaires affectent positivement leur performance soutenable et la qualité de la collaboration entre les différentes parties prenantes.

4. Résultats et discussions

Sur la base de l'assemblage des 4 articles qui composent cette thèse, les résultats sont présentés par la suite. En ce qui concerne la définition de la performance soutenable, la littérature montre que c'est un concept complexe et multifacette, étroitement lié à des termes tels que la transition circulaire (Farooque et al., 2019), la mise en œuvre de l'économie circulaire (Sudusinghe and Seuring, 2022), la compétitivité en termes de durabilité (Allais and Gobert, 2016) et l'accomplissement des objectifs de développement soutenable selon Les Nations Unies (United Nations, 2015). Cependant, sa définition demeure sujette à différentes interprétations et domaines d'application en raison de la variété des définitions et des méthodes de mesure présentes dans la littérature et la pratique. Cette recherche a tenté de parvenir à une définition commune de la performance soutenable en prenant en compte ses dimensions économiques, environnementales et sociales, en utilisant des indicateurs clés

définis dans les chapitres 2, 4 et 5, pour ensuite quantifier l'impact de la confiance sur la qualité de la collaboration et la performance soutenable des supply chains circulaires.

En ce qui a trait à la collaboration, il a été observé que ce terme est discuté à la fois dans la littérature sur la supply chain linaire et circulaire. Cependant, la relation entre la collaboration et la performance de la supply chain est plus développée dans les systèmes linéaires (Boughzala and De Vreede, 2015; Wu et al., 2014). Alors que les chercheurs en économie circulaire soulignent la nécessité de discussions supplémentaires sur la mise en œuvre de la collaboration dans la supply chain circulaire pour améliorer la performance soutenable (Saccani et al., 2023; Sudusinghe and Seuring, 2022). Dans la littérature, il a été constaté que la collaboration peut présenter différents niveaux de maturité (Boughzala and De Vreede, 2015), ce qui peut influencer sa qualité (Yan and Dooley, 2014) et potentiellement la transformer en avantage concurrentiel (Cao and Zhang, 2011). En conséquence, cette recherche aborde la qualité de la collaboration comme un élément multidisciplinaire. Au chapitre 4, les indicateurs composant le concept de qualité de la collaboration ont été identifiés, et ces indicateurs ont été analysés quantitativement au chapitre 5.

En ce qui concerne les comportements sociaux parmi les acteurs des supply chains circulaires, cette recherche se base sur la théorie de l'échange social. Cette théorie, qui repose sur quatre piliers (la confiance, l'engagement, la réciprocité et le pouvoir), est introduite dans ce travail au chapitre 4. Grâce à une revue approfondie de la littérature et à de multiples études de cas, l'étude identifie des indicateurs spécifiques pour chacun de ces piliers. Au chapitre 4, l'étude détaille également les impacts potentiels de ces facteurs sur la qualité de la collaboration et la performance soutenable des supply chains circulaires, en prenant en compte les perspectives et motivations des acteurs industriels. Le chapitre 5 quantifie ces effets. Il est important de noter qu'au cours de l'élaboration des indicateurs pour ces quatre piliers au chapitre 4, la confiance émerge comme l'élément le plus largement discuté et compris dans la littérature et le contexte industriel, en particulier en ce qui concerne l'importance d'un dialogue transparent entre les acteurs. Cette emphase sur la confiance est confirmée au chapitre 5 par le biais d'analyses statistiques, qui confirment la confiance comme le seul pilier de la théorie de l'échange social validé en vue de son intégration dans le modèle quantitatif final.

En ce qui concerne les effets et relations entre les comportements sociaux, la qualité de la collaboration et la performance des supply chains circulaire, une analyse qualitative a été effectuée au chapitre 4, suivie d'une analyse quantitative au chapitre 5. Le chapitre 4 a présenté un modèle conceptuel comme principal résultat, divisé en deux niveaux (micro et macro), englobant les résultats issus de la revue de la littérature et de multiples études de cas. À un niveau macro, ce modèle illustre que la théorie de l'échange social agit comme un

antécédent de la performance soutenable et la qualité de la collaboration agissant comme médiateur partiel. Ce modèle macro suggère également que la théorie de l'échange social peut avoir un effet direct sur la performance soutenable, avec un effet modérateur des stratégies d'économie circulaire.

Par la suite, au chapitre 5, le modèle a été partiellement évalué, en considérant la confiance comme le seul élément de la Théorie de l'Échange Social à prendre en compte. Cette analyse quantitative a révélé que la qualité de la collaboration ne joue pas le rôle de médiateur entre la confiance et la performance soutenable, contrairement à certaines études menées dans le contexte des supply chains linéaires (Cao and Zhang, 2011; Wu et al., 2014; Yan and Dooley, 2014). Dans ces résultats, la confiance a un effet positif significatif sur la performance soutenable et la qualité de la collaboration, suggérant que cette dernière peut être considérée comme une dimension de la performance. De plus, le modèle quantitatif a examiné les différences de réponses en fonction des stratégies d'économie circulaire (un élément présenté comme un modérateur au chapitre 4), mais aucune différence statistiquement significative n'a été trouvée. La Figure 2 montre le modèle final proposé dans ce travail de thèse, dans lequel les trois principaux concepts et les indicateurs qui les composent sont représentés.

5. Conclusions

En conclusion, Ce travail de recherche explore le rôle des comportements sociaux dans les supply chains circulaire et leur impact sur la collaboration et la performance soutenable. Il met en évidence l'importance cruciale de la confiance dans ces relations, démontrant son influence positive sur la qualité de la collaboration et la performance soutenable des supply chains circulaires.

En tant que principale implication théorique, ces résultats explorent la relation entre les comportements de collaboration et le succès des supply chains circulaires dans le cadre d'une approche de performance soutenable, enrichissant ainsi la discussion académique sur la mise en œuvre et l'amélioration des collaborations par le biais d'actions dans les supply chains circulaires afin d'améliorer la performance soutenable. En ce qui concerne les implications pratiques, ce travail peut guider les managers et les responsables politiques dans leur prise de décision sur la sélection des pratiques de collaboration appropriées pour stimuler la performance soutenable des supply chains circulaires.

Les limites du chapitre 2 sont inhérentes à une analyse documentaire. Cette analyse a été réalisée en 2021. Cela signifie que les résultats peuvent être mis à jour à l'aide d'une littérature plus récente. D'autre part, cette analyse documentaire est principalement composée de

publications scientifiques, ce qui pourrait suggérer qu'il existe d'autres moyens, tels que la littérature grise.

En ce qui concerne le chapitre 3, dans l'étude de cas transversale, il n'a pas été possible de réaliser des entretiens avec tous les acteurs de l'écosystème, ce qui a limité l'accès à une vision globale, prenant en compte toutes les interactions et tous les points de vue des parties prenantes.

Concerne le chapitre 4, en raison de son caractère exploratoire et de la taille limitée des études de cas, toutes les stratégies d'économie circulaire et tous les participants à ces supply chains circulaires n'ont pas été couverts dans les études de cas, ce qui signifie que les aspects collaboratifs des supply chains circulaires ne sont que partiellement décrits. Finalement, dans le chapitre 5, la principale limite est liée à la complexité du modèle, en raison de la complexité élevée de l'ajout de tous les concepts au test quantitatif final. Des recherches supplémentaires peuvent être menées en intégrant progressivement plus de concepts à ce modèle afin d'avoir une vision intégrale des relations de collaboration dans les supply chains circulaires.

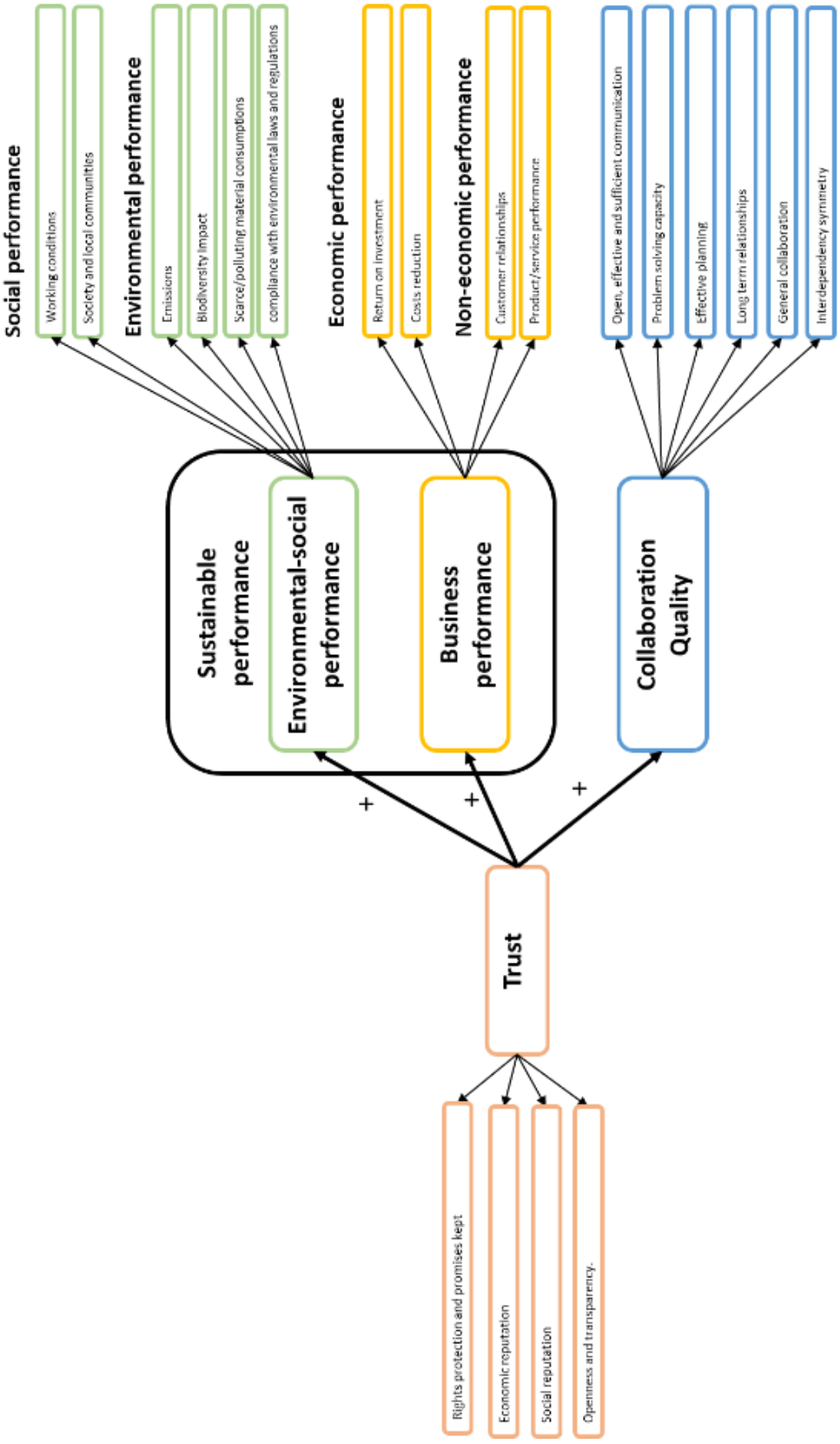


Figure 2. Final model proposition of trust and its influence on collaboration and sustainable performance