

Deusto Business School

PhD Programme in Business and Territorial Competitiveness, Innovation and Sustainability

Unravelling Traceability and Transparency for Sustainable Apparel-Fashion Supply Chains: A Mixed-Methods Approach

PhD dissertation

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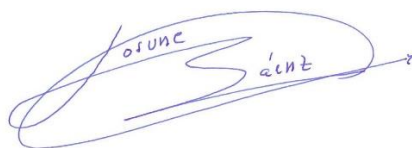
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and

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Dedication

*A Jaime, Mencía, Emma y Rafa,
por alegrarme la vida
y por dar sentido
a cada segundo invertido
en construir un mundo mejor.*

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*Yo soñaba cada día poder alcanzar la playa
Y ahora está tan cerca, casi ya la puedo oler
Y espero cada vez más próximo al final
Ya puedo sentir tierra seca tras la arena mojada*

*Y no me da la gana de pensar que nada es para siempre
Si esta canción se acaba que acabe el mundo para todos
Todos somos nada sin las palabras dime qué nos queda*

*Y vuelven algunas rimas a mi mente cansada
Partes de guiones que creía olvidadas
Melodías que una vez pensé que iba a perder
Se tornan ahora bellas y valientes sinfonías*

*Y hace tiempo que yo ya me fui, yo siempre me estoy yendo
Pero siempre estoy contigo, aunque a veces pienses que no hay nada
Cuando me quedo mirando como si estuviera ausente
Es porque estoy viajando, no pienses que voy a perderme*

*Sí, ya sé que el mundo seguirá girando cuando ya no quede nada
Y nosotros vaguemos por la historia como simples hombres solitarios
Reyes que perdieron todo, todo lo que tanto amaban por quererlo demasiado*

*Y lo intento cada día ser todo lo que había imaginado
Y me encuentro que la vida siempre tiene algo preparado
Que supera cualquiera de mis fantasías
Nada comparado con lo que realmente sucedía*

*Yo soñaba cada día poder alcanzar la playa
Yo soñaba cada día poder alcanzar la playa*

Tierra. Xael López, 2012

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List of Abbreviations

ASSOC: Number of Associations
CB-SEM: Covariance-Structural Equation Modelling
COLLRP: Collaborative Relationships
CSR: Corporate Social Responsibility
DC: Dynamic Capability
ECPF: Economic Performance
ENVPF: Environmental Performance
SOCPF: Social Performance
EU: European Union
FWF: Fair Wear Foundation
GFA: Global Fashion Agenda
IPT: Information-processing theory
ISO: International Organization for Standardization
IT: Information Technology
NACE: Nomenclature of Economic Activities
NGO: Non-Governmental Organizations
PLS-SEM: Partial Least Squares-Structural Equation Modelling
PV: Practice-Based View
RBV: Resource-Based View
RMG: Ready-Made Garments
RV: Relational View
SABI: Iberian Balance Sheet Analysis System
SAC: Sustainable Apparel Coalition
SC: Supply Chain
SCM: Sustainable Chain Management (sometimes referred to as 'traditional' Supply Chain Management)
SCPV: Supply Chain Practice View
SDGs: Sustainable Development Goals
(S)SCM or SSCM: (Sustainable) Supply Chain Management (or Sustainable Supply Chain Management)
TBL: Triple Bottom Line
TTfS or TfS: Traceability and Transparency for Sustainability
TRACE: Traceability
TRANSP: Transparency
UN: United Nations
VIF: Variance Inflation Factor
VRIN: Valuable, Rare, Inimitable, and Non-substitutable

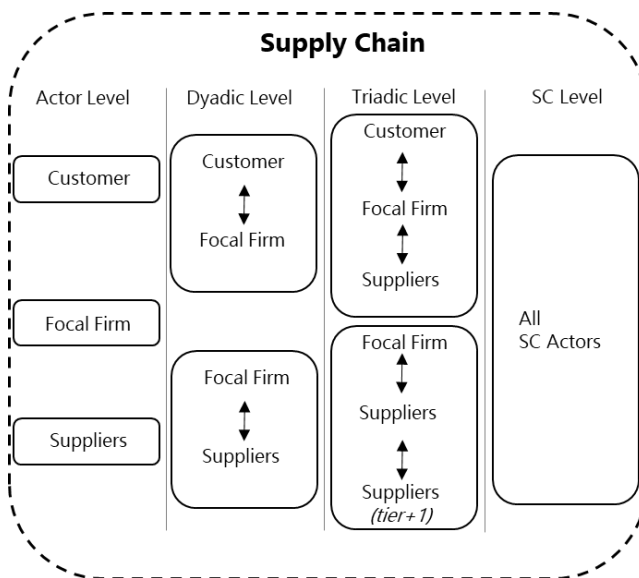
Key Terms

Fashion-Apparel Supply Chain: The SCs that encompass all the processes involved in “the manufacture, distribution, sale and use of fashion clothing” (Pal & Gander, 2018, p. 252), from the raw materials to the distribution and sale of fashion garments in the market (Gereffi & Korzeniewicz, 1994). The fashion component (as opposed to standardized garments) lies in the fact that products change according to retail seasons and collection calendars (Gereffi & Korzeniewicz, 1994) and that those products are sold under a brand name (Brun & Castelli, 2008).

Focal companies: “Those companies [in the supply chain] that usually (1) rule or govern the supply chain, (2) provide the direct contact to the customer, and (3) design the product or service offered” (Seuring & Müller, 2008b, p. 1699).

Level of analysis: The primary level of analysis of this doctoral research is the SC, understood as the aggregate of organizational levels or polyadic relationships within the chain. Although SCs are the aimed level of analysis, at some points it is only inferred from information gathered at a lower level. Figure 1 below summarizes the continuum from the organizational to the SC level of analysis.

Figure 1. Main levels of analysis in SC research



Stakeholders play a key role in this research project. They include both traditional stakeholders, also named SC actors, i.e., those actors with contractual relationships as focal companies (retailers), (multi-tier) suppliers/service providers and customers, and non-traditional stakeholders, also named non-SC actors or societal stakeholders, i.e., actors without contractual relationships such as NGOs, media or environmental networks.

Supply Chain: Business structures that “encompass all activities associated with the flow and transformation of goods from raw materials stage (extraction), through to the end user, as well as the associated information flows” both up and down the supply chain, integrating both traditional and non-traditional SC actors into the same ecosystem. (Garcia-Torres et al., 2019; Seuring & Müller, 2008b, pp. 1699, 1700).

(Non-traditional) SC actors: Stakeholders without contractual/commercial relationships but that can affect or be affected by the activity and objectives of the SC (e.g., NGOs, media, civil society, environment and environmental networks, etc.) (Freeman & Reed, 1983).

(Traditional) SC actors: Stakeholders with contractual/commercial relationships such as suppliers, focal companies and customers.

Sustainable Supply Chain: This doctoral research borrows Pagell & Wu (2009)’s definition of sustainable supply chain as the one that “would at worst do not net harm to natural or social systems whilst still producing a profit over an extended period of time; [a supply chain that] could, customers willing, continue to do business forever. (Pagell & Wu, 2009, p. 38).

Sustainability: In keeping with the Brundtland Report’s definition of sustainability development as development “that meets the needs of the present without compromising the ability of future generations to meet their own needs” (UN General Assembly, 1987), and operationalized through Elkington’s triple-bottom line (TBL) concept, sustainability is understood in this doctoral research as (the strategy to and outcome from) balancing three dimensions –environmental, social and economic with none of these compromised for the benefit of the others (Elkington, 1998).

(Sustainable) Supply Chain Management is understood in this doctoral project as the strategic and transparent management of companies and material, information and capital flows and cooperation among SC actors to address environmental, social and economic aspects derived from customer and other stakeholder requirement, to simultaneously achieve competitive advantages and (at least) a neutral effect on the natural and social environment (Carter & Rogers, 2008; Pagell & Wu, 2009; Seuring & Müller, 2008b).

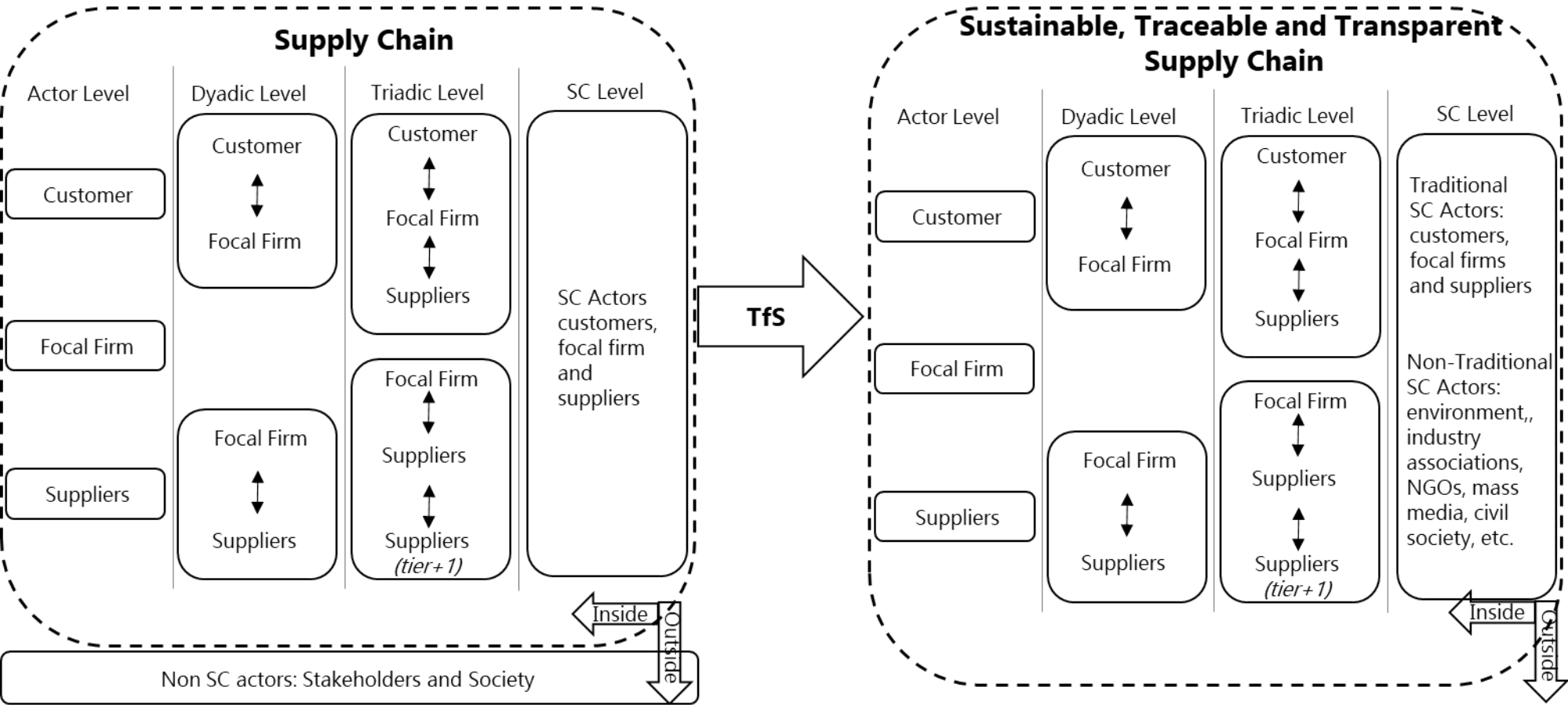
The Traceability and Transparency for Sustainability (TfS) macro-concept represents the focus of this doctoral work and is understood as “traditional” traceability when coupled with the aim of achieving transparent, sustainable and responsible networks (Closs et al., 2011). Although originally delimited to traceability, as typical from mixed-methods studies, this macro-concept has ended up embracing transparency as an essential and core element which, in an intricate relation with traceability, aims to achieve SC sustainability. Thus, TfS is defined as the ability to combine

SC information-sharing and visibility in such a way that actors within the chain have access to information that is accurate, trusted, timely and useful for operational reasons and to ensure the reliability of sustainability claims. SC traceability allows retracing steps back and forward and verifying the processes, history and locations of the products under consideration (Barratt and Oke, 2007, p. 1218; Brandon-Jones et al., 2014; Fawcett et al., 2011). SC transparency is defined as “acting in a way that enables others, both internal and external stakeholders, to perceive and understand what the company does, as well as the quality disclosure of the information needed for this” (Gold and Heikkurinen, 2018, p. 321).

Table 1. Main Existing/initial vs. new/proposed/operationalized definitions (i.e., this doctoral project's outcomes)

Definitions	Existing/initial definitions	New/proposed/operationalized definitions
Sustainability	"Sustainability refers to the need to address and manage issues across economic, social, and environmental dimensions in a balanced and integrated manner" (Reefke and Sundaram, 2017, p. 195).	(Positive) outcome of optimizing and managing the economic (including governance), social and environmental dimensions of any activity with a strategic, integrated and transversal approach. The above definition gives rise to the 'sustainability strategy' concept. In this research, both CSR and (S)SCM are understood as the two broad interrelated sustainability strategies.
(Traditional) traceability	"The ability to trace the history, application or location of a product in relation to the origin of its materials and parts; the processing history; and the distribution and location after delivery" (International Organization for Standardization, 2000).	
Traceability (with a sustainable aim)	"The ability to identify and trace the history, distribution, location and application of products, parts and materials to ensure the reliability of sustainability claims in the areas of human rights, labour (including health and safety), the environment and anti-corruption" (United Nations Global Compact Office, 2014, p. 6).	An organization's ability to identify and control the trajectory and conditions of each component, material, process and human resource related to its products, from the initial conception until the end of its lifecycle, with a triple objective: (i) operations/decision-making; (ii) track and trace processes and products; and (iii) ensure the reliability and the capacity to tackle sustainability claims regarding products and processes.
(Traditional) transparency	"Extent to which information is readily available to [. . .] other firms in the supply chain" (Awaysheh and Klassen, 2010, p. 1249).	
Transparency (with a sustainable aim)	"The corporate disclosure of: (i) the names of the suppliers involved in producing the firm's products; (ii) information about the sustainability conditions within these suppliers' facilities; and (iii) the buying firms' purchasing practices" (Egels-Zandén et al., 2015, p. 96).	An organization's decision to reveal all the relevant information regarding its products and internal policies and practices to legitimate partners or stakeholders, ensuring its intellectual property rights are not at risk. "Acting in a way that enables others, both internal and external stakeholders to perceive and understand what the company does, as well as the quality disclosure of the information needed for this" (Gold & Heikkurinen, 2017, p. 5).
SC	Business structures that "encompasses all activities associated with the flow and transformation of goods from raw materials stage (extraction), through to the end user, as well as the associated information flows" both up and down the supply chain linking "suppliers, focal companies and customers" by the "information, material and capital flows" (Seuring & Müller, 2008b, pp. 1699, 1700). Focal companies are "those companies that usually (1) rule or govern the supply chain, (2) provide the direct contact to the customer, and (3) design the product or service offered" (Seuring & Müller, 2008b, p. 1699).	SC models in which traditional and non-traditional SC actors are integrated into the same ecosystem: the sustainable traceable and transparent SC (see Figure 2 below).

Figure 2. SC reconfiguration: Existing supply chain vs. proposed sustainable, traceable and transparent supply chain



Main Academic Outcomes

Table 2. Contribution to academic knowledge: Journal articles and conference communications

Title	Type	Peer-reviewed	Journal/Conference	Status	Contribution to this doctoral research	Additional Information
"Effective disclosure in the fast-fashion industry: From sustainability reporting to action"	Journal article	Yes	<i>Sustainability</i> (ISSN: 2071 1050)	Accepted: December 3 rd , 2017 Garcia-Torres, Rey-Garcia, M., & Albareda-Vivo, L. (2017) Sustainability (Switzerland), 9(12). DOI: 10.3390/su9122256	Background/motivation/getting to know sustainability status and challenges in global (fast) fashion-apparel SCs QUAL0	Preliminary version presented at the Symposium on Ethics and Social Responsibility Research. Porto (Portugal). June 2017
"Traceability for sustainability – literature review and conceptual framework"	Journal article	Yes	<i>Supply Chain Management: An International Journal</i> (ISSN: 1359-8546)	Accepted: October 4 th , 2018 Garcia-Torres, S., Albareda, L., Rey-Garcia, M., & Seuring, S. (2019). DOI: 10.1108/SCM-04-2018-0152	Literature review/ Getting to know the state of the art regarding the three key elements of this work: traceability, transparency and sustainability/ Proposition of a conceptual framework QUAL1	Preliminary version presented at EurOMA Sustainable Operations and Supply Chain Forum. Kassel (Germany). March 2018
"Traceability for Sustainability in Global Supply Chains-An instrument development"	Conference paper	Yes	EurOMA Sustainable Operations and Supply Chain Forum. Göteborg (Sweden) March 2019	Authors: Garcia-Torres, S., Sáenz-Martínez, J., Rey-Garcia, M., & Seuring, S	Measurement instrument for QUAN1	
"Traceability and Transparency for Sustainable Fashion-Apparel Supply Chains"	Journal article	Yes	<i>Journal of Fashion Marketing and Management</i> (1361-2026)	Accepted: June 1 st , 2021 Garcia-Torres, S., Rey-Garcia, M., Sáenz-Martínez, J., & Seuring, S. (2021) DOI: 10.1108/JFMM-07-2020-0125	QUAL2	
"Traceability and SC Collaboration-Combining Forces for SC Sustainability-An empirical analysis"	Conference paper	Yes	EurOMA Sustainable Operations and Supply Chain Forum. Nottingham (UK) February 2020	Authors: Garcia-Torres, S., Sáenz-Martínez, J., Rey-Garcia, M., & Seuring, S	QUAN1	To be published as a journal article (to be submitted on/before December 2021)

Main Informative Outcomes

Table 3. Contribution to informative knowledge

What	Where	Practical application
Fast-fashion Sustainability Score Card	Effective disclosure in the fast-fashion industry: From sustainability reporting to action June 2017 DOI: 10.3390/su9122256	Universal (i.e., transferrable to other industries) disclosure framework for systematic reporting focused on action.
Informal Workshop (<i>Tómate un Café Conmigo</i>)	VII Jornada de moda sostenible. Museo del Traje. Madrid (Spain) April 2018 https://www.slowfashionnext.com/vii-jornada-moda-sostenible/	Sharing the preliminary results of this doctoral research: the (intertwined) role that traceability and transparency play in the sustainability of fashion industry supply chains, emphasizing the need for collaboration between the different actors inside and outside these chains, so that traceability, transparency and sustainability can be more than a utopia.
Informative article: "Moda Sostenible: ¿Es el verde el nuevo negro?"	Mas: Mujeres a Seguir December 2019 https://www.mujeresaseguir.com/social/noticia/1156332048615/moda-sostenible-verde-nuevo-negro.1.html	Reflections regarding fashion sustainability: a question of survival for a sector facing the greatest challenge in its history, i.e., how to renew a model that is no longer admissible.
Informative article: "Sostenibilidad para la competitividad de la industria de la moda española: hacia una moda circular, digitalizada, trazable y colaborativa"	<i>Información Comercial Española, ICE: Revista de economía</i> January 2020 ISSN: 0019-977X	Review of the antecedents of sustainability to support the competitiveness opportunity that the Sustainable Development Goals (SDGs) represent for fashion in Spain. Contextualize the challenges of improving productivity, digitally transforming and satisfying new consumer preferences that are shaping a new paradigm. Circularity, digitization and traceability are developed as the main sustainability levers for competitiveness. It concludes calling for collaboration between the main fashion industry stakeholders in Spain.

Abstract

Supply chain (SC) traceability and transparency are considered key antecedents to corporate and SC sustainability (Khurana & Ricchetti, 2016; Pagell & Wu, 2009). However, they remain a utopia in complex global SCs hindered by both conceptual and practical barriers.

This research aims to understand and help the deployment of the three phenomena (sustainability, traceability and transparency) in the particular context of the fashion-apparel industry, where their advancement is especially necessary due to the high environmental and social risks associated with their activities, and to the complex, labour-intensive, and geographically dispersed character of their SCs.

To this end, the present doctoral project blends qualitative and quantitative methods and combines insights from academia and the fashion-apparel industry in three sequential studies. It begins with an integrative literature review that resulted in a conceptual framework depicting the phenomena under analysis (traceability and transparency for SC sustainability). Next, building on this framework, a Delphi study was conducted with experts representing key stakeholders in fashion-apparel SCs resulting in down-to-earth definitions of the three phenomena and a prospective model linking them. In addition, it provided insights about their drivers (including actors) and barriers. Finally, this model is tested using the partial least squares structural equation modeling technique on data collected through surveys from a sample of fashion-apparel suppliers located in Portugal or Spain.

As a result, definitions that set clear boundaries for sustainability, traceability, and transparency in the fashion-apparel context are formulated, and a theory is proposed to explain the interrelations between traceability and transparency and with collaboration—unveiled as the key enabler—for SC sustainability.

In doing so, this study contributes to the corporate social responsibility and (sustainable) supply chain management literature with a managerial theorization of traceability and transparency for sustainability and with practical insights about how to advance them in fashion-apparel SCs.

Furthermore, the unique contribution of this study lies in its focus on how to deploy traceability and transparency for sustainability with an emphasis on the suppliers' point of view, rather than on the retailer's.

Key words

Sustainability, Traceability, Transparency, Fashion-Apparel Supply Chains, SSCM, CSR, SDGs

Resumen

La trazabilidad y transparencia se consideran antecedentes clave para la sostenibilidad de empresas y cadenas de suministro (Khurana & Ricchetti, 2016; Pagell & Wu, 2009). Sin embargo, siguen siendo una utopía en cadenas de suministro complejas y globales en las que encuentran barreras tanto prácticas como conceptuales.

Este trabajo doctoral tiene como objetivo comprender y ayudar al desarrollo de los tres fenómenos (sostenibilidad, trazabilidad y transparencia) en el contexto particular de la industria de textil-moda, donde su avance es especialmente necesario debido a los altos riesgos ambientales y sociales asociados a sus actividades y al carácter complejo, intensivo en mano de obra y geográficamente disperso de sus cadenas de suministro.

Para ello, la presente investigación combina métodos cualitativos y cuantitativos y conocimientos académicos y de la industria de textil-moda a lo largo de tres estudios conectados secuencialmente. Comienza con una revisión integrativa de la literatura de la que deriva un marco conceptual que describe los fenómenos de análisis (trazabilidad y transparencia para la sostenibilidad de la cadena de suministro). A continuación, sobre la base de este marco conceptual, se lleva a cabo un estudio Delphi con expertos que representan a los stakeholders clave de la industria textil-moda. De este estudio se obtienen definiciones para los tres fenómenos, una aproximación a sus principales elementos impulsores (incluidos actores) y sus barreras y la propuesta de un modelo que vincula la trazabilidad, la transparencia y la sostenibilidad. La investigación concluye con un estudio cuantitativo en el que se testa este modelo, utilizando la técnica de modelado de ecuaciones estructurales de mínimos cuadrados parciales sobre datos recopilados a través de encuestas a una muestra de proveedores textiles.

Entre los resultados de esta tesis cabe destacar la formulación de definiciones que establecen límites claros para la trazabilidad, la transparencia y la sostenibilidad en el contexto de las cadenas de suministro de textil-moda, y la propuesta de una teoría que ayuda a explicar sus interrelaciones, con la participación de la colaboración, que se revela como su impulsor y facilitador clave.

Palabras clave

Sostenibilidad, trazabilidad, transparencia, cadena de suministro, textil-moda, SSCM, CSR, ODS

Chapter 1: Introduction

1. 1. The Relevance of Traceability and Transparency for Sustainable Fashion-Apparel Supply Chains

The present doctoral project explores the role of traceability and transparency on the path towards achieving sustainable supply chains (SCs) in the particular context of the global fashion-apparel industry. The final objective is to understand traceability and transparency in this particular context (definitions, boundaries and interrelations) and to propose and test an explanatory theory that may contribute to their development in favour of achieving the sustainability of fashion-apparel SCs. The underlying hypothesis is that, by leveraging traceability and transparency, the still unresolved tensions amongst the three sustainability dimensions —environmental, social and economic— could be balanced (Walker et al., 2014) and, borrowing from Pagell and Wu, fashion-apparel SCs “could, customers willing, continue to do business forever” (Pagell & Wu, 2009, p. 38).

Thus, this study aims to contribute to the corporate social responsibility (CSR) and (sustainable) supply chain management literatures ((S)SCM), helping the development of these disciplines and the managerial theorization of traceability and transparency, whilst also being useful for practitioners and SC stakeholders who will be provided with an operational approach to sustainability through traceability and transparency.

To this end, three sequential research projects combining knowledge from academia and the industry have been carried out blending qualitative and quantitative methodologies and techniques as typically found in mixed-methods research. The author undertook an integrative literature review on the confluence of traceability/transparency, the apparel industry and SC sustainability, resulting in a conceptual framework that depicted the phenomena under analysis (traceability and transparency for SC sustainability). The author then conducted a Delphi study with experts representing key stakeholders in fashion-apparel SCs. The findings deliver down-to-earth definitions of the three phenomena as well as a prospective model linking the three, along with insights about fostering and hindering factors (and actors) affecting them. This doctoral project ends with a quantitative research study in which the author operationalizes and tests the prospective model resulting from the Delphi study amongst a sample of fashion-apparel suppliers located in Portugal or Spain, thus providing empirical evidence for the theoretical propositions formulated in the previous phases.

To the best of the author’s knowledge, this study is unique as it directly targets how to deploy traceability and transparency as a means for enhancing sustainability performance with an emphasis on the suppliers’ point of view. Surprisingly, although the potential for sustainability

impacts increases as the actors move upstream in the chain (Mena et al., 2013), research with a supplier focus is currently neglected in favour of retailers' views as they normally act as the leaders (focal companies) in fashion-apparel SCs (Huq et al., 2016; Laudal, 2010).

1.1.1. Positioning Sustainability within Two Interconnected Research Streams: Corporate Social Responsibility and (Sustainable) Supply Chain Management

Since the final decades of the last century, we have witnessed the rapid and generalized growth of supply chain (SC) business structures as companies have attempted to build competitive advantages through specialization and cost reductions. No matter their complexity, the elemental SC concept refers to the "range of activities involved in the design, production, and marketing of a product" (Gereffi, 1999, p. 38), these activities normally taking place at a transnational level with many SC actors (mainly upstream producers) located in developing countries. Whilst these SCs can be a vehicle for the development and industrial upgrading of those countries (Gereffi & Korzeniewicz, 1994), we can automatically intuit that the process is not free of challenges. In addition to the governance issues associated to complex and geographically dispersed structures, the lack of (or lax) regulations and their enforcement in developing countries are further hurdles.

Sustainability is frequently understood based on the Brundtland Report's definition of sustainable development. Formally titled "Our Common Future", the Brundtland Report was issued in 1987 upon the conclusion of the United Nations World Commission on Environment and Development created in 1983, containing definitions and sustainability principles that are still the most widely accepted today. In said report, sustainability development is presented as the type of development "that meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN General Assembly, 1987). More recently, UN member countries agreed on the instrumentalization of this definition in 2015 based around 17 goals (the United Nations Sustainable Development Goals (SDGs)) and their 169 associated targets. They have become a universal agenda for sustainable development, embraced by governments, civil society, citizens and private sector actors (Stafford-Smith et al., 2017; UN General Assembly, 2015). Eventually, in the private sector —or, more broadly, in the business management field— sustainability is generally operationalized through Elkington's triple-bottom line (TBL) concept, i.e., the balance of three dimensions —environmental, social and economic—, in which none of these is compromised for the benefit of the others (Elkington, 2018, 1998). This TBL management has been progressively incorporated by companies, also fostered by governments, civil society and citizens calling for CSR, which needs to be extended throughout their SCs.

The CSR concept became popular in the middle of the last century, generating an enormous debate between academics and practitioners who frequently consider it a 'contested' concept (Quarshie et al., 2016). Approaches range from those proclaiming the maximization of economic benefit as the most important (and only) contribution that companies should make to society (Friedman, 1970) to those who highlight the social responsibilities intrinsically inherent to corporations since they are devoted to their stakeholders and their contract with society (Donaldson & Preston, 1995; Freeman & Reed, 1983).

Amongst all the different stances, there are four common distinguishing features of CSR worth highlighting: a) its voluntary nature as it builds above legal obligations; b) the recognition of (and focus on) the positive and negative impacts of all the activities on society at large and stakeholders; c) the integrated embracement of economic (competitiveness) responsibility with the responsibilities towards society and the environment; and d) the primary risk management goal.

However, CSR cannot be considered voluntary but, rather, embedded "within a wider field of social networks, business associations and political and regulatory rules" (Carbone et al., 2012, p. 477). Matten and Moon (2008) differentiate between explicit (corporate policies that articulate societal responsibilities) and implicit CSR (corporate societal obligations within "wider formal and informal institutions") (Matten & Moon, 2008, p. 409). Although *explicit* CSR is normally triggered by stakeholder pressure, enacting it remains at the company's discretion. *Implicit* CSR, for its part, is often defined and legitimized by business associations and is thus collective rather than an individual obligation (Matten & Moon, 2008). This study embraces both acceptations, and understands CSR as "the responsibility of enterprises for their impact on society" (European Commission, 2011) and the "context-specific organizational actions and policies that take into account stakeholders' expectations and the TBL of economic, social, and environmental performance" (Aguinis & Glavas, 2012, p. 933). At the SC level, these actions and policies take the form of sustainable supply chain management (SSCM) as the instrument corporations need to (*or must*) develop to meet their responsibilities as a consequence of their activities currently taking place along complex global SCs (Khurana & Ricchetti, 2016). In fact, SSCM has come to disrupt traditional SCM to the point that there are voices claiming for its "disappearance" as a branch of SCM, arguing that it should be primitively embedded in SCM's very DNA (Ansari & Kant, 2017a; Beske & Seuring, 2014; Pagell & Shevchenko, 2014). This is also the position of this doctoral research that prefers to name it (sustainable) supply chain management and defines it as:

The strategic and transparent management of companies and material, information and capital flows and cooperation with SC actors to address environmental, social and economic aspects derived from customer and other stakeholder requirements to simultaneously achieve competitive advantages and (at least) a neutral effect on the natural and social environment (Carter & Rogers, 2008; Pagell & Wu, 2009; Seuring & Müller, 2008b).

Thus, in this doctoral project, CSR and (S)SCM, besides research streams, are also considered interconnected strategies triggering sustainability. One way of understanding the interconnection (embraced in this research) is CSR as the triggering (philosophical) strategy taken at the corporate level and deployed at the SC level thanks to (S)SCM (Andersen & Skjoett-Larsen, 2009; Perry & Towers, 2013).

1.1.2. Traceability and Transparency for SC Sustainability

In pursuing this goal, the umbrella term, 'information transparency', appears to be one of the most relevant dimensions of (S)SCM, as shown by the large percentage of frameworks that include this element in their conceptual models (Ansari & Kant, 2017b, pp. 12, 13). This goes in hand with the increasing importance given to traceability's role in the (S)SCM equation as: one of the focuses of sustainable chain managers (Pagell & Wu, 2009, p. 52,53); a key risk management factor (Roth, Tsay, Pullman, & Gray, 2008); a tool for inter-organizational control (Macchion et al., 2015); or a critical operational issue when adverse events emerge in a given process (Skilton & Robinson, 2009), just to mention a few of its functionalities.

Thus, general (S)SCM literature is beginning to give traceability a preponderant role on this path towards the radical sustainability of complex SCs, with a focus on regulated and critical industries such as food and health care. This implies broadening (S)SCM's scope to encompass not only quality and efficiency issues but also wider sustainability aspects (Closs et al., 2011; Pagell & Wu, 2009) and corroborating the consideration of transparency as a supporting facet of (S)SCM (Carter & Rogers, 2008). In addition to being coupled with responsible SCs (Closs et al., 2011; United Nations Global Compact Office, 2014), traceability and transparency appear as potential sources of interorganisational competitive advantage if effectively governed. This is because they require and foster collaboration amongst all SC actors and enable end customers (and consumers) to become aware of the complete product lifecycle (Gold et al., 2010; Guercini & Runfola, 2009; Macchion et al., 2015).

Furthermore, the UN recognizes the significant role of SC traceability and transparency in achieving SDGs, 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), amongst others (UN General Assembly, 2015). Likewise, the European Union (EU) has defined transparency and traceability in SCs as one of the key priorities to advance sustainability, promote sustainable and responsible management in global SCs and underpin the achievement of SDGs (European Commission, 2017b, 2017a).

1.1.3. The Context: Fashion-Apparel SCs

One paramount example of complex global SCs urging for (S)SCM is found in the fashion-apparel industry (Gereffi & Korzeniewicz, 1994), which is the focus of analysis and the application field of this doctoral project.

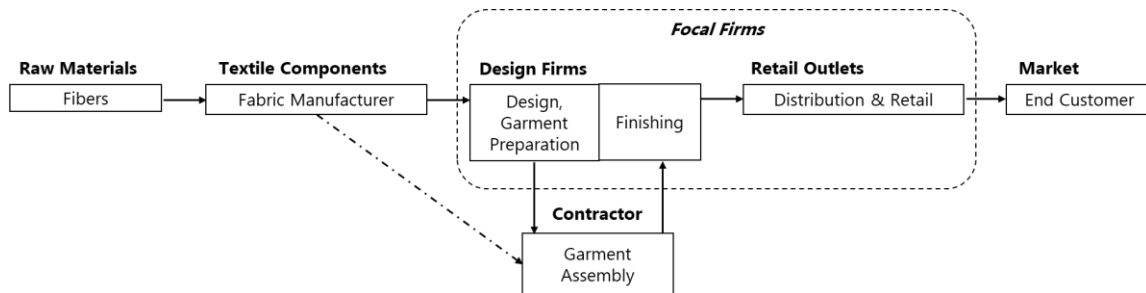
The fashion-apparel industry, traditionally related to art, innovation and culture and a great contributor to employment worldwide, is also one of the industries in which sustainability issues are more intense, thus mobilising fashion researchers and practitioners in the search for SC sustainability (Business of Fashion (BOF) and McKinsey, 2019; Pal, 2016; Pal et al., 2019).

At the environmental level, these sustainability concerns are materialised in the form of pollution, water contamination and resource depletion associated to the industry's activities. At the social level, there is suspicion regarding unequal/abusive working conditions (de Brito et al., 2008; Gobbi & Massa, 2015; Laudal, 2010; Lehmann et al., 2018; Stevenson & Cole, 2018). The management of this industry's SCs is further jeopardized by the particular features of the industry explained below which, in addition, favour tensions with the economic dimension (Boström et al., 2012; de Brito et al., 2008; Egels-Zandén, 2016).

Due to its labour-intensive nature, (fashion)-apparel companies have historically been amongst the first to enter less-developed countries. The result is a highly globalised industry with its activities carried out throughout long and complex SCs (Appelbaum & Gereffi, 1994). These SCs comprise all the processes involved in "the manufacture, distribution, sale and use of fashion clothing" (Pal & Gander, 2018, p. 252), from sourcing the raw materials to distributing and selling the final fashion garments in the market (Gereffi & Korzeniewicz, 1994). Figure 3 illustrates an example fashion-apparel SC, where upstream processes are normally carried out by many fragmented suppliers orchestrated by a focal firm (normally the fashion brand/retailer) which is visible to end customers (Gereffi & Korzeniewicz, 1994; Moretto et al., 2018). The focus of this

doctoral project is on the complex and global character of SC and the trendy attributes of the product without any other (*a-priori*) differentiation in terms of fashion products (i.e., between fast-fashion, slow fashion or luxury fashion, for example).

Figure 3. An example fashion-apparel SC



Source: Adapted from Gereffi & Korzeniewicz (1994)'s 'Fashion-oriented chain'

Fashion-apparel SCs are thus a representative example of "buyer-driven" chains. They are chains in which the pivotal (focal) role is played by big companies downstream (i.e., fashion brands/retailers), whilst production is normally carried out by independent factories upstream (many of them operating in developing countries (Gereffi & Korzeniewicz, 1994, p. 97) where a critical part of the sustainability challenges lie (Mena et al., 2013)).

On the one hand, these characteristics provide the sector with enormous potential and responsibility to help the development of those countries, especially considering that it employs millions of workers worldwide, particularly young women (ILO.org, 2020).

On the other, the social complexity and geographical dispersion described provokes a lack of visibility beyond direct suppliers (Boström et al., 2012; Guo et al., 2015) which, together with the high dynamism and volume linked to the fashion-apparel industry, increases the social and environmental risks inherent to its activities (Moretto et al., 2018; Pedersen & Andersen, 2015) urging the need for (S)SCM, traceability and transparency. This is especially imperative given that the industry-related environmental and social breaches associated to its high-risk activities (Gobbi & Massa, 2015; Greer & Purvis, 2016; Laudal, 2010) can rarely be acknowledged in the end product (Busse, Schleper, et al., 2017).

In 2016, Khurana and Ricchetti reviewed and discussed the main (S)SCM lessons learnt by the fashion-apparel industry throughout two decades (1990-2010) of trials and errors. They singled out five key lessons summarised as: "integrate[-ing] sustainability to core business practices, adopt[-ing] a comprehensive approach, go[-ing] beyond monitoring, look[-ing] beyond first tier of suppliers, and bring[-ing] transparency to the supply chain" (Khurana and Ricchetti, 2016, p.

92). The first three call for strategically embedding sustainability in current business models and operations. The last two put the emphasis on and stress two particular elements— traceability and transparency—, already described here as indispensable for sustainability in fashion-apparel SCs where the lack of visibility beyond direct suppliers is one indisputable characteristic (Pedersen & Andersen, 2015; Sandvik & Stubbs, 2019). Thus, securing the real traceability of the production process and fostering transparency appear to be pivotal preconditions for fashion-apparel SC sustainability. Indeed, the EU argues that traceability and transparency are particularly pertinent for the apparel industry “due to its fragmented production and the prevalent practice of illegitimate subcontracting” (European Commission, 2017b, p. 20).

However, true fashion-apparel sustainability is far from a reality, and traceability and transparency remain a utopia in practice (Doorey, 2011; Egels-Zandén, 2016; Lehmann et al., 2019). As proof of the former, the UN recently declared the fast-fashion business model as an environmental emergency (United Nations Forum on Sustainable Development, 2018). Proving the latter, the finding of so-called “organic” cotton fraudulently produced in India, the accusations of forced labour by minority Uighurs in Xinjiang (China) or the implication of “ambiguities in the definition [...] involving traceability” in scandals such as investigations into working conditions in H&M’s factories overseas (Borit & Santos, 2015, <https://global-standard.org/news/gots-press-release-gots-detects-evidence-of-organic-cotton-fraud-in-india>; “Xinjiang issues place US firms in a difficult position”, 2021).

1. 2. Literature Review, Gaps and Problem Spotting

1.2.1. SC Traceability

Until recently, the most widely adopted definition of traceability was the one used in the ISO 9000 norm, i.e., “the ability to trace the history, application or location of a product in relation to the origin of its materials and parts; the processing history; and the distribution and location after delivery” (International Organization for Standardization, 2000). Consequently, it has been historically related to total quality or just-in-time systems (Alfaro & Rábade, 2009; Aung & Chang, 2014). Traceability is associated to process quality and security (which protect brand reputation and allow for product differentiation) (Kamann et al., 2019; Roth et al., 2008), as well as to flexibility, inventory performance and operational agility improvements (Kamann et al., 2019; Marconi et al., 2017). Nowadays, together with the ‘growth’ of traceability within (S)SCM, traceability definitions are starting to incorporate sustainability issues and claims. This is the case with the Global Compact which adds a sustainability purpose to the ISO’s definition, including the aim of ensuring “the reliability of sustainability claims”, in the areas of human rights, labour (including health and

safety), the environment and anti-corruption" (United Nations Global Compact Office, 2014, p. 6). Likewise, Marconi et al. (2017) explicitly point to tracing energy data and resource consumption to the associated production means and environmental conditions data. Similarly, Olsen and Borit (2013) define traceability as the ability that enables retrieving and making the particular information accessible when needed for operational or sustainability aims (Olsen & Borit, 2013).

Academic literature addressing the intersection between traceability and sustainability, although evolving, is still scarce (Maruchek et al., 2011; Thöni & Tjoa, 2017) save for two exceptions. On the one hand, some work examines industries with higher levels of regulation and/or where consumer health might be a risk (e.g., food, agriculture or pharma) (Kamann et al., 2019; Moe, 1998; Regattieri et al., 2007; Roth et al., 2008), with a focus on product health and safety concerns. On the other, scholars have undertaken research on technological advances for traceability, mainly IoT, RFID and blockchain technologies, oriented towards the economic/operational dimension of sustainability; only in a few cases has it been extended to include the environment (Cannon et al., 2008; Green et al., 2017; Kshetri, 2018).

In terms of the 'SC sustainability role' (or its broader view), traceability is frequently associated to and even interchanged with 'transparency' (Doorey, 2011; Egels-Zandén et al., 2015; Khurana & Ricchetti, 2016). At times, some refer to transparency as an indisputable antecedent of traceability (e.g., Fraser et al.'s (2020) framework); others conceive it as an umbrella term comparable to the disclosure of "traceability information" (e.g., SC transparency as proposed by Egels-Zandén et al., 2015); and others even pair it with SC traceability (Khurana & Ricchetti, 2016).

1.2.2. SC Transparency

With its origins in the right-to-know movements of the second half of the last century, transparency is becoming central to corporate and SC sustainability (Egels-Zandén et al., 2015; Mol, 2015). It has moved from being defined as a mere disclosure of information (Mol, 2015) to include a behavioural component such as "acting in a way that enables others [...] to perceive and understand what the company does" (Gold & Heikkurinen, 2018, p. 321). Already in 2008, Carter and Rogers proposed that transparency should go beyond reporting to actively engage with stakeholders in a bidirectional relationship from which SC processes can be ameliorated (Carter & Rogers, 2008).

Albu and Flyverbom (2019) ascertained two different streams for organizational transparency literature. The first focuses on the verifiability of transparency, understanding it as 'mere' disclosing of information and concerned about its quality, transmission and consequences, mainly

in terms of efficiency and trust. A second stream moves from labelling, disclosing or verifying information to also “do[-ing] things” (Albu & Flyverbom, 2019, p. 285; Lamming et al., 2004), focusing on transparency performativity.

This study focuses on this second stream of literature and builds on understanding transparency (and, ultimately, SC transparency) from a stakeholder perspective, i.e., as a process that is built in (SC) relationships (Lamming et al., 2004; Rebs et al., 2018). Along these lines, corporate transparency has been defined as “acting in a way that enables others, both internal and external stakeholders, to perceive and understand what the company does, as well as the quality disclosure of the information needed for this” (Gold and Heikkurinen, 2018, p. 321). This definition is equally transferable to the SC level. In this study, the definition of SC transparency also adopts a broad perspective, simultaneously pursuing operational and sustainability goals. SC transparency is understood as the combination of both the acting and disclosing of the actors within the network to prevent sustainability failures whilst positively influencing consumers’ purchasing intentions (Bhaduri & Ha-Brookshire, 2011; Gold & Heikkurinen, 2018).

The potential benefits associated to SC transparency as an antecedent of SC sustainability are numerous. They range from reducing or preventing negative market signals regarding environmental and social impacts and building trust (Egels-Zandén et al., 2015) to facilitating the assessment of regulatory and voluntary compliance (Fritz et al., 2017), enhancing the efficiency and quality of (S)SCM (Khurana and Ricchetti, 2016) or being associated with attitudes favouring purchase intention (Bhaduri & Ha-Brookshire, 2011). On the one hand, transparency provides insights on what is happening in the SC, thus enabling improvements at any level and dimension. On the other, it has a “strong element of social responsibility” by safeguarding any SC stakeholder from being abused in any way (Pagell and Wu, 2009, p. 49). The main downsides stem from increased exposure to ‘name-and-shame’ campaigns, the risk of innovation lifespan reductions or even distrust derived from certificates not supported by a government agency (Bhaduri & Ha-Brookshire, 2011; Egels-Zandén et al., 2015; Khurana & Ricchetti, 2016).

1.2.3. From Literature Gaps to Problematization

In the current debate about the boundaries and interrelations between traceability, transparency and sustainability, an emerging stream in CSR and (S)SCM literatures considers that traceability and transparency may potentially contribute to enhance stakeholder relationships in SCs towards sustainability. The reason for this can be found in their mutually reinforcing relationship, as traceability and transparency both demand and nurture profound SC collaboration and coordination for sustainability (Gold et al., 2010; Guercini & Runfola, 2009; Pagell & Wu, 2009).

However, the debate is still at the theoretical level (Gardner et al., 2019; Gupta et al., 2020; Kumar et al., 2017) and, when brought to empirical work, it delivers mixed results, shows trade-offs amongst the three sustainability dimensions —environmental, social and economic (Conca et al., 2021; Egels-Zandén et al., 2015; Wognum et al., 2011) or focuses on only one of these (Marconi et al., 2017). Thus, there is still no consensus regarding the relationship between traceability and transparency for sustainability.

Actually, besides the absence of consensus regarding the relationship between the three concepts, there is a lack of conceptual understanding of traceability and transparency, sometimes also including sustainability. Not surprisingly, transparency and visibility have been rated as the fourth most under-researched topic amongst the most important issues in SCM (Wieland et al., 2016). Traceability is at times claimed as necessary to guarantee SC transparency (Egels-Zandén et al., 2015; S. Stranieri et al., 2017). At other times, transparency is referred to as the necessary antecedent of traceability (Fraser et al., 2020), while, for others, transparency is conceived as an umbrella term comparable to the disclosure of “traceability information” (e.g., Egels-Zandén et al., 2015). There are authors that pair transparency with visibility (e.g., in Wieland et al. (2016)) or even with traceability (Khurana & Ricchetti, 2016). Arguments supporting traceability as transparency’s antecedent are found in the fact that good traceability offers possibilities to follow a product and its processes, thus contributing to ‘better’ transparency in the sense of providing verified information to offer to buyers and consumers (Wognum et al., 2011). Fraser et al. (2020) state the opposite, however. They understand transparency as knowing who is who in the SC and they state that any company must know “who is my Tier 2?” before trying to trace any product (Fraser et al., 2020, p. 6).

Focusing more closely on the fashion-apparel literature, and although there is still scarce specific literature exploring traceability and transparency in depth in sustainable fashion-apparel SCs, some remarkable exceptions published since 2015 (e.g., Conlon (2020); Agrawal and Pal (2019); Kumar et al. (2017); Henninger et al. (2016); Khurana & Ricchetti (2016); Egels-Zandén & Hansson (2016) or Egels-Zandén et al. (2015)) serve to illustrate the replication of the above-described situation.

First, there are myriad notions and individual interpretations about what sustainable fashion actually is (Henninger et al., 2016), and the overlap or even inter-changeability between the concepts and terms for traceability, transparency and sustainability can be found in both academic literature (Egels-Zandén et al., 2015; Henninger et al., 2016; Khurana & Ricchetti, 2016) and industry and institutional reports (European Commission, 2017). Table 4 summarizes (when

Table 4. Definitions of traceability, transparency and sustainability in fashion-apparel literature

Reference	Definitions		
	Traceability	Transparency	Sustainability
Conlon (2020)	"The ability to chronologically interrelate product lifecycle information and to track all accesses and changes to data" (p. 5)	Missing	Not explicit (It defines value creation as "performing activities that increase the value of an organisation's goods or services, generating wealth for its shareholders, and satisfying customers' expectations" (p. 5)
Agrawal & Pal, (2019)	"The ability to identify and trace the history, distribution, location, and application of products, parts, materials, and services. A traceability system records and follows the trail as products, parts, materials, and services come from suppliers and are processed and ultimately distributed as final products and services" (p.1)	"Transparency is the extent to which information is shared among the supply chain partners" (p. 4)	Not explicit (It alludes to "sustainability aspects in the form of green certifications, eco-cotton labels, carbon footprint data, or supplier details" (p. 2)
European Commission (2017)	"Traceability is the process by which enterprises track materials and products and the conditions under which they were" (p. 20)	"Transparency refers to disclosing information to the public in a comprehensible, accessible, and timely manner. produced through the supply chain" (p. 20)	Not explicit (It alludes to "sustainability in the garment sector in terms of human rights, labour, and the environment" (p. 21) "with its economic, social and environmental dimensions" (p. 26)
Kumar et al. (2017)	"Ability to verify the history, location, or application of an item by means of documented recorded identification" "A link that connects various element of information pertaining to a product"(p.4)	Missing	"Economic and social development that meets the needs of the current generation without undermining the ability of future generations to meet their own needs" "Three pillars of sustainability, namely, ecological, societal, and economic (p.1)
Henninger et al. (2016)	Missing	"Transparency looks at the origins of raw materials, dyes and chemicals used in the manufacturing process, and the employees and their working conditions" (p. 409)	"Meeting the needs of the present without compromising the ability of future generations to meet their needs" (p. 403)

Reference	Definitions		
	Traceability	Transparency	Sustainability
Khurana & Ricchetti (2016)	"Traceability is a well-known concept in business management, that can be extended from within-the company processing (company level traceability) to sourcing and SCM, allowing products to be traced back to the whole supply chain ultimately to the raw material used (supply chain traceability)" "Through public traceability, the disclosing companies transfer power from the firm to its stakeholders" (p.97)	"An umbrella definition that comprises corporate disclosure of: the names of the suppliers for traceability, information about the sustainability condition at these suppliers and the buying/purchasing practices of the brand. (Egels-Zandén et al. (2015)" (p.100)	Non-explicit definition. (This article states that "the triple bottom line concept (Elkington, 1999) summarizes in social, environmental and economic sustainability a multifaceted field" (p.91))
Egels-Zandén & Hansson (2016)	"The ability to track a product's flow throughout the production process and supply chain" (understood as a dimension of transparency) (p.6)	"Disclosure of both supplier names and sustainability conditions" (p.6)	Missing
Egels-Zandén et al. (2015) (accepted and available since 2014)	"Corporate disclosure of the names of the suppliers involved in producing the firm's products" (p.96)	"Disclosure of information about supplier names, sustainability conditions at suppliers, and buyers' purchasing practices" (p.95)	Missing

available) the explicit definitions of the three terms found in the seven academic exceptions mentioned above and in the European Commission Working Document on sustainable garment value chains published in 2017.

This enables us to ascertain that there is no single study integrating the three concepts, thus jeopardizing the conceptual clarity (definitions, boundaries and interrelations) of the traceability, transparency and sustainability.

This reveals an imperious gap as demonstrated by the many sustainability-related problems or breaches in fashion-apparel SCs (Huq & Stevenson, 2020; Khurana & Ricchetti, 2016; Lehmann et al., 2018). Thus, taking a critical and problematizing approach to the analysis of the literature (Alvesson & Sandberg, 2011), the starting point of this study contests (or at least reframes) the postulate that traceability and transparency contribute to positive TBL performance in fashion-apparel SCs, asserting, instead, that their absence, lack of development or conceptual inconsistency act as a barrier to the advancement of sustainability in the fashion-apparel industry (Huq & Stevenson, 2020; Khurana & Ricchetti, 2016).

The goal of eliminating this barrier and aiding the adoption of sustainability in fashion-apparel SCs guided this doctoral project whose detailed objectives and subsequent research questions are introduced next. This doctoral project is not about overturning current fashion-apparel SCs but about advancing on how to fortify their weakest points before they potentially collapse.

1.2.4. Doctoral Project Objectives and Research Questions

The final objectives of this research project can thus be summarized as: (i) understanding traceability and transparency when converging in the CSR/(S)SCM field and in the particular context of fashion-apparel SCs; and (ii) proposing and testing an explanatory theory that may contribute to their development in favour of sustainability.

Table 5 summarizes the detailed objectives and research questions (RQ) around which these main aims unfold.

Table 5. Objectives and RQs

	Main objective: To understand traceability and transparency when converging in the CSR/(S)SCM field and in the particular context of fashion-apparel SCs and to propose and test an explanatory theory that may contribute to their development in favour of sustainability.			
	Detailed Objectives QUAL 1	Detailed Objectives QUAL 2	Detailed Objectives QUAN 1	Research Questions
	Analyse the organizational antecedents of traceability and transparency in apparel SCs	Help improve consistency in the understanding of sustainability, traceability and transparency in the practical and specific context of fashion-apparel SC sustainability Leverage traceability and transparency deployment in practice in the specific realm of fashion-apparel SC sustainability	Test SC collaboration as the antecedent of traceability and transparency	QUAL1: 1. How is TfS developed and implemented in global SCs? 2. How does TfS contribute to SC Sustainability? QUAL2: 3. How are sustainability, traceability and transparency operationalised in fashion-apparel SCs? 4. How do the three concepts relate to each other? 5. What are the key stakeholder groups, drivers and barriers that foster or hinder their implementation in practice? QUAN1: 6. How does collaboration influence traceability in fashion-apparel SCs? 7. How does collaboration influence transparency in fashion-apparel SCs? 8. How does collaboration contribute to TBL performance in fashion-apparel SCs? 9. How does traceability contribute to TBL performance in fashion-apparel SCs? 10. How does transparency contribute to TBL performance in fashion-apparel SCs?
	Explore the consequences of traceability and transparency on fashion-apparel SC sustainability	Specifically: (i) clarify the three concepts, (ii) examine how they relate to each other, and (iii) determine their key enabling and inhibiting factors	Test the consequences of SC collaboration, traceability and transparency on TBL performance	
Research Methods	Integrative literature review by means of content analysis	Delphi Study with in-depth interviews and semi-structured questionnaire	Survey method and PLS-SEM analysis	

1.3. Theoretical Lenses

(Sustainable) SCs and their related phenomena have been studied with the aid of a broad array of theories, depending on the focus (Quarshie et al., 2016). Thus, transaction cost theory and the resource based view (RBV) (and related frameworks) have been frequently chosen to study the performance consequences of SC relationships (Coase, 1937, Williamson, 1975; Barney, 1991; Dyer & Singh, 1998). Other times (some of them conjointly), and especially works nestled in the CSR stream, scholars have used stakeholder theory with the same aim, emphasising the importance of simultaneously attending to and integrating all stakeholders' interests (Donaldson & Preston, 1995; Freeman & Reed, 1983). Agency theory or institutional theory are commonly applied when dealing with multi-tier SCs (Jensen and Meckling, 1976; institutional theory (DiMaggio and Powell, 1983) and systems or network theories (Granovetter, 1985) when studying how social behaviours affect individual and conjoint SC behaviours. Recently, other theories such as paradox theory (Smith and Lewis, 2011) or Galbraith's (1979) information-processing-theory (IPT) application to (S)SCM (Brandon-Jones et al., 2014; Busse, Meinlschmidt, et al., 2017) have gained prominence to explain how sustainability challenges and risks can be managed (IPT) and even leveraged (paradox theory) in favour of SC performance.

Although all of these can offer insightful and valid angles to explore and understand the path towards fashion-apparel SC sustainability, given that the focus of this research project is on traceability and transparency (understood as organizational and inter-organizational capabilities that involve traditional and non-traditional SC stakeholders), this study applies the RBV (and related frameworks) and stakeholder theory as the lenses chosen to naturally zoom in on in this particular reality.

1.3.1. RBV, Dynamic Capabilities and Related Theories

The resource-based view of the firm understands organizations as a bunch of heterogeneous resources responsible for their growth and competitive advantage (Barney, 1991; Kor et al., 2016; Penrose, 1959). This view is rooted in Penrose's 1959 work, *The Theory of the Growth of the Firm* (Penrose, 1959), though it has been further developed since then by key authors such as Wernerfelt, Rumelt or Grant, and popularized by Barney with the "VRIN resources" framework (Barney, 1991; Grant, 1991; Rumelt, 1984; Wernerfelt, 1984). In 1991, Barney developed the assumption that the resources/capabilities that a company holds (i.e., its physical—including technology—, human and organizational capital) can be a source of sustained competitive advantage when meeting some requisites: They have to be valuable, rare, inimitable and non-substitutable (collectively referred to as "VRIN resources") (Barney, 1991). Scholars have

subsequently adapted RBV to the dynamic and interconnected nature of most markets by introducing a dynamic component: Dynamic capabilities (DCs). DCs are defined as “the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments” (Teece et al., 1997, p. 516). As Teece et al. explain, “the term ‘*dynamic*’ refers to the capacity to renew competences so as to achieve congruence with the changing business environment”, whilst “the term ‘*capabilities*’ emphasizes the key role of strategic management in appropriately adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competences to match the requirements of a changing environment” (Teece et al., 1997, p. 515). Due to the markets’ high-velocity and their great interconnectivity, these capabilities are no longer rare or inimitable; thus, “their value for competitive advantage lies in the resource configurations they create, not in the capacities themselves.” (Eisenhardt and Martin, 2000, p. 1106). Resource re-configuration happens through four different processes: reconfiguration; leveraging; learning; and integration (Bowman & Ambrosini, 2003).

Collis (1994)¹ further developed this concept with the notion of meta-capabilities (or ‘regenerative DCs’ as referred to by Ambrosini et al. (2009)). Different scholars have also proposed various levels of DCs, which represent a continuous improvement of the resource base (Ambrosini et al., 2009; Collis, 1994; Eisenhardt & Martin, 2000; Teece et al., 1997; Winter, 2003; Zollo & Winter, 2002). According to Ambrosini et al. (2009), starting from the resource base, a second level consists of incremental capabilities that evolve in stable environments to adapt the resource stocks to the new environment which, although incremental and slow, do experiment a change. The next level of DCs consists of renewing DCs referent to changing environments. Companies build on incremental capabilities to adapt, change and augment their previous capabilities and organizational routines into practices that represent more complex activities and organizational learning processes. Finally, companies can regenerate their previous DCs to achieve a higher level of complexity. This can potentially result in a meta-capability (or regenerative DC) that transforms previous renewing capabilities into a new complex set of organizational practices and learning processes. Meta-capabilities emerge to extend and renovate the companies’ previous organizational routines and practices and allow them to move forward to build complex processes (Collis, 1994). These meta-capabilities would then apply the four DC processes *ad infinitum*: reconfiguring assets and resources; leveraging processes and systems; learning; and integrating resources—over-renewing DCs, changing their form (e.g., from leverage to reconfiguration) or

¹ Although Collis’ work appears to be prior to Teece et al.’s seminal text, the latter builds on previous working papers on which the work by Collis builds.

their mix (adding leverage to an existing reconfiguration capability) (Ambrosini et al., 2009; Collis, 1994). The exponential power of these meta-capabilities ultimately enables them to change the companies' resource base and their processes disruptively. Table 6 summarizes the different DC conceptualizations and their development along different levels and processes, with the terminology used by the different authors.

Table 6. DC conceptualization, content and processes

Type	DCs Levels	Content	Processes (How)
Resources and Capabilities	Resource Base	Resources/capabilities that companies hold (physical (including technology), human and organizational capital)	Reconfiguring, leveraging, learning and integrating (Bowman & Ambrosini, 2003)
Dynamic Capabilities, i.e., firms' ability to create, adapt and reconfigure their resources and capabilities	Incremental DCs (Ambrosini et al., 2009)	Resource base adjusted and adapted to the incremental changes of the environment	
	Renewing DCs (Ambrosini et al., 2009) or First-order DCs (Winter, 2003)	Resource base renewed & refreshed	
	Regenerative DCs (Ambrosini et al., 2009) or Meta-capabilities (Collis, 1994) or Higher order DCs (Winter, 2003)	Incremental or renewing DCs renewed & refreshed, ultimately renewing the resource base	

With the relational view (Dyer & Singh, 1998), the RBV incorporates an external component and further broadens the dynamic approach by adding inter-firm routines and processes to the possible sources of competitive advantage (in this case, referring to cooperative strategies/interorganizational structures, i.e., SCs). Gold, Seuring and Beske (2010, p. 230) also support this view, stating that "inter-firm resources and capabilities emerging from supply-chain-wide collaboration are prone to become sources of sustained inter-firm competitive advantage, since they are socially complex, causally ambiguous and historically grown and hence particularly difficult to imitate by competitors." More recently, the practice-based view (PBV), like RBV and associated theories, analyses "publicly known, imitable activities, or practices amenable to transfer across firms" (instead of VRIN resources) (Bromiley and Rau, 2014, p. 1249) as performance drivers (instead of competitive advantages) at the firm level (Bromiley and Rau, 2014). Carter et al. (2017) extend this theory to the interorganisational level of analysis, both in terms of practices and performance under the name of supply chain practice view (SCPV), bringing the PV to the SC level.

Research on the RBV and DCs is frequently applied to SCM literature (Beske, Land & Seuring, 2014; Epelbaum & Martinez, 2014; Fawcett, Wallin, Allred, Fawcett, & Magnan, 2011). This doctoral research embraces the broader, dynamic RBV of the firm and understands both VRIN resources and the configuration of imitable activities or practices as potential sources of competitive advantage or abnormal performance for firms or for the entire SC in which they operate. Concretely, this study highlights the relational view (RV), practice-based view (PBV) and supply chain practice view (SCPV) (Barney, 1991; Bromiley and Rau, 2014; Carter, Kosmol, and Kaufmann, 2017; Dyer and Singh, 1998) as having a key role in understanding traceability and transparency and their connection to CSR deployment and effective (S)SCM. Whilst the (dynamic) RBV and RV focus on detecting VRIN resources, capabilities and routines and how to maintain these VRIN characteristics to achieve and maintain competitive advantage, the PBV and SCPV focus on identifying the activities and practices (no matter their imitability) that may lead to better performance as well as on the conditions under which that outperformance happens (i.e., how they are used, their interaction with other activities/practices and how competitors behave). Table 7 below summarizes the five views.

1.3.2. Stakeholder Theory

Stakeholder theory has a major say in the practice of “sustainable and ethical value creation” (Parmar et al., 2010, p. 404). Rooted in the discussions on the role of business in the society, this theory advocates stakeholder relationship management as the way to understand and solve three meaningful and interlinked problems: value creation and its distribution, ethics and capitalism, and how managers can lead companies by simultaneously addressing the two previous challenges (Freeman & Reed, 1983; Hörisch et al., 2014; Parmar et al., 2010).

Since stakeholders are defined as “any identifiable group or individual who can affect the achievement of an organization's objectives or who is affected by the achievement of an organization's objectives” (Stanford Research Institute, 1963; Freeman & Reed, 1983, p. 91), under the lens of this theory, the success of any business project is inexorably linked to the contentedness of its stakeholders (Donaldson & Preston, 1995; Freeman & Reed, 1983). In fact, “business can be understood as a set of relationships among groups which have a stake in the activities that make up the business” (Freeman, 2010, p. 7). Thus, effective business (or SC) management requires identifying the stakeholders involved in each business activity and effectively managing their relationships with a long-term focus that dilutes eventual trade-offs between potentially conflicting interests (Freeman, 2010; Rey-Garcia et al., 2020). This means

Table 7. Summary of the sources of competitive advantage/performance under the different theoretical lenses

Theoretical Lens	Source/Driver of		Requisites	Main authors
	Competitive Advantage (CA)	Performance		
Resource-Based View	Resources/capabilities that a company holds (physical (including technology), human and organizational capital)		Valuable, rare, inimitable, and non-substitutable (i.e., "VRIN resources")	Barney (1991)
Dynamic Capabilities	Dynamic capabilities: "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments"		The source of CA is the ability to create VRIN resource configurations, not the capacities themselves	Teece et al. (1994); Collis (1994); Teece et al. (1997, p. 516); Ambrosini et al. (2009)
Relational View	Inter-firm routines and processes		Valuable, rare, inimitable, and non-substitutable (i.e., "VRIN routines/processes")	Dyer & Singh (1998); Gold, Seuring and Beske (2010)
Practice-Based View		"Publicly known, imitable activities, or practices amenable to transfer across firms" (firm level) The focus is on detecting which activities/practices, although imitable, are associated to higher (TBL) performance	The driver of performance is the use of "publicly available management practices", not the practises themselves. Concretely, performance depends on: (i) the use of specific practices, (ii) the details of how those practices are used, (iii) the interaction of those practices with other practices in the firm, and (iv) the behaviour of competitors	Bromiley & Rau (2014, pp. 1249; 1254; 1255)
SC Practice View		Activities, practices (or a set of them) that span different formal organizations and that other supply chain dyads or networks can imitate. Interorganizational SCM practices conceptually differ from intraorganizational practices "amenable to transfer across firms" (interorganizational level; performance both at the firm and SC levels)		Carter et al. (2017, p. 116)

putting value creation (and distribution) for stakeholders at the heart of management (Hörisch et al., 2014; Parmar et al., 2010). As R. Edward Freeman puts it,

Managing for stakeholders is about creating as much value as possible for stakeholders, without resorting to trade-offs. The key idea that holds this value creation mind-set together is the idea that businesses can have a purpose. [...] Capitalism works because we can pursue our purpose with others. When we coalesce around a big idea, or a joint purpose evolves from our day-to-day activities with each other, then great things can happen. (Freeman, 2010, p. 9).

In this way, knowing how to navigate the coexistence of environmental, social and economic interests and concerns in search of synergies whilst tackling trade-offs and tensions is central to stakeholder theory. Along these lines, stakeholder theory informs both CSR and (S)SCM fields.

Although stakeholder theory has been criticised for being more inclined towards the normative side (Donaldson & Preston, 1995), scholarly studies underpinning its managerial tenets (i.e., stakeholder management delivering superior and long-term value creation and distribution) are growing in number, and they are especially significant in the sustainability arena within CSR and (S)SCM fields (Donaldson & Preston, 1995; Hörisch et al., 2014; Schaltegger et al., 2019).

The reasons for this can be found in the *search for sustainability* becoming the *purpose* triggering *great things to happen*. In 2014, Hörisch and colleagues, aware of the challenge of integrating the three dimensions of sustainability within all the stakeholders' interests, presented a framework in which education, regulation and value creation (and distribution) opportunities can act as mechanisms to transform sustainability into a "source of mutual interest for all stakeholders" (Hörisch et al., 2014, p. 338). In this view, stakeholders are assumed to collaborate in the creation and distribution (i.e., appropriation) of sustainability value (Hörisch et al., 2014).

The stakeholder theory lens serves as a loupe for this doctoral project both in its normative aspect (i.e., how business/SC and their management need to be understood), as well as in its more instrumental version (i.e., how appropriate stakeholder management results in superior performance/value creation (and distribution) and how important stakeholder involvement is in such outcomes).

1.4. Epistemology, Theoretical Perspective, Methodology and Methods

The methodology the author applied in this doctoral project (i.e., the research strategy and design) and the methods used to gather and analyse data were selected in accordance with the posited

research objectives as well as with the epistemology and theoretical perspective of both the author and the research itself.

Along these lines, this work is developed from a (social) constructivist epistemology perspective, where knowledge (or meaning) is not encountered or discovered but, rather, constructed or interpreted (Crotty, 1998). Thus, (social) constructivism can be defined as a view that understands that "all knowledge and therefore all meaningful reality as such is contingent upon human practices, being constructed in and out of interaction between human beings and their world and developed and transmitted within an essentially social context" (Crotty, 1998, p. 42). Within this worldview, the researcher embraces pragmatism as the guiding philosophy or theoretical perspective (Crotty, 1998; Johnson & Onwuegbuzie, 2004). The pragmatic orientation claims that "the value of knowledge is equal to its practical use" (Arbner & Bjerke, 2009, p. 121), and achieving knowledge can happen through thinking, practical experiences or experiments (Johnson & Onwuegbuzie, 2004). Although at times branded as a conformist and accommodative position that is eager for effectiveness (Crotty, 1998), classical pragmatism (i.e., as initially conceived by Charles Sanders Peirce, William James and John Dewey) is about taking a "balanced and pluralistic position" in which different approaches are mixed to achieve the best combination in response to the posited research questions (Johnson & Onwuegbuzie, 2004, p. 16). Thus, pragmatism moves from confronted dual positions towards a moderate version in which each position can contribute depending on its fit with the particular case. Pragmatism views knowledge as *both* constructed *and* based on the reality we live in and considers human inquiry as "analogous to experimental and scientific inquiry" (Johnson & Onwuegbuzie, 2004, p. 18).

This constructivist worldview and pragmatic perspective together with the status of the field of study, the final objective of this doctoral project and its concrete research questions, determined the methodology applied and the methods and techniques used for gathering and analysing data.

Regarding the research strategy, the author chose a (sequential) mixed method approach for this doctoral project. It is the methodology (or research strategy) in which "a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration" (Creswell & Plano Clark, 2018, p. 3; Johnson & Onwuegbuzie, 2007, p. 123).

Thus, this approach is considered a perfect fit for the ultimate goal of this research: understanding traceability and transparency for sustainability and suggesting and testing (i.e., corroborating) a plausible explanatory theory for their deployment and interrelations.

Regarding the concrete typology or research design, the author chose an exploratory sequential design (Creswell & Plano Clark, 2018) in line with the objective of the research and the research questions. As any other mixed method design, it combines qualitative and quantitative rationales and instruments for data collection and data analysis, though giving a triggering and preponderant role to the qualitative part as its outputs will conform the inputs for the subsequent quantitative phase.

This iterative design allowed mapping and ascertaining the current state of traceability and transparency in fashion-apparel SC, and then helped to sustain the theoretical results with the analysis and testing of the hypotheses through quantitative analyses.

Adding to the constructivist and pragmatic mind-set and approach, it can be said that the early stage of development of the phenomena under study (traceability and transparency when converging in the CSR/(S)SCM field) set the research design. Later, with that same world-view and perspective, the particular context (fashion-apparel industry) and the fact that the problems to be resolved are shared by industry and academia served to fine-tune the final outline with two additional layers to further enrich the research with: (i) context-specific (fashion-apparel) insights and (ii) dialogue between industry and academia.

Figure 4 illustrates the generic representation of an exploratory sequential design created by Creswell and Plano Clark (2018) adapted specifically to this work, which will be explained next.

This doctoral project is composed of three sequential studies (QUAL1, QUAL2 and QUAN1) which constitute the core part of the research. However, they were preceded by an additional study (QUAL0) that served as an introduction to CSR/(S)SCM in the apparel-fashion context and a confirmation of the relevance of the phenomena under analysis in this particular context.

The core qualitative research (QUAL1 and QUAL2) was performed by means of an exploratory literature review of traceability, transparency and sustainability in fashion-apparel SCs (QUAL1), whose results were corroborated and contrasted with a panel of practitioners (traditional SC actors, NGOs representatives and other apparel sector stakeholders) and academic experts in the field using a Delphi study (QUAL2).

The quantitative research (QUAN1) was carried out by means of a structured questionnaire amongst a sample of apparel companies located in Spain and Portugal and supplying (directly or indirectly) garments, fabric or yarn, to fashion retailers selling the final garments under a recognisable brand name.

As explained above, in addition to the qualitative-quantitative sequence typical of the mixed method methodology, this research design adds two additional layers to further enhance the research with (i) context-specific (fashion-apparel) insights, and (ii) industry and academia dialogue. Regarding the context-specific insights, they were brought into the design to validate and refine the research outcomes for the particular fashion-apparel context. With respect to the industry-academia dialogue, either academia or industry played a prominent role in each of the three main studies carried out. The design has been structured to alternate an academia-led phase with an industry-led one.

Table 8 illustrates the doctoral project's research outline.

Although the specific data collection and analysis approach for each of the three core pieces of research conforming this work are subsequently detailed in their distinct chapters, it is worth highlighting the unifying threads that this doctoral project share.

SC behaviours and relationships as the main focus and level/unit of analysis. The main focus of this doctoral research is, first and foremost, the (fashion-apparel) supply chain. The objective is to understand and explain the analysed phenomena at the SC level, although being aware of the many different actors (with their individual behaviours and relationships) that comprise that level. When one standpoint needed to be favoured, the suppliers' was chosen (since, as explained above, sustainability challenges intensify as we move up in the chain, whilst research on upper echelons is currently overlooked compared to those dedicated to brands, retailers or consumers).

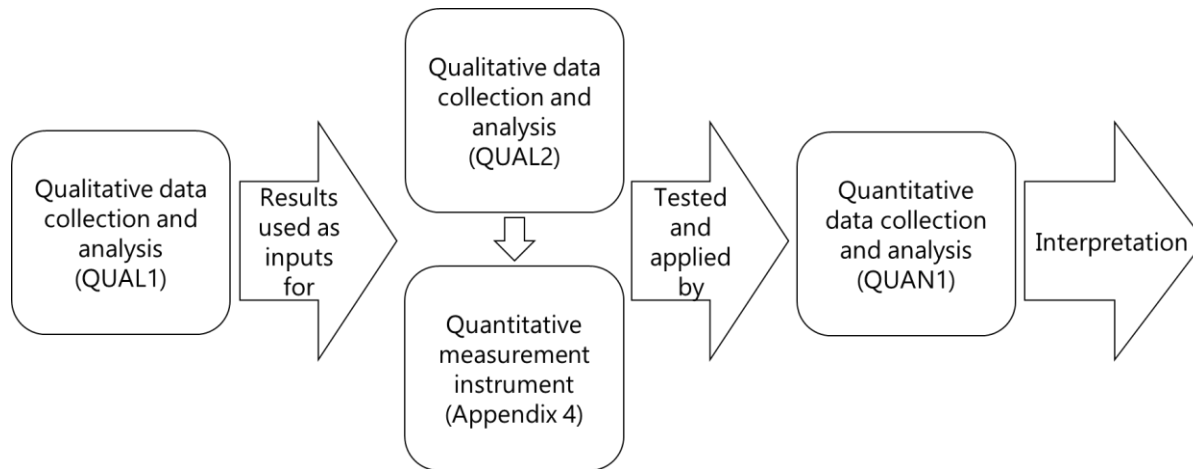
Abductive reasoning as the preferred option. From the three main forms of reasoning (i.e., deduction, induction and abduction), this research project is biased towards abductive reasoning although it makes use of all three. Abduction is about making use of the set of (robust) explanations that best justify the results obtained; it is also about interpreting evidence as inferences to explanations, without ruling out other alternative hypotheses (Johnson & Onwuegbuzie, 2004; Mantere & Ketokivi, 2013). This is very much what this research is about. Even the most inductive coding is, at some point, constrained by previous frameworks or mind-sets, and the most straightforward deduction can be confronted with a surprising (or contingent) fact not covered by the rule.

Engaged scholarship. Engaged scholarship can be defined as a collaborative form of research, where researcher and practitioners collaborate to co-produce knowledge by testing alternative ideas and different views on a common problem which is considered too complex to be captured by one investigator or perspective (Van De Ven & Johnson, 2006). This doctoral project advocates

in favour of engaged scholarship as a formula to reduce the theory-practice gap and enrich the research (Van De Ven & Johnson, 2006). Thus, the research design implies constantly triangulating the data and fostering dialogue between industry and academia, either by recruiting industry experts to interact with the research team or by analysing industry reports together with academic literature. Different (traditional and non-traditional) SC actors have participated in this research though not as funding sources; rather, they served as knowledge (co)producers engaged in sense-making of the collected data (Van De Ven & Johnson, 2006). In addition, they have also been data collection sites (fashion-apparel suppliers) and actively involved in the data collection for the quantitative study (industrial associations and fashion-apparel brands) (QUAN1).

Relevance of the (fashion-apparel) context. This doctoral research conceives the context (i.e., fashion-apparel SCs) as essential to understand the phenomena under study (traceability and transparency in CSR/(S)SCM) and the sense-making process of the data. Thus, special efforts have been made to understand the nuances of the sector from a sustainability perspective before undertaking the core part of the research (QUAL0) and to ensure the applicability of the findings to the particular context. As mentioned above, the focus of this work is the complex and global character of apparel SC and the trendy attributes of the product without any other (*a-priori*) differentiation in terms of fashion product (i.e., between fast-fashion, slow fashion or luxury fashion, for example). Although, for convenience reasons, at some point (e.g. QUAL0), the analysis focuses on just one segment (e.g., fast-fashion) of the fashion industry.

Figure 4. Summary of research design



Source: Adapted from Creswell & Plano Clark's (2018) generic exploratory sequential design

Table 8. Research outline

Phase	Research Method	Leading Role	Data Collection Techniques	Data Analysis Techniques	Output for Next Phase(s)	Additional Outputs (not 'used' in this dissertation)
Phase 1: Problem Statement, Literature Review, Research Objectives, Research Questions, Research Design: Academia+Industry						
QUAL0	Qualitative	<u>Industry</u> + Academia	Content analysis (sustainability reports)	Inductive coding and sense-making	- Contextualisation and confirmation of key practical problems	Fast-fashion Sustainability Scorecard
QUAL1	Qualitative	Academia	Integrative literature review	Abductive coding and sense-making	- TfS framework - Constructs for measuring instrument	Only two dimensions of the TfS Framework (i.e., collaboration and tracking and tracing are used in this dissertation. The governance dimension can be analysed in the future.
QUAL2	Qualitative	<u>Industry</u> + Academia	Delphi method: In-depth interviews and online questionnaire	- Abductive coding and sense-making - Frequency count	Relational model	The information regarding Fostering & Hindering Factors (including actors) can be further analysed.
Survey Building		<u>Academia</u> + Industry			Scales for questionnaire	Only two dimensions of the TfS Framework (i.e., collaboration and tracking and tracing are used in this dissertation. Governance dimension can be analysed in the future.
QUAN1	Quantitative	<u>Industry</u> + Academia	Survey technique	PLS-SEM	N/A	

Chapter 2. Traceability and Transparency for Sustainability – Literature Review and Conceptual Framework (QUAL1)

2.1. Background and Objectives

As discussed above, the absence of or incomplete traceability has been behind different social and environmental sustainability crises, tragedies and scandals, affecting industries as powerful and diverse as food, toys, mineral extraction and apparel (Busse et al., 2016; Khurana & Ricchetti, 2016; Wilhelm et al., 2016). These events have given rise to emergent voices that couple it with the need to transform complex global SCs into more transparent, sustainable and responsible networks (Closs et al., 2011), enabling companies and suppliers to trace social and environmental breaches (Pagell & Wu, 2009). Thus, traceability is interlinked with transparency to conform what in this doctoral research is understood as Traceability and Transparency for Sustainability (TfS or TTfS), which is the focus of the study. TfS is defined as the ability to combine SC information-sharing and visibility in such a way that actors within the chain have access to information that is accurate, trusted, timely and useful for operational reasons and to ensure the reliability of sustainability claims. SC traceability allows retracing steps back and forward and verifying the processes, history and locations of the products under consideration (Barratt and Oke, 2007, p. 1218; Brandon-Jones, Squire, Autry, and Petersen, 2014; Fawcett, Wallin, Allred, Fawcett, and Magnan, 2011).

Consequently, after introducing the background of this doctoral project as well as the problem statement and aim of the study, the next step is to map the literature in the confluence of traceability and transparency, sustainability and apparel SCs, searching for the organisational antecedents of traceability and transparency when deployed for sustainability (see table 5, QUAL1). This literature review not only represents an essential element to build the research outline; it is also the way to overcome one of the mentioned gaps/problems: the academic work addressing the intersection between traceability and sustainability, although evolving, is still scarce (Maruchek et al., 2011; Thöni & Tjoa, 2017).

Thus, the goal of this research phase is further concretised in the following RQs:

QUAL1.RQ1: How is TfS developed and implemented in global apparel SCs?

QUAL1.RQ2: How does TfS contribute to SC Sustainability?

2.2. Research Methods

In order to answer these RQs, the author carried out an integrative and systematic literature review by means of content analysis (Seuring & Gold, 2012; Torraco, 2005), which allowed blending

qualitative and quantitative (frequency) analyses when meaningful for the research (Seuring & Gold, 2012).

The content analysis and its codification process is based on Gioia, Corley and Hamilton (2013) and Saldaña, (2012). The integrative review design was determined as the most appropriate method as it is “a form of research that reviews, critiques, and synthesizes representative literature on a topic in an integrated way such that new frameworks and perspectives on the topic are generated” (Torraco, 2005, p. 356). To ensure its rigour and replicability, a systematic review was adopted, following the milestones proposed by Seuring and Gold (2012) summarized in Table 9. This ensures a transparent process and analysis and prevents a lack of rigour and biased results (Tranfield et al., 2003).

Table 9. Milestones for conducting literature reviews as content analysis

Milestones	Critical Considerations
Sample definition and material collection	Peer-reviewed articles exploring how TfS is developed and deployed in apparel SCs. Keyword search in academic databases (Scopus, Web of Science and EBSCOhost), completed with top 100 Google Scholar hits per relevance and citations.
Pattern of analytic categories	Open coding process that derived in key categories or themes to analyse and/or synthesize the material around the RQs.
Material evaluation	Critical assessment of the material that gave rise to the proposed conceptual framework.
Research quality	Reported quality measures in terms of replicability, reliability and validity.

Source: The author based on Seuring and Gold, 2012

2.2.1. Sample Definition and Material Collection

In line with the aim of this study and its RQs, the search focused on peer-reviewed articles intersecting traceability and transparency, sustainability and apparel topics in the SC context. Studies that only addressed a unique echelon of the SC and those that only examined interchanges between focal companies and customers were excluded. An exception were highly-cited articles, which were added to the sample following a snowballing process described further below. During that process, other texts with relevant insights and implications for the global apparel industry were kept in the sample, even if pertaining to other sectors. For example, this is the case with Regattieri et al. (2007) and Roth et al. (2008). Setting the boundaries around more generic apparel SCs was preferred given that delimiting the literature review to “fashion-apparel” would deliver overly limited results.

2.2.2. Search Strategy

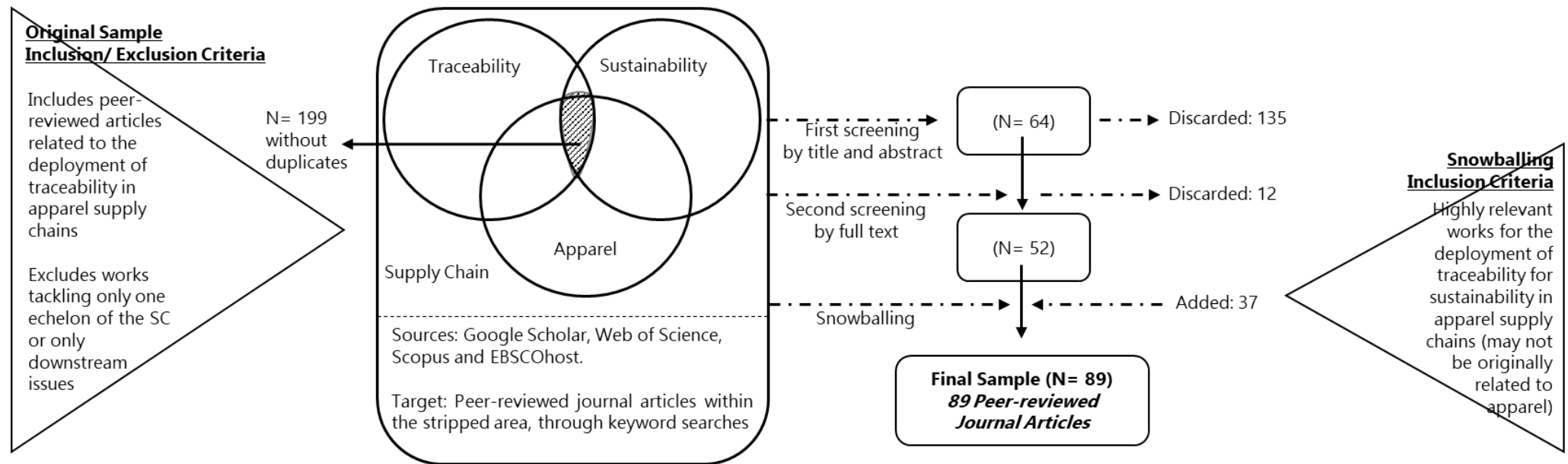
The search strategy (summarized in Figure 5) addressed the scattered nature of the literature in the targeted areas, implying a broad and transversal initial search. Thus, a keyword search in the Scopus, Web of Science and EBSCOhost academic databases was completed with an online search in Google Scholar. The keywords were exhaustively determined to find each document possibly related to the targeted intersection, applying an iterative process. For instance, even though the focus was initially on traceability, transparency was immediately included as inherent to traceability as well as other related terms such as 'visibility', 'RFID' and 'blockchain'. The complete list of keywords and the Boolean combinations that the author applied in the academic databases and Google Scholar searches are detailed in Table 10.

Table 10. Keyword search in academic databases and Google Scholar

Academic Database Search		
Topic	Keywords	Appearing in
Traceability	"transparency", "traceability", "tracking", "tracing", "visibility", "RFID", "EPC", "IoT", "blockchain"	Web of Science: Topic (TS) Scopus: Title, abstract, keywords (TITLE-ABS-KEY) EBSCOhost: Title, abstract, subject terms and keywords (TI-AB-SU-KW)
Sustainability	"stakeholder*", "sustainab*", "CSR", "TBL", "social issues", "health and safety", "health & safety", "EHS", "child labor", "slavery", "forced work", "labor issues", "human rights", "working hours", "wages"	
Apparel	"apparel", "garment*", "textile*", "cloth*", "fashion industry", "manufactur*", "retail*", "fast-fashion", "fast fashion", "fastfashion", "slow-fashion", "slow fashion", "slowfashion"	
Supply Chain	"supply chain*", "value chain*", "supply network*", "commodity chain*", "production network*", "SCM", "SSCM"	
Boolean Formula: (("transparency" OR "traceability" OR "tracking" OR "tracing" OR "visibility" OR "RFID" OR "EPC" OR "IoT" OR "blockchain") AND ("fast-fashion" OR "fast fashion" OR "fastfashion" OR "slow-fashion" OR "slow fashion" OR "slowfashion" OR "apparel" OR "garment*" OR "textile*" OR "cloth*" OR "fashion industry" OR "manufactur*" OR "retail" OR "retailer" OR "retailers" OR "retailing") AND ("supply chain*" OR "value chain*" OR "supply network*" OR "commodity chain*" OR "production network*" OR "SCM" OR "SSCM") AND ("stakeholder*" OR "sustainab*" OR "CSR" OR "TBL" OR "social issues" OR "health and safety" OR "health & safety" OR "EHS" OR "child labor" OR "slavery" OR "forced work" OR "labor issues" OR "human rights" OR "working hours" OR "wages"))		
Google Scholar Search (via Harzing's Publish or Perish software)		
Topic	Keywords	Appearing in
Traceability Sustainability Supply Chain	"traceability" "supply chain sustainability"	All fields

Only peer-reviewed journal articles were targeted as they "represent a major mode of communication among researchers" (Seuring & Gold, 2012, p. 547). The first keyword search in the academic databases returned 185 results after filtering out duplicates. This initial sample was completed with 14 new articles stemming from the analysis of the 100 top results (by citations and relevance (GS rank)) from an online search in Google Scholar using Harzing's Publish or Perish software. This ensured that no seminal papers on traceability or SC sustainability were left out.

Figure 5. Search strategy and sampling process



The author first screened the 199 peer-reviewed articles retrieved by title and abstract. Then the full text of 64 preselected pieces was analysed, reducing the collection to 52 documents able to shed light on the RQs. As suggested by Webster and Watson (2002), this initial sample was iteratively completed with the relevant references and citations (back and forward snowballing), a process that lasted until the last document did not produce any critical item. Figure 5 also shows the steps taken until defining the final corpus of the literature (n = 89 peer-reviewed journal articles). The publication outlets of these articles are shown in Table 11 and the 89 reviewed documents are marked with an asterisk (*) in the bibliography section at the end of the dissertation.

Table 11. Publication outlets

Academic Journal	Num. of Papers	%
<i>International Journal of Production Economics</i>	9	10.11%
<i>Journal of Business Ethics</i>	6	6.74%
<i>Journal of Cleaner Production</i>	5	5.62%
<i>Journal of Operations Management</i>	4	4.49%
<i>Journal of Supply Chain Management</i>	4	4.49%
<i>Supply Chain Management: An International Journal</i>	4	4.49%
<i>International Journal of Operations and Production Management</i>	3	3.37%
<i>International Journal of Physical Distribution and Logistics Management</i>	2	2.25%
<i>Production and Operations Management</i>	2	2.25%
<i>MIT Sloan Management Review</i>	2	2.25%
<i>Food Control</i>	2	2.25%
<i>European Management Journal</i>	2	2.25%
<i>Business Horizons</i>	2	2.25%
<i>International Journal of Retail and Distribution Management</i>	2	2.25%
Others	40	44.94%
Total	89	100.00%

2.2.3. Pattern of analytic categories

The author applied an abductive approach to category-building driven by the question of how TfS is developed and deployed in global SCs, all in constant dialogue with the previous literature for interpretation (Mantere & Ketokivi, 2013). Thus, a qualitative analysis of the literature based on inductive codification (Gioia et al., 2013; Saldaña, 2012) was undertaken followed by an iterative process, comparing inductive codes and categories directly derived from the literature with the analysis of prior theory, revisited until a robust conceptual framework arose (Mantere & Ketokivi, 2013; Saldaña, 2012; Seuring & Gold, 2012). Then, all the selected papers were coded following consecutive levels or cycles of analysis, as proposed by Gioia et al. (2013).

The first step involved open coding and included informant terms that emerged after reading each paper. This resulted in more than 650 codes referring to enablers and barriers appearing in the documents. The second step involved seeking first-order concepts, analysing similarities and differences as a descriptive analysis of the data (Gioia et al., 2013). First-order concepts included 399 nodes. The third codification step was based on second-order codes seeking highly abstracted concepts; this resulted in 32 categories. These 32 categories were further revisited and compared to finally refine them into three main elements: actors, enablers and barriers. These served to give content to the three aggregate dimensions of the analysis: governance; collaboration; and tracking and tracing, all of which represent the highest level of abstraction (Gioia et al., 2013). The three dimensions are discriminant to each other, while, together, they represent the complete picture of the phenomenon under analysis (TfS). These dimensions are explained in detail, together with their dynamic interrelations, in subsection 2.3. Findings and Discussion below.

2.2.4. Research Validation

The specialized software NVivo 11, supported the literature's coding process, helping to ensure the transparency and replicability of the process. To enhance the validity and reliability of the findings of the content analysis process and prevent subjective bias, four researchers were involved in the different phases (Seuring & Gold, 2012). The author of this dissertation was responsible for the initial first and second-order coding of the full sample. Said author randomly chose three papers which a second researcher coded in an early stage of the coding process. The discrepancies that arose between the two coders were resolved in dialogue with the literature, and the agreed interpretation of constructs was applied to the whole sample (Seuring & Gold, 2012). Once all the documents were fully coded, two researchers independently proceeded with the consecutive cycles of analysis, consolidating second-order themes, contrasting the codes, categories and concepts. They discussed disagreements until reaching consensus (Durach et al., 2017; Seuring & Gold, 2012). A reflexive process with the previous literature was adopted applying an iterative procedure, with constant back and forward dialogue with the theory to prevent expectancy bias (Durach et al., 2017; Mantere & Ketokivi, 2013). The final framework was open to the scrutiny of two additional researchers (Durach et al., 2017) through a validation process. This reiterative process across results helped to review and improve the original framework.

2.3. Findings and Discussion

These results start with the definition of the TfS components: the three aggregate dimensions (governance, collaboration and tracking and tracing) and their main elements (actors, enablers and barriers), which are summarized in Table 12.

Table 12. TfS aggregate dimensions and main categories

Governance Dimension	Collaboration Dimension	Tracking and Tracing Dimension
Traditional SC actors Focal companies (retailers) and (multi-tier) suppliers (*the articles related only to interchanges between focal companies and customers were not taken into account; for this reason, customers do not appear as main subcategory). Non-traditional SC actors Societal stakeholders (e.g., NGOs, media and environmental networks, etc.) Enablers Methods, actions, practices and systems that allow for TfS development or existence Barriers Circumstances or obstacles that prevent TfS from progressing		

2.3.1. The Aggregate TfS Dimensions

The three TfS dimensions and elements are detailed in the following subsections in connection to the reviewed sample and their frequencies. Table 13 includes this study's understanding of each dimension. This allows setting the limits of the three interlinked constructs, whose (blurred) boundaries have different interpretations in prior traditional and (S)SCM literature (Beske et al., 2014; Cao & Zhang, 2011; Chen & Paulraj, 2004b; Ellram & Cooper, 1990; Neutzling et al., 2018; Pagell & Wu, 2009; Seuring & Müller, 2008b). By combining these learnings with the content analysis of the reviewed sample, these three dimensions can be argued to be discriminant towards each other while, as a whole, comprising a comprehensive framework that explains the TfS phenomenon in global apparel SCs.

It is important to underscore that the dimensions and their elements respond to the development and deployment of *traceability and transparency for sustainability*. Dissimilar findings may be expected if the sustainability goal is removed from the *TfS* equation.

Table 13. Aggregate dimension definitions

Category	Definition	Core References
Governance	"Authority and power relationships that determine how financial, material and human resources are allocated and flow within a chain."	(Gereffi, 1994, p. 90)
Collaboration	Two or more autonomous actors that form long-term relationships and work closely to plan and execute supply chain operations towards common goals, thereby achieving more benefits than if acting independently.	(Cao & Zhang, 2011)
Tracking and Tracing	Conditions, organizational practices, processes and mechanisms required or directly involved in facilitating real-time tracing and monitoring of products and their history through the SC.	(Ajana et al., 2011)

2.3.1.1. Governance Dimension

Definition

In the global apparel SC context, the paramount example of buyer-driven SCs, governance is inevitably defined as the "authority and power relationships that determine how financial, material and human resources are allocated and flow within a chain" (Gereffi, 1994). The literature reflects how retailers located downstream in the SC lead the global network and are subject to external scrutiny; it also describes different governance processes and mechanisms that retailers promote or support and which foster TfS throughout the SC (Egels-Zandén et al., 2015). In the case of TfS technologies and practices, they transform (S)SCM governance, promoting new non-traditional SC actors and altering the power and authority relationships of traditional and non-traditional SC actors to frame the integration of TBL dimensions.

Actors

The analysis revealed the importance of non-traditional SC actors, especially NGOs, together with traditional SC players such as retailers, acting as focal companies, and (multi-tier) suppliers in order to articulate the organizational routines and practices of the TfS governance dimension.

Enablers

In line with the extant literature on interorganizational governance (Heide, 1994; Neutzling et al., 2018; Wang & Wei, 2007), this analysis found both formal and informal mechanisms shaping the governance dimension:

(i) Formal governance mechanisms include regulations, compliance mechanisms, corporate and supplier codes of conduct, industry-wide standards and certifications, industry self-regulation, audits and monitoring practices (Boström et al., 2012; Gobbi & Massa, 2015) that facilitate the emergence of TfS. In contrast to the food industry, in the globally deregulated apparel SCs, rules and mandates from focal firms appear to be more relevant than regulatory frameworks and standards from governments and institutions which, if they exist, are scarcely enforced (Bailey et al., 2016; Roth et al., 2008; Wognum et al., 2011).

(ii) Informal governance mechanisms include soft governance practices based on trust (or distrust) and relational control that retailers promote to enable TfS across the SCs (Aulakh et al., 1996; Ciliberti et al., 2009; Egels-Zandén et al., 2015; Hernandez-Espallardo et al., 2010). These informal governance mechanisms include whistle-blowing mechanisms, name-and-shame campaigns, informal visits to suppliers and factories, etc.

Barriers

The literature points to three main barriers that hinder the efficacy of the TfS enablers described above: the lack of regulation and enforcement compelling traceability and transparency; the non-existence of globally accepted standards (Boström et al., 2012; Laudal, 2010; Roth et al., 2008); and the audit-related problems such as audit fatigue or double record-keeping practices (Huq et al., 2016; Marshall et al., 2016; Plambeck et al., 2012).

Table 14 summarizes the governance dimension and shows the number of articles in the reviewed sample that mention each category in relation to TfS.

Table 14. Governance dimension

Governance Dimension Categories	Definition	Core References	Frequency (n of articles in the sample referring to the issue in relation to TfS)
Governance-related enablers			
Formal mechanisms	Formal control is based on internal rules and audits: Focal-firm-initiated mechanisms which are generally linked to specific economic (output control) and behavioural (process control) outcomes, respectively.	(Aulakh et al., 1996, p. 1013)	38
Informal mechanisms	Relational control based on trust: It does not control behaviour through explicit, verifiable measures. Rather, an informal control system consists of common values, beliefs and traditions that direct the behaviour of group members. Trust: Expectation that parties will make a good faith effort to behave in accordance with any commitments, be honest in negotiations and not take advantage of the other, even when the opportunity is available.	(Aulakh et al., 1996, p. 1008; Falkenberg & Herremans, 1995)	18
Governance-related barriers			
Lack of regulations/enforcement			18
Lack of standards			6
Audit-related problems			8

2.3.1.2. Collaboration Dimension

Definition

Collaboration is defined as two or more autonomous actors that form long-term relationships and work closely to plan and execute SC operations to achieve common goals, thereby reaping more benefits than if acting independently (Cao, Vonderembse, Zhang, and Ragu-Nathan, 2010). This is the backbone of traditional SCM (Chen & Paulraj, 2004b; Ellram & Cooper, 1990). Collaboration constitutes a strategic issue when targeting sustainability (and (S)SCM), compelling the participation of SC actors other than firms (e.g., social enterprises) and non-traditional SC actors (Pagell & Wu, 2009; Seuring & Müller, 2008b; Touboulic & Walker, 2015b). Traditionally linked to enhanced communication, information-sharing and technological integration (Beske & Seuring, 2014; Cao & Zhang, 2011; Chen & Paulraj, 2004b), it is thus not surprising that collaboration appears as one of the three main aggregated dimensions involved in TfS development.

Actors

Also not surprisingly, the actors found to be involved in the TfS collaboration dimension are a combination of traditional and non-traditional SC actors who collaborate using different formulas: from long-term relationships to all manner of multistakeholder initiatives and partnerships, including peer-to-peer collaboration (Boström et al., 2012; Doorey, 2011; Egels-Zandén et al., 2015).

Enablers

Under this category, this study includes collaborative practices, policies and routines that retailers enact to collaborate with other members and enhance shared goals towards the implementation of TfS (Cao & Zhang, 2011). In this respect, the reviewed literature shows the emergence of new types of collaboration (Pagell & Wu, 2009; Selsky & Parker, 2005; Touboulis & Walker, 2015a) between focal firms, suppliers and non-traditional SC actors to implement TfS. These include collaborative practices between peers (e.g., between focal firms or between suppliers) and between traditional SC actors and non-traditional SC stakeholders such as NGOs, private institutions and foundations forming multi-stakeholder collaborations (Doorey, 2011; O'Rourke, 2006; Plambeck et al., 2012). Through long-term relationships (Boström et al., 2012), collaboration ultimately results in alliances and partnerships (Burchielli et al., 2009; de Brito et al., 2008; Khurana & Ricchetti, 2016).

Examples include Fair Wear Foundation (FWF), the Sustainable Apparel Coalition (SAC), the Bangladesh Accord on Fire and Building Safety (now transitioned into the RMG Sustainability council) and the Global Fashion Agenda (GFA). Additional information can be found via their websites: <https://fairwear.org/>; <https://apparelcoalition.org/>; <https://bangladeshaccord.org/>; <https://www.rsc-bd.org>; and <https://globalfashionagenda.com/>.

Barriers

The analysis of the literature revealed two main obstacles: cultural differences and the lack of shared values and vision. These were responsible for hindering integration in global apparel SCs, in turn complicating the development of effective collaboration (Gobbi & Massa, 2015; Gold et al., 2010; Wilhelm et al., 2016). These barriers can be considered endemic within the global apparel industry due to their direct connection to complex and geographically dispersed SCs (Busse, Meinschmidt, et al., 2017; Roth et al., 2008). Eliminating these barriers is thus required for TfS to be effectively deployed in the apparel industry.

Table 15 summarizes the collaboration dimension and shows the number of articles in the reviewed sample that mention each category in relation to TfS.

Table 15. Collaboration dimension

Collaboration Dimension Categories	Definition	Core References	Frequency (n. of articles in the sample referring to the issue in relation to TfS)
Collaboration-related enablers			
SC collaboration	Two or more autonomous actors that form long-term relationships and work closely to plan and execute supply chain operations towards common goals, thereby achieving more benefits than if acting independently.	(Cao et al., 2010)	69
Long-term relationships	Long-term contractual commitments exist, but the relationship is often kept at arm's-length and adversarial, pitting the customer against the vendor in a battle focused on low price.	(Webster, 1992)	12
Partnerships	A small number of vendors/suppliers and focal firms incorporate a pattern of cooperation in the early stages of product development. Trust replaces adversarial assumptions.	(Webster, 1992)	20
Alliances	Partnerships to achieve some long-term, strategic goals and vision.	(Webster, 1992)	8
Collaboration-related barriers			
Local/cultural aspects and cultural distance			5
Lack of shared vision and/or values			7
Lack of integration (resulting from the above)			9

2.3.1.3. Tracking and Tracing Dimension

Definition

The tracking and tracing dimension comprises the conditions, organizational practices, processes and mechanisms required or directly involved in facilitating real-time product tracing and monitoring and their history throughout the SC (Ajana et al., 2011).

Actors

For the deployment of this dimension, the analysis revealed participation of traditional and non-traditional SC actors, both in bilateral relationships or through multi-actor platforms and networks. Regarding (S)SCM, the integration of enabling TfS technologies interconnects SC actors across

traceability systems, incorporating TBL variables (Ajana et al., 2011; Azevedo & Carvalho, 2012; Cannon et al., 2008; Maruchek et al., 2011).

Enablers

Visibility and transparency are the interlinked preconditions for effective tracking and tracing as they refer to having access to and enabling others to access qualitative and relevant data for their mutual operations and benefit (Barratt & Oke, 2007; Gold & Heikkurinen, 2018).

The literature shows that the presence and development of these preconditions is mainly supported by the consolidation of tracking and tracing capabilities such as technological tools and management systems (from the simplest record-keeping mechanisms to complex blockchain technology assuring provenance) (Golan et al., 2004; Tian, 2016) as well as traceability-oriented innovations that enhance capabilities and practices. Under this category, the literature includes both technological and organizational innovations seeking to extend information beyond traditional and non-traditional SC actors and authorities (Bailey et al., 2016; de Brito et al., 2008; Gobbi & Massa, 2015).

First, the integration of visibility is important, referring here to the extent to which actors have access to or share information that they consider important, useful and of mutual benefit (Barratt & Oke, 2007). Second, transparency becomes a core element, not only as a principle but also as a practice. SC actors include new enabling technologies that facilitate continuous disclosure and detailed information about their operations, sources and impacts (Gold & Heikkurinen, 2018). Third, the integration of traceability systems (which correspond to the traditional understanding of traceability) to facilitate real record-keeping and information-tracking processes throughout the entire SC (Golan et al., 2004). Fourth, traceability-related innovation including technological and organizational creativity is needed to extend transparency from traditional SC actors to non-traditional ones integrating TBL variables (Bailey et al., 2016).

Barriers

Similar to the findings for the previous dimensions, tracking and tracing processes are mainly obstructed by the social and geographic complexity of the apparel industry stemming from outsourcing and delocalization (Boström et al., 2012; Egels-Zandén, 2016; O'Rourke, 2006) and the lack of commonly accepted standards. These barriers range from the non-existence of a common definition of traceability to the lack of a unique technological language that would support the dimension's emergence and continuance (Marshall et al., 2016; Regattieri et al., 2007). Equally important is the cost of traceability both economically and organizationally (Cheng &

Simmons, 1994; Stranieri et al., 2017) which is preventing the originally predicted, widespread implementation of tracking technologies such as RFID (Balocco et al., 2011). The lack of resources and capabilities amongst SC actors (mainly upstream suppliers) aggravates the problem (Boström et al., 2012; Plambeck et al., 2012).

Table 16 summarizes the tracking and tracing dimension and shows the number of articles in the reviewed sample that mention each category in relation to TfS.

Table 16. Tracking and tracing dimension

Collaboration Dimension Categories	Definition	Core References	Frequency (n. of articles in the sample referring to the issue in relation to TfS)
Tracking and tracing-related enablers			
Visibility	"Extent to which actors within a supply chain have access to or share information which they consider as key or useful to their operations and which they consider will be of mutual benefit."	(Barrat and Oke, 2007 p.1218)	30
Transparency	"Acting in a way that enables others, both internal and external stakeholders to perceive and understand what the company does, as well as the quality disclosure of the information needed for this". "Transparency is not merely about sharing information but also about acting transparently."	(Gold & Heikkurinen, 2017, p. 5)	37
Traceability systems	"Recordkeeping systems designed to track the flow of product or product attributes through the production process or supply chain."	(Golan et al, 2004 p. 1)	33
Traceability-related innovation	Technological and organizational innovations necessary to extend information beyond SC actors and authorities.	(Bailey et al, 2016)	21
Tracking and tracing-related barriers			
Outsourcing/subcontracting			15
Complexity			39
Lack of standards			9
Costs			44
Lack of resources/ capabilities			7

2.3.2. Conceptual framework: TfS as a meta-capability

As Torraco explains (2005), the ultimate goal of an integrative literature review is the emergence of a conceptual framework that generates a novel perspective on the studied phenomenon. In this case, the findings from the analysis of the literature enable conceiving TfS as a distinctive meta-capability construct built on advanced levels of renewing DCs (Ambrosini et al., 2009; Collis, 1994). Thus, drawing on the dynamic RBV of the firm and its ramifications (RV, PBV and SPCV),

the following conceptual framework (Figure 6) is proposed to explain the development of TfS in global SCs.

The following subsections provide details on the emergence of the framework applying the DC transformation lens.

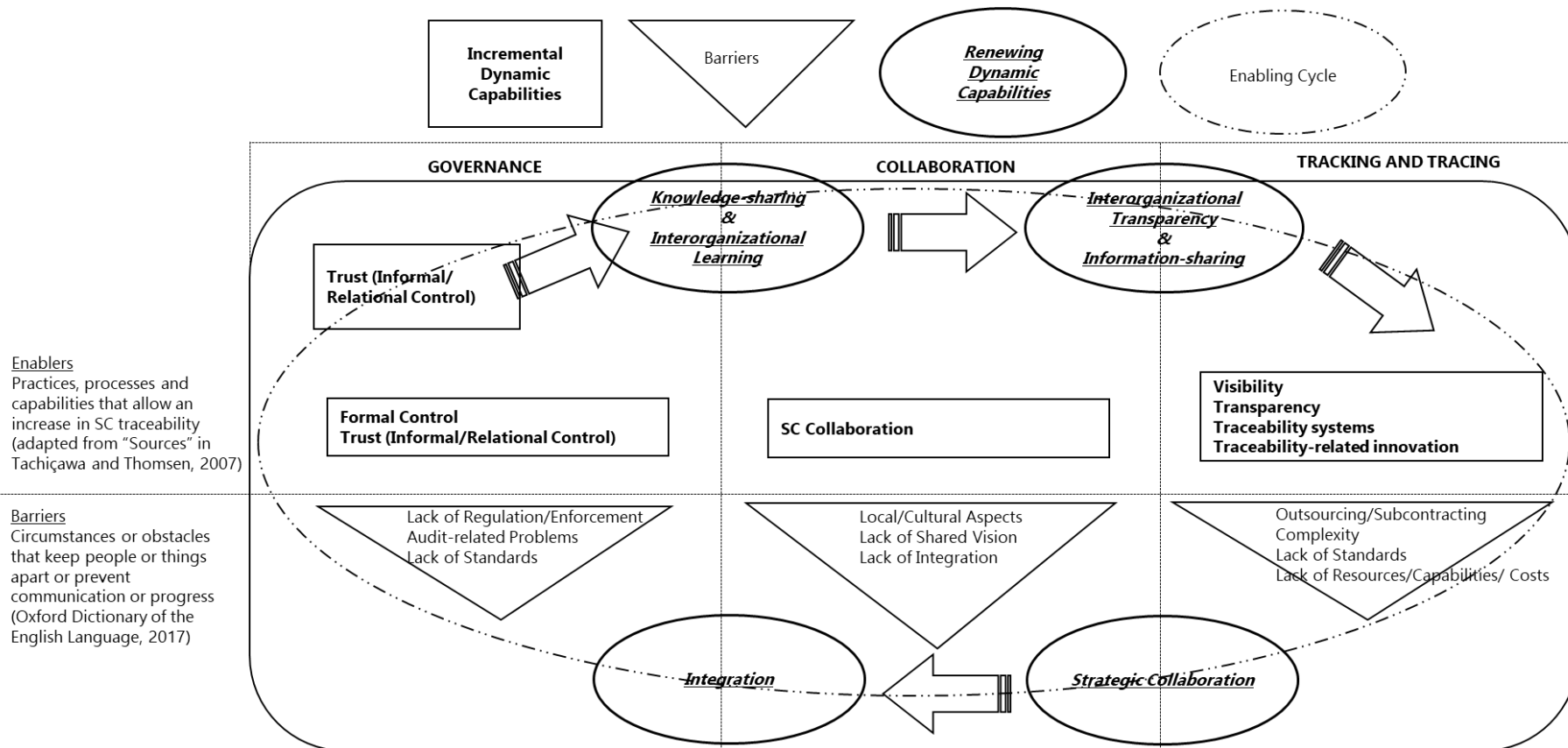
2.3.2.1. Renewing Capabilities for TfS

The results of the content analysis allow suggesting that the interconnected activities and interactions amongst the three aggregate dimensions and their main elements lead to advanced renewing DCs which, as discussed above, are capable of transforming the existing resource base through four main processes: reconfiguring; leveraging; learning; and integrating practices, routines and tools (Ambrosini et al., 2009). In doing so, these renewing DCs generate a higher meta-capability: *TfS*. Table 17 below describes the six key renewing DCs (Ambrosini et al., 2009), together with the number of articles that mention each DC in relation to TfS in the reviewed sample. These renewing capabilities are the following: knowledge-sharing; interorganizational learning; interorganizational transparency; information-sharing; strategic collaboration; and integration.

Table 17. Renewing capabilities

Renewing Capabilities/ Constructs	Definition	Core References	Frequency (N. of articles)
Knowledge-sharing for TfS	Regular pattern of inter-firm interaction that permits the transfer, recombination or creation of specialized knowledge.	(Dyer & Singh, 1998; Grant, 1996)	14
Inter-organizational learning for TfS	The collective acquisition of knowledge amongst a set of organizations. This includes the learning synergy or interaction effect between the organizations and which would not have occurred if there had not been any interaction.	(Jean & Sinkovics, 2010; Larsson et al., 1998)	11
Inter-organizational transparency	"Extent to which information is readily available to [...] other firms in the SC."	(Awaysheh & Klassen, 2010, p. 1249)	12
Information-sharing for TfS	The willingness to make strategic and tactical data available to firms, forming SC nodes.	(Cao et al., 2010)	47
Strategic collaboration for TfS	"Extent to which SC partners actually carry out planning on business activities with a shared objective to jointly improve the long term well-being of each other."	(Kim & Lee, 2010, p. 956)	16
Integration	Unified control (or ownership) of several successive or similar process formerly carried out independently.	(Flynn et al., 2010)	12

Figure 6. TfS as a meta-capability: The enabling cycle



Source: Garcia-Torres et al. (2019, p. 95)

The first two renewing capabilities (knowledge and learning) link to knowledge management. First, knowledge-sharing for TfS requires advanced organizational routines and learning practices related to traceability and sustainability that let focal firms, suppliers and other traditional and non-traditional SC actors transfer, recombine and create specialized (S)SCM knowledge. Therefore, the simplest form of codes of conducts between focal firms and suppliers or the individual audits carried out by a single firm can turn into public agencies, specialized media or platforms storing information or consortium audits preventing audit fatigue (Carter and Rogers, 2008; Guercini and Runfola, 2009; Huq, Chowdhury, and Klassen, 2016; Khurana and Ricchetti, 2016; Plambeck, Lee, and Yatsko, 2012). Second, interorganizational learning for TfS follows with the acquisition of new knowledge amongst different partners, including collective learning synergies and interactions (Larsson et al., 1998). Starting from ad-hoc supplier training provided by individual focal firms, complex learning routines become collective learning processes between traditional and non-traditional SC actors (Chkanikova and Kogg, 2015; Ciliberti, de Groot, de Haan, and Pontrandolfo, 2009; Huq et al., 2016; O'Rourke, 2006). The next two renewing capabilities are related to information: interorganizational transparency fosters and allows the exchange of open information inside the SC network (Egels-Zandén et al., 2015; Lamming et al., 2001, 2004). Information-sharing for TfS is based on seeing transparency and exchanges on TBL issues and impacts as a strategic and tactical practice that leads to increased efficiency (Barratt and Oke, 2007; Cao et al., 2010; Fernie, Sparks, and McKinnon, 2010). The last group of renewing capabilities is related to strategic goals. First, the strategic collaboration amongst SC partners to share objectives in the pursuit of TfS (Gold, Seuring, and Beske, 2010; Huq et al., 2016; Kim and Lee, 2010) leads to the sixth capability: integration. The latter is based on unified economic, social and environmental (S)SCM governance practices and processes (Flynn, Huo, and Zhao, 2010; Guercini and Runfola, 2009; Khurana and Ricchetti, 2016; Soosay and Hyland, 2015) and represents an advanced renewing capability that requires focal firms and suppliers to constantly collaborate and align themselves to achieve common goals and performance.

2.3.2.2. The Enabling Cycle: TfS as a Meta-Capability

Finally, this study argues that the sequenced interaction between this set of six renewing DCs with the practices, tools and actors within each dimension ultimately results in the emergence of TfS as a meta-capability that acts upon the system to transform and interconnect prior managerial, organizational and knowledge-based capabilities across SCs, moving towards more connected governance, collaboration and tracking and tracing dimensions. Understanding TfS as a meta-capability (or regenerative DC) (Ambrosini et al., 2009; Collis, 1994) refers to the creation of a

virtuous cycle in which previous DCs are reconfigured, leveraged, learned and integrated, giving rise to more complex and specific practices and tools that can disruptively transform prior (S)SCM processes and systems. This frames the emergence of new sustainable SC models in which traditional and non-traditional SC actors are integrated into the same ecosystem, and, with the adoption of the TBL approach, sustainable performance is enhanced throughout and beyond SC networks (Govindan et al., 2016).

Integrating economic, social and environmental needs in TFS demands new forms of governance and increasing collaboration. This, in turn, fosters new collaborative practices, for example, sustainability certifications, industry-wide codes of conducts and consortium audits. In addition, enabling technologies facilitate detailed transparency, sharing information and continuous knowledge exchanges between traditional and non-traditional SC actors to change prior conditions, practices, processes and traditional (S)SCM mechanisms.

2.4. Conclusions and Implications

This research has provided answers to the posed question of how traceability (and transparency) are deployed for sustainability through the proposed TFS framework. In the latter, traceability systems and transparency are considered incremental DCs belonging to the so-called tracking and tracing dimension. They are embedded in a virtuous cycle with other DCs pertaining to the governance and collaboration capabilities due to their interactions being associated to TBL (out)performance.

In addition, this study identifies barriers within the three dimensions which may jeopardise both the development of the DCs as well as the associated (out)performance.

Finally, the key actors involved in the deployment of the three dimensions have been distilled.

The proposed TFS framework contributes to (S)SCM as it represents an advancement on the 'how to' of traceability and transparency, considered key (S)SCM mechanisms.

In addition, QUAL1 represents a first step in reaching the main objective of this doctoral project. It proposes a theoretical but comprehensive approximation to traceability and transparency's definitions, boundaries and interrelations, as well as the barriers and actors contributing to (or jeopardising) their development in favour of sustainability.

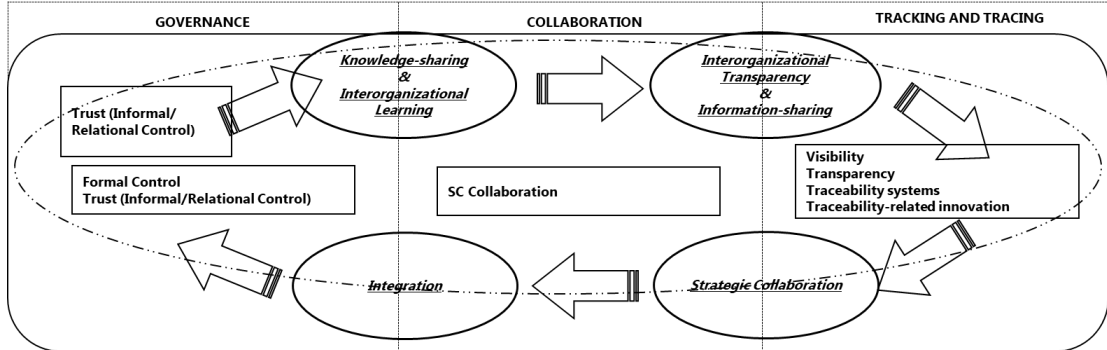
Table 18 below summarizes the RQ answers and highlights in bold the part of the main objective to which QUAL1 has contributed.

Building on these outcomes, QUAL2 will serve to contrast (and enrich) the academic insights with those from the fashion-apparel industry to determine operational and down-to-earth definitions of traceability, transparency, and sustainability, as well as their boundaries and interrelations. The DCs (i.e., enablers), barriers and traditional and non-traditional actors involved in the deployment of TfS are also part of the contrast.

In parallel, the three TfS dimensions are operationalized to build the survey instrument that will be used in QUAN1 (details about how the operationalization took place are provided in subsection 4.3.1).

An ad hoc (and extended) version of this research (QUAL1) was published by the author and colleagues in the journal Supply Chain Management: An International Journal (ISSN: 1359-8546): García-Torres, Albareda, L., Rey-García, M., & Seuring, S. (2019). Traceability for sustainability – literature review and conceptual framework. Supply Chain Management: An International Journal, 24(1), 85-106. <https://doi.org/10.1108/SCM-04-2018-0152>

Table 18. QUAL1-Objectives and research questions

Main objective: To understand traceability and transparency (definitions, boundaries and interrelations) when converging in the CSR/(S)SCM field and in the particular context of fashion-apparel SCs, and to propose and test an explanatory theory that may contribute to their development in favour of sustainability.	
Detailed Objectives QUAL 1	Research Questions
Analyse the organizational antecedents of traceability and transparency in apparel SCs	QUAL1: 1. How is TfS developed and implemented in global SCs? Through an evolving cycle that comprises three dimensions: governance, collaboration and tracking and tracing. Within each dimension, DCs are developed <i>ad infinitum</i> through their interaction with other DCs and the assistance of traditional and non-traditional SC actors. Both DCs and actors can evolve and work together to overcome the posed barriers.
Explore the consequences of traceability and transparency on apparel SC sustainability	 2. How does TfS contribute to SC Sustainability? (i) Traceability (and transparency) are re-conceptualized under the name 'TfS' as a core enabler of (S)SCM, incorporating new applications that include not only economic and operational efficiency aspects but also social and environmental implications. (ii) TfS is conceived as a meta-capability, thus associated to increased TBL performance (and competitive advantages).

Chapter 3. Traceability and Transparency for Sustainable Fashion-Apparel Supply Chains – A Delphi Study (QUAL2)

3.1. Background and Objectives

Building on the results from the integrative literature review, this study aims to concretize the TfS framework and further adapt it to the reality of the fashion-apparel industry by incorporating insights from key global fashion-apparel SC stakeholders.

Concretely, to help improve the consistency of the understanding of sustainability, traceability, and transparency and to leverage their deployment in practice in the specific realm of fashion-apparel SC sustainability, this study aims to: (i) operationalise the three concepts in the fashion-apparel SC context; (ii) examine how they relate to each other; and (iii) determine their key enabling and inhibiting factors. To this end, the author reviewed relevant academic literature and then informed with the perspectives of practitioners representing key stakeholders in the entire fashion-apparel SC (including fashion brands, suppliers and other main stakeholders such as NGOs, trade unions, governments, etc.).

The goals are further developed based on three research questions (RQs):

QUAL2.RQ1: How are sustainability, traceability and transparency operationalised in fashion-apparel SCs?

QUAL2.RQ2: How do the three concepts relate to each other?

QUAL2.RQ3: What are the key stakeholder groups, drivers and barriers that foster or hinder their implementation in practice?

3.2. Research Methods

Consistent with the aim of this study, actionable responses are sought for the RQs through an engaged scholarship method where knowledge is coproduced by researchers and practitioners (Van De Ven & Johnson, 2006). The Delphi technique was considered the appropriate one because it is "a method for structuring a group communication process [and] so is effective in allowing a group of individuals, as a whole, to deal with a complex problem." (Linstone and Turoff, 1975, p. 3). As a "group facilitation technique", the Delphi method consists of an iterative multistage process designed "to obtain consensus on the opinions of `experts'" (Hasson et al., 2000, p. 1009). Thus, starting from many different realities, the Delphi panel leads to a single one, defined through the interactions amongst the respondents (field experts) and the monitoring team (Linstone and Turoff, 1975), answering the RQs more appropriately rather than any individual expert's responses (Okoli and Pawlowski, 2004). A meaningful characteristic of the Delphi technique is its flexibility

to adapt the communication process to the circumstances and aims of each particular study (Linstone & Turoff, 1975). Here, the research design was devised to facilitate interaction and communication between the literature and practitioners –mediated by the monitoring team– in search of a comprehensive and consensual response that could serve as the basis for an industry-wide accepted framework (Guercini, 2004). In this study, fourteen industry experts along the whole fashion-apparel SC contributed with their experience and insights on the issues of sustainability, traceability and transparency in fashion-apparel SCs and discussed their practical implementation. The anonymity that the Delphi method provides compared to focus groups was a decisive factor when choosing it for this study as opposed to opinions and interests from the different (sometimes antagonistic) fashion-apparel SC stakeholder groups (brands, trade unions and NGOs, for instance) which could have blocked open reflection on the topic (Doorey, 2011; Linstone & Turoff, 1975).

The research was designed with the twofold goal of preventing the bias commonly associated to qualitative research and ensuring the reliability of the methods and the validity of the results. The method's reliability was pursued with the preparation of the Delphi rounds, the data collection process and the analysis of the results. An in-depth analysis of the literature informed both the interview protocol for the first round, based on in-depth semi-structured interviews, and the online structured questionnaire for the second round, designed to quantify the level of consensus attained. Then, before data collection, both the interview protocol and the questionnaire were pretested. Recording devices were employed (when allowed) and the interview notes immediately transcribed. The 'SoSci Survey Software', a public and free tool for scientific use (Sauer and Seuring, 2018), was applied to collect and process the data for the final round. In addition, the research team's engagement during the interpretative phase added additional 'trustworthiness' to the findings regarding the collected material (Noble and Smith, 2015).

The use of the Delphi technique *per se* enhances the validity of the results in comparison to one-off instruments (Okoli & Pawlowski, 2004). It reduces the potential bias of other forms of qualitative research as the collected data is contrasted amongst the different respondents within one collection phase and it globally validates results in the final 'searching for consensus' phase. This enables a high degree of internal validity, which is one of the strengths of Delphi studies (Sauer and Seuring, 2018).

The research design with the related gathering data methods is presented in Figure 7.

Figure 7. QUAL2. Research design

	Research Strategy	Data Gathering Method	Data Analysis Method	Output
Phase 0:	Literature Review - Academic peer-reviewed articles - Grey literature	- Academic peer-reviewed articles - Grey literature	- Inductive coding - Research team reflexion and discussion	Interview Protocol for Phase 1: - Existing/initial definitions for sustainability, traceability and transparency - Initial categories' taxonomy: drivers, barriers and SC stakeholders (and their role: pressuring or collaborative, agents)
Phase 1:	Delphi Study- Round 1	- Interviews to fashion-apparel SC experts	- Abductive coding - Research team reflexion and discussion	Questionnaire for Phase 2: - Proposal of co-created definitions for sustainability, traceability and transparency - Refined categories' taxonomy: fostering and hindering factors (i.e., stakeholder groups, drivers and barriers) - Proposal of co-created list of key fostering and hindering factors - Proposal of co-created relational model connecting the key variables of the research
Phase 2:	Delphi Study- Round 2	- Online questionnaire	- Frequency count of the answers	- Consensual definitions for sustainability, traceability and transparency - Consensual list of key fostering and hindering factors - Consensual relational model connecting the key variables of the research

3.2.1. Sample Definition - Respondent group

The Delphi group size does not depend on statistical power but on group dynamics to achieve consensus, 10–18 experts being the (flexible) recommendation found in the literature (Okoli and Pawlowski, 2004). In this study, the group was defined using a snowball sampling approach where participants were added to the research through referrals (O’Leary, 2010), thereby recruiting experts throughout the entire SC until ensuring that all the key stakeholders (fashion brands, suppliers and other key stakeholders such as NGOs, trade unions, government, scholars, etc.) were represented in the sample. Consequently, a “more holistic and systemic perspective [...] to address the global and interrelated sustainability challenges in the SC” (Pedersen and Andersen, 2015, p. 316) is achieved. The snowballing process began with four experts, each of them giving voice to a different fashion-apparel SC stakeholder group: a fast-fashion retailer, an audit company, a trade union and an NGO. The success of the Delphi outcome does not depend on achieving a representative sample but on recruiting the most relevant informed experts (Reefke & Sundaram, 2017). Thus, the experts were carefully selected for their knowledge on the topic and for being leading figures or highly respected experts within the industry at the international level. The sample was then cascaded through referrals until reaching fourteen contributors. Thus, even though the sample size prevents generalization as is typical for exploratory research, the participant experts in the sample represented a broad range of SC stakeholders in the fashion-apparel industry, allowing a holistic picture and theoretical saturation. Only two out of the 14 experts participated in only one of the two rounds. Thus, in-depth interviews were conducted with twelve fashion-apparel industry experts. For their part, the second round’s semi-structured questionnaires were also validated by twelve of the 14 participants included in the Delphi study. Table 19 details the composition of the respondent group (i.e., the sample).

3.2.2. Phase 0. Literature Review

The theory-practice dialogue, essential for engaged scholarship, began with an in-depth literature review whose outcome was the existing/initial operational definitions for sustainability, traceability and transparency and the categories’ taxonomy that led to the interview protocol for the in-depth interviews in the first round of the Delphi analysis. To the literature reviewed in QUAL1, the author added newer articles informing the confluence of the three variables and grey literature on industry initiatives and tools (RILA’s Retail Sustainability Leadership Model, Fashion Transparency Index or the Guide to Traceability of the Global Compact to cite just some). Replicating the analytical procedure, the articles were inductively coded, followed by the research team’s analysis, reflexion and discussion, leading to the most frequent/relevant definitions and categories of the fostering and hindering factors found in the literature. The existing/initial

definitions are included in Table 20.

Table 19. QUAL 2. Sample composition - participants

Fashion SC Stakeholder	Role within the Organization	Educational Background	Expertise Profile
Fashion brand	Sustainability Manager	Business Administration/Economics	Senior
Supplier	CEO/Sustainability Manager	Textile Engineering	Senior
Supplier	Sustainability Manager	Textile Engineering	Senior
Supplier	Sustainability Manager	Textile & Chemical Engineering	Senior
Trade union	Global Coordinator	Law	Senior
Public administration/regulator	Area Manager	Agricultural Engineering	Senior
Public administration/regulator	Parliamentary Assistant	Politics & International Business	Senior
Public administration/regulator	Parliamentary Assistant	Sociologist	Senior
Auditing company	Auditor	Forestry Engineering & CSR	Senior
Certification firm	Sustainability Manager	Chemical Industry	Senior
NGO	CEO	Design	Senior
Technical institute/university	Researcher & Lecturer	Textile Engineering	Senior
Technical institute/university	Researcher & Area Manager	Textile Engineering	Senior
Technical institute/university	Researcher & Lecturer	Textile Engineering	Senior

Table 20. Existing/initial definitions

Phenomenon	Existing/Initial Definition (in protocol interview)
Sustainability	"Sustainability refers to the need to address and manage issues across economic, social, and environmental dimensions in a balanced and integrated manner" (Reefke and Sundaram, 2017, p. 195).
Traceability (with a sustainability aim)	"The ability to identify and trace the history, distribution, location and application of products, parts and materials to ensure the reliability of sustainability claims in the areas of human rights, labour (including health and safety), the environment and anti-corruption" (United Nations Global Compact Office, 2014, p. 6).
Transparency	"The corporate disclosure of: (i) the names of the suppliers involved in producing the firm's products; (ii) information about the sustainability conditions within these suppliers' facilities; and (iii) the buying firms' purchasing practices" (Egels-Zandén et al., 2015, p. 96).

The initial categories' taxonomy was composed of drivers, enablers, barriers and SC stakeholders (and their role: pressuring or collaborative agents) which means that the factors that foster or hinder the three phenomena under analysis (sustainability, traceability and transparency) were broken down into the key stakeholder groups involved in their development and into the key fostering and hindering mechanisms (i.e., their drivers and barriers).

Regarding stakeholders, since fashion-apparel SCs are globalised with upstream suppliers distributed around the globe and the activities of the fashion brands (acting as focal firms) visible to the market, a broad range of groups are likely to play a role in the development of traceability and transparency for SC sustainability. These stakeholder groups can be internal (e.g., suppliers, fashion brands and customers) or external (e.g., government/regulators, NGOs, trade unions, media, society and competitors) (Rebs et al., 2018). In either case, they can adopt a pressuring or a collaborative role, or both (Rebs et al., 2018). Pressure is understood as pushing someone (or a company/department) to change its behaviour or situation (Gold et al., 2010). Collaboration refers to "two or more parties working together to achieve a common goal" (Moon et al., 2017, p. 4). Depending on the action performed, a single stakeholder group can play a pressuring and/or a collaborative role.

Regarding fostering (drivers) and hindering (barriers) mechanisms, they refer to the practices and tools capable of aiding or hampering the deployment of traceability and transparency for SC sustainability.

The interview protocol is provided in Appendix 1, and the peer-reviewed articles added to QUAL1's corpus of literature review are marked with (**) in the bibliography chapter.

3.2.3. Phase 1. Delphi Study - First Round: In-depth Interviews

This first phase consisted of in-depth semi-structured interviews to understand the phenomena from the experts' point of view (Guercini, 2004).

Data collection

Guided by the interview protocol, the experts were inquired about sustainability, traceability and transparency: their definition and portrayal –as a strategy, process or outcome–, their interrelations and the key stakeholder groups, drivers and barriers currently fostering or hindering their implementation in fashion-apparel SCs. Interviews were carried out between October 2017 and May 2018 by telephone and Skype (except for one case collected by email). They were recorded and transcribed, and, when not allowed, the interviewer took notes with the interviewee's consent. We conducted in-depth 50 to 120-minute interviews with 12 of the 14 fashion-apparel industry experts. The total processed material amounted to 13 recorded hours

and 72 transcript pages.

Data analysis

The author of this dissertation analysed the transcriptions and interview notes in detail following an abductive codifying process that enabled organizing the collected data into categories (Mantere & Ketokivi, 2013). The categories established in the RQs (definitions, relations, stakeholder groups, drivers and barriers) guided the codification process, and findings were enriched by iterative dialogue with the literature (Mantere & Ketokivi, 2013). NVivo 12 software supported the codification and analysis. The research team subsequently discussed the findings until reaching agreement. This analysis provided three differentiated definitions for sustainability, traceability and transparency, as well as a prospective model relating the three concepts and a compendium of stakeholder groups, drivers and barriers for each of them. Table 21 presents the evidence gathered from experts' interviews (quotations) and literature (references) supporting the interim results emerged after this first round. The interim list of stakeholder groups, drivers and barriers are provided in Appendix 2.

3.2.4. Phase 2: Delphi Study - Second Round: Online Questionnaire

As part of the iterative interaction between theory and practice mediated by the research team, the above-mentioned interim results led to the questionnaire (available in Appendix 3) sent to the experts to reach a consensual response to the RQs. This consensus was determined when agreement was over 65% of the collected responses. Agreement is classified as high when over 85% of experts agreed and medium when over 65% of experts concurred (Hasson et al., 2000).

Data collection

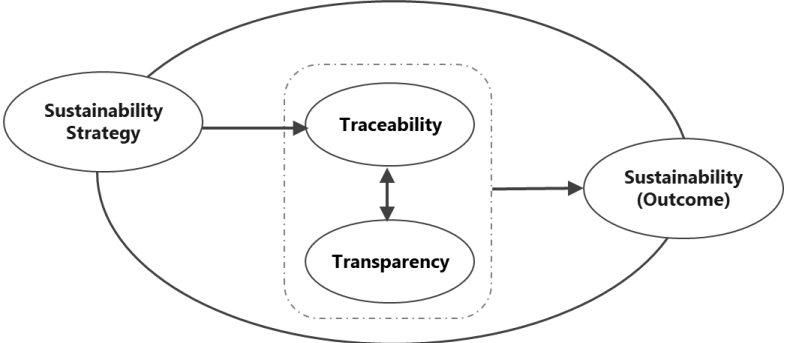
This round was conducted online. The questionnaire was created using 'SoSci Survey Software' and distributed by email to the sample experts. Twelve responses were collected (out of the 14 experts) from February to June 2018.

Consensus on the different questions was achieved immediately as per the criteria established for this study, thus eliminating the need for an additional round (Okoli and Pawlowski, 2004).

Data analysis

The analysis of the data collected in this second round was reduced to a frequency count of the affirmative answers, which showed consensus for the three sections.

Table 21. Interim results: Evidence from Delphi's round 1 data collection and analysis and the consensus achieved in round 2

Phenomenon	Definition/Level of Consensus	Evidence from Interviews	Evidence from the Literature
Sustainability	<i>"(Positive) Outcome of the optimization and management of the economic (including governance), social and environmental dimensions of any activity, with a strategic, integrated and transversal approach."</i> <i>75% agreement- Medium</i>	"Sustainability is the outcome reached thanks to a process outlined through a strategy." "Definitions in the literature miss a basic concept: transversality. TBL integration is needed but also their transversality along the SC and companies' departments" "When I read 'balance' in the definitions in the literature, I find it ambiguous. My balance can differ from yours and in the name of balance, I can favour business over other aspects. I rather prefer integration to balance"	Caniato et al. (2012); Fritz et al. (2017); Reefke & Sundaram (2017)
Traceability	<i>"Ability of an organization to identify and control the trajectory and conditions of each component, material, process and human resources related to its products, from its initial conception until the end of its lifecycle, with a triple objective: (i) operations/decision-making; (ii) track and trace processes and products; and (iii) ensure the reliability and the capacity to tackle sustainability claims regarding products and processes."</i> <i>92% agreement- High</i>	"Traceability is being able to know the trajectory of the product in each of its processes. From raw material extraction (...) to the end of life of the product." "Traceability should encompass all the echelons, from conception, design, materials, energy, all the resources used, materials, labour, process and transformation, packaging and sale." "From an economic point of view, ensuring traceability sounds interesting. (...). Getting closer to suppliers, getting to know them, having them perfectly aligned with my structure and with my operations and processes is fundamental for the economic part, independently of the social and environmental part."	Egels-Zandén et al. (2015); Garcia-Torres et al. (2019); Khurana & Ricchetti (2016); Macchion et al. (2015)
Transparency	<i>"Decision of an organization to reveal all the relevant information regarding its products and internal policies and practices to legitimate partners or stakeholders, so intellectual property rights are not at risk."</i> <i>67% agreement- Medium</i>	"We choose to be 100% transparent." "Decision to communicate in a truthful way" "I think it is not necessary to disclose to all customers and suppliers. It would be better to name an institutional agent to receive all the information for verification and control." "It is essential to define who is the legitimate expert of that information. If I want to be transparent about the workers' conditions, it is still important that this information is passed on to the unions, which are the ones that represent the legitimate interests of the manufacturers."	Carter & Rogers (2008); Egels-Zandén et al. (2015); Gold & Heikkurinen (2018); Roth et al. (2008)
 <i>75% agreement - Medium</i>		"Sustainability is a strategy, triggered by the company, which guides all the processes towards an adequate and sustainable result. " "There is a very narrow level of dependence between the three. Traceability and Transparency are necessary for Sustainability. (...) and traceability and transparency are both very intertwined" "Traceability and Transparency go hand in hand" "I don't know if we would communicate so transparently without having previously worked on traceability" "To be sustainable you need to be traceable and transparent." "Traceability is necessary for any company willing to be transparent, and only a traceable product can be sustainable."	De Brito et al. (2008); Doorey (2011); Garcia-Torres et al. (2019); Plambeck et al. (2012); Wognum et al. (2011)

3.3. Findings and Discussion

3.3.1. QUAL2-RQ1. How are sustainability, traceability and transparency operationalised in fashion-apparel SCs?

The participants' consensual understanding validated, with a medium-high degree of consensus, the definitions of the three constructs under analysis: sustainability, traceability and transparency, helping differentiate the three phenomena (Table 21). Sustainability was defined as a SC outcome (triggered by an internal strategy), traceability as an ability that a company (and, consequently, its SC) can acquire, and transparency as an internal decision.

Concerning sustainability, the concurred definition (75% agreement) refers to the outcome of strategic, integrated and transversal management, thus containing the two common (S)SCM characteristics revealed thus far (i.e., strategy and integration) whilst adding a third one: transversality. If strategy and integration are about embedding sustainability into corporate/SC strategy (Khurana & Ricchetti, 2016), transversality advocates for the necessary involvement of every single function, department and echelon within a company and its SC. (Egels-Zandén, 2016; Reefke and Sundaram, 2017). In fact, sustainability was the only concept interpreted by experts at the SC level; the other two were operationalised at the single organizational level.

Regarding traceability, the consensual definition (92% agreement), although aligned with the main body of the literature, presents some novel elements. The experts explicitly mention human resources as traceable subjects and the implicit inclusion of the full lifecycle, incorporating circular economy and closed-loop principles which are needed for sustainable fashion-apparel SCs.

Finally, the agreed definition of transparency (67% agreement) is in line with Lamming et al. (2004. P. 301), who see transparency as "intrinsically linked with action and commitment rather than posture and pretence", and with Gold and Heikkurinen (2018), who define transparency as "acting in a way that enables others [...] to perceive and understand what the company does." It adds a behavioural component to Egels-Zandén et al.'s (2015) umbrella term, "SC transparency", namely, a quasi-synonym for corporate disclosure, whereby 'reducing' transparency to a broad type of reporting which, although helpful, proves insufficient to achieve truly sustainable SCs (Wognum et al., 2011). The proposed definition applies a 'restrictive' approach, which limits the need to reveal information to "legitimate partners or stakeholders" only. However, transparency was the most contested construct for the experts due to the trade-off between protecting sensitive information and being opaque and the need to establish a minimum threshold of information disclosure that is regulated and monitored/audited by a third party. On this issue, one of the experts stated that "the protection of one's own privacy and competitiveness should be

interpreted in a rather restrictive way and follow the criterion established by a third party (ideally the regulator), same for all the businesses. If each business can establish its own criteria, we risk a race to the bottom.” Contrarily, another expert advocated “protecting company’s competitiveness when demanding any kind of information. Restricting transparency to stakeholders with a legitimate interest is key.”

3.3.2. QUAL2-RQ2. How do the three concepts relate to each other?

The relational model (the figure portrayed in Table 21) achieved unanimity (100% agreement) amongst the experts. It departs from the sustainability strategy, i.e., the managerial decisions and actions taken to create a sustainable SC (Pagell and Wu, 2009) which drives the sustainability outcome in a looped relationship. This relationship is mediated by traceability and transparency in a mutually reinforcing relationship. As one of the experts stated, “traceability and transparency are necessary but not sufficient conditions to ensure sustainability.”

The model underscores the traditional view of CSR/(S)SCM (understood as a sustainability strategy) as a driver (antecedent) of SC sustainability, which is conceived as an outcome (Pagell and Shevchenko, 2014). The novelty of this finding comes from, first, seeing the relationship as a virtuous cycle where the better the sustainability performance (outcome), the stronger/more developed the sustainability strategy, and, second, by envisioning traceability and transparency as mediators (processes) of that relationship in a mutually reinforcing association.

Regarding the virtuous cycle, these findings come to extend and structure what was already observed by Pal (2016) when referring to the “information transparency” mechanism for extended responsibility through servitisation. In his work, Pal illustrates how the strategic decision of participating in a used-clothing product service system leads to not only more direct sustainability benefits (mainly environmental) but also reinforces other strategic mechanisms such as more profound interaction with SC partners and collaborative decision-making (Pal, 2016). This would consequently result in better in-store collections and enhanced customer service (thus improving the economic and social dimensions) (Pal, 2016).

Regarding traceability and transparency’s mutually reinforcing association, the results revealed that traceability needs transparency for its deployment, and transparency in turn needs to be backed by traceability to deliver positive sustainability outcomes. The reasoning being that environmental and social dimensions benefit from monitoring, follow-up systems and rapid interventions in case of sustainability breaches enabled by traceability (Gobbi and Massa, 2015) and from the firm/SC’s self-discipline stemming from transparency (Egels-Zandén et al., 2015).

Economic improvements may come (*inter alia*) from the operational benefits of traceability that transparency strengthens (Lamming et al., 2004) as well as from transparency's potential as a market tool backed by traceability (Khurana and Ricchetti, 2016).

Thus, the coexistence of traceability and transparency is considered the process that connects the sustainability strategy (i.e. CSR or (S)SCM) to sustainability while, at the same time, contributing directly to improved sustainability performance. This extends Plambeck et al.'s (2012) claim that any sustainability efforts in the SC context must facilitate identification and visibility within the chain, as it moves from seeing transparency and traceability as necessary conditions for SC sustainability to also consider them as key assets to achieve improved sustainability performance.

3.3.3. QUAL2-RQ3. What are the key stakeholder groups, drivers and barriers that foster or hinder their implementation in practice?

The participants also reached agreement on the factors (i.e., stakeholder groups, drivers and barriers) that may foster or hinder the deployment of traceability and transparency for sustainable fashion-apparel SCs. For any factor to be considered key, it had to be identified as playing a pivotal role in the advance (or restraint) of either traceability or transparency as preconditions for sustainability. Only factors achieving over 65% agreement (i.e., at least medium consensus) were included in the analysis. These are presented in Table 22. Factors considered key for traceability AND transparency for sustainability are marked with an asterisk (*).

Stakeholder groups

The analysis of the responses portrayed a scenario in which suppliers, mass media and regulators obtained the highest level of agreement amongst the experts. For suppliers, experts reached the highest degree of consensus regarding sustainability/CSR departments as collaborators. The experts cited mass media and regulators as key pressure agents. They also indicated that mass media exerted pressure on retailers, whilst regulators put pressure both on retailers and suppliers.

In terms of retailers, the experts more recurrently cited the CEOs who exert pressure on suppliers upstream and sustainability/CSR and R&D departments (as collaborators).

Quite surprisingly, the experts did not cite NGOs as key for traceability and transparency deployment, nor did they point to the potential role of mass media (by disseminating best practices, for instance) and regulators as collaborators. The latter were related to the lack of public administration's formal support and guidance. As one of the experts pointed out, "there is the need for an external agent (ideally the regulator) that establishes and monitors traceability and transparency standards" for every company operating in the industry.

Drivers and barriers

The results identify protocols, ISO norms and quality systems as key drivers (Olsen & Borit, 2013) in line with that found in more advanced sectors (in terms of traceability) such as the food or pharmaceutical industries.

Consistent with the academic literature, collaboration between companies and stakeholders was the fostering element agreed on by the highest number of experts as key for both traceability and transparency. SC collaboration between companies and stakeholders is crucial to tackle complex situations such as tracking and tracing processes, products and parts throughout an innumerable number of tiers and actors who are geographically dispersed but aim to act transparently. Thus, consistent with the literature, collaboration may be pivotal in leveraging the potential of traceability and transparency as necessary mediators to achieve sustainability in fashion-apparel SCs. Turning again to the example on servitisation, the mediation role and mutually reinforcing association can also be seen. The direct “sustainability strategy-sustainability outcome” loop is assisted by traceability and transparency, which are also assisted by SC collaboration. SC collaboration will in turn benefit from improved traceability and transparency. The used-clothing product service system depends completely on traceability and transparency to exist. It demands traceability and transparency from all SC stakeholders (including customers) which reach higher levels over time that result in closer interaction amongst them, “building a trusted relationship, which in turn improves the service quality” (Pal, 2016, p. 464). Consequently, in a new form of virtuous cycle, traceability and transparency can be considered key mechanisms for collaboration and coordination in (sustainable) SCs.

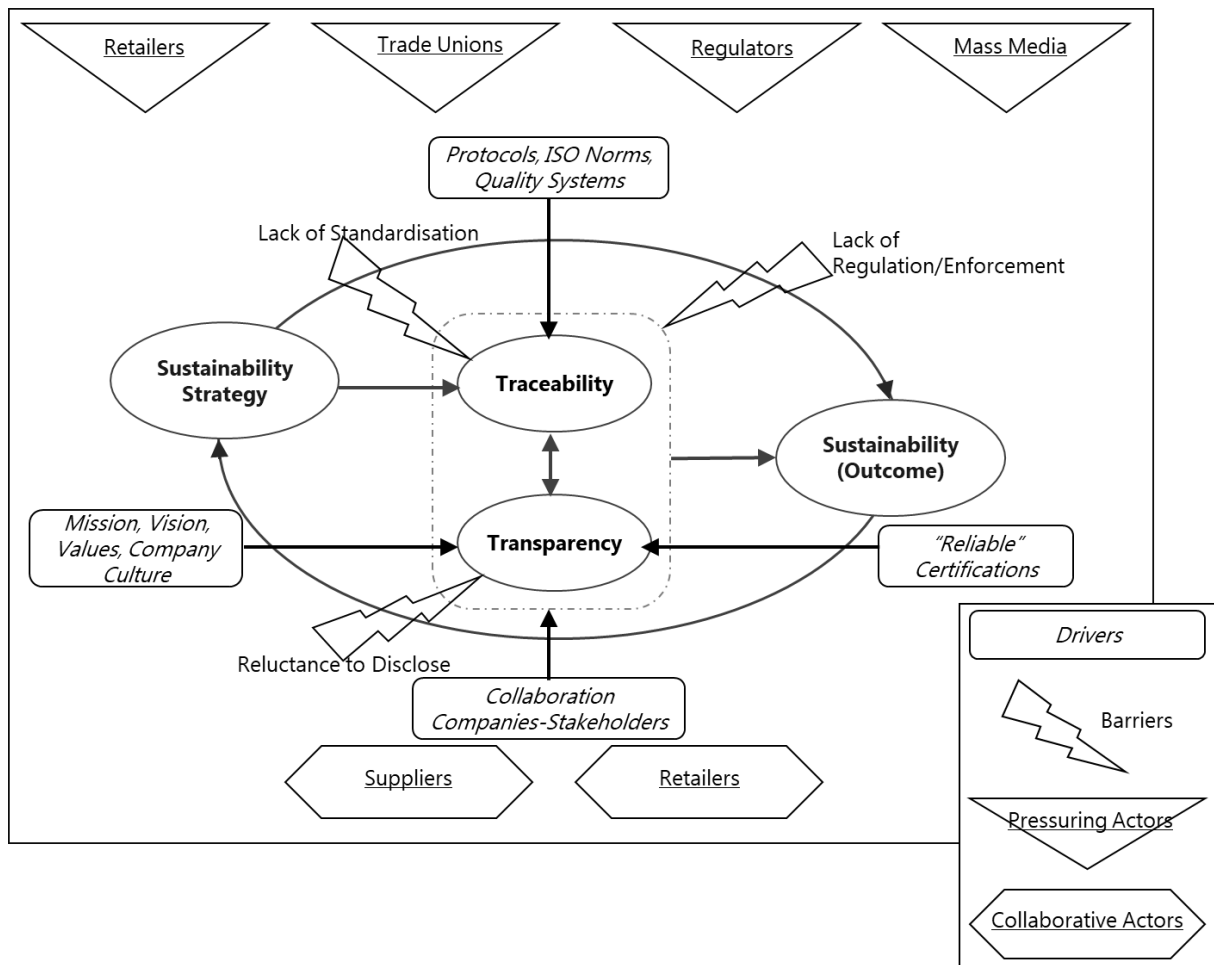
The barriers were strongly related to the need for standardised criteria and certifications, regulation and enforcement, described as a ‘lack of the drivers’ above. In addition, the results illustrate that the internal desire of companies to hide (or to not share or disclose) information represents an important obstacle for the deployment of the traceability and transparency needed for sustainable fashion-apparel SCs.

Figure 8 below sums up the relational model proposed and validated by the experts, integrating the key stakeholders and fostering and hindering factors agreed on by them. The drivers and barriers affecting both traceability and transparency (i.e., the ones marked with an asterisk (*) in Table 22) point to the dotted area that collates the two variables, whilst the ones influencing only one of them point to the relevant single variable.

Table 22: Fostering and hindering factors: Stakeholder groups and their roles, drivers and barriers

Fashion-apparel SC Stakeholder Groups		Role/ Level of Consensus		Illustrative Examples	Type of Mechanism	Mechanism	Level of Consensus	Description	References in the Literature
		Pressure	Collaboration						
Retailers	CEOs/top management	Medium		Exert pressure/force upstream suppliers to put traceability mechanisms in practice or disclose SC information.	Driver	Collaboration between companies-stakeholders (*)	Medium	Bringing multiple organisations together (private-sector partners and competitors, government, NGOs, etc.) to pool their expertise and resources and engage in inclusive, collaborative decision-making to tackle a complex problem.	Chen et al. (2016); Hardy et al. (2006)
	Sustainability/ CSR department		Medium	Assist/train suppliers on how to fulfil CEO's demands.		'Reliable' certifications	Medium	"Labels and seals about specific features of the supply chain, based on traceability standards and schemes."	Khurana and Ricchetti (2016, p. 98)
	R&D department		Medium	Research on traceability mechanisms (IT systems, RFID, tracer products, etc.).		Mission, vision and values	Medium	Common elements emanating from owners/CEOs that are transmitted to the entire company and the whole supply chain, determining their behaviour.	Caniato et al. (2012)
Suppliers	CEOs/top management		Medium	Collaborate with retailers to have their demands fulfilled.		Protocols, ISO norms, quality systems	Medium	Standards, tools and systems used to assist traceability and transparency.	Fritz et al. (2017); Wognum et al. (2011)
	Sustainability/ CSR department		High	Establish mechanisms and follow up to make sure demands from retailers are fulfilled.	Barrier	Lack of regulations or enforcement (*)	Medium	Even though some countries are improving their national laws, there is still no global regulation that requires companies to disclose the identity of the factories within their global SCs. In addition, when regulations exist, emerging economies have an additional problem related to the lack of enforcement.	Doorey (2011); Gobbi & Massa (2015); Huq et al. (2016)
	Quality department		Medium	Put in practice and monitor the protocols from CSR		Lack of standardised criteria and certifications	Medium	As a result of the lack of regulations/enforcement, companies develop their own systems, with the inconvenience of ill-defined standards and a lack of standardised reporting systems or common technology platforms. The proliferation in the market of a myriad of certification systems creates confusion, and delivering accurate information/messages is even more difficult.	Gobbi & Massa (2015); Marshall et al. (2016)
	Workers		Medium	Put in practice the protocols from CSR department.					
Other Groups	Mass media	High		Potential threat of "name-and-shame" campaigns.					
	Public administration regulators	High		California Transparency Act, Modern Slavery Act, etc.					
	Trade unions	Medium		Push retailers and suppliers to inform about SC workers' conditions.		Reluctance by companies to provide "certain" information	Medium	Companies are hesitant to share information that they consider proprietary and possibly damaging, either to protect their competitive advantage or to not risk their reputation.	Doorey, (2011); Maruchek et al. (2011)

Figure 8. Relational model, stakeholder groups, drivers and barriers



3.4. Conclusions and Implications

Based on the TfS macro-concept, this study has provided answers to the posed questions of how sustainability, traceability and transparency are operationalised in the fashion-apparel SCs; how the three concepts relate to each other and what the key stakeholder groups, drivers and barriers are that foster or hinder their implementation in practice.

The Delphi study's findings present operational and down-to-earth definitions of the three variables, with clear boundaries, insights and nuances specific to the fashion-apparel context and, thus, directly applicable to this industry. The study also presents a model that connects the three variables and the key fostering and hindering factors for the practical deployment of traceability and transparency as preconditions for sustainable fashion-apparel SCs. Traceability, defined as an ability, together with transparency, conceptualised as an internal decision, and assisted (*inter alia*) by collaboration between companies and stakeholders are found to be necessary but not sufficient conditions to achieve SC sustainability, conceived as an outcome.

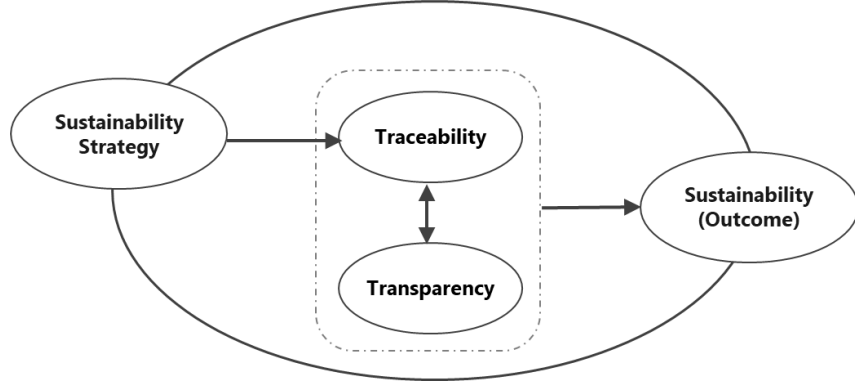
Regarding the stakeholders involved, the most surprising finding, which calls for further research, is that experts only consider suppliers and retailers as collaborative actors, despite collaboration between companies and stakeholders being key for traceability and transparency deployment in favour of sustainability.

Table 23 below summarizes the RQ answers and highlights in bold the part of the main objective to which QUAL2 has contributed.

Building on these outcomes, QUAN1 will serve to further define the proposed relational model in the form of an exploratory theory that could advance knowledge about how traceability and transparency are deployed in practice for sustainability. It will also help determine whether (and how) this sustainability outcome can be asserted, as well as analysing the role of collaboration between companies and stakeholders.

In parallel, the nuances of fashion-apparel reality concerning the three TfS dimensions are taken into account to build the survey instrument used in QUAN1 (details about how the operationalization took place are provided in subsection 4.3.1).

Table 23. QUAL2. Objectives and RQs

Main objective: Understand traceability and transparency (definitions, boundaries and interrelations) when converging in the CSR/(S)SCM field and in the particular context of fashion-apparel SCs and propose and test an explanatory theory that may contribute to their development in favour of sustainability	
Detailed Objectives QUAL 2	Research Questions
Help improve consistency in the understanding of sustainability, traceability and transparency within the practical and specific context of fashion-apparel SC sustainability Leverage traceability and transparency deployment in practice within the specific realm of fashion-apparel SC sustainability Specifically: (i) clarify the three concept, (ii) examine how they relate to each other, and (iii) determine the key enabling and inhibiting factors	QUAL2: 3. How are sustainability, traceability and transparency operationalised in fashion-apparel SCs? Traceability is defined as an ability, transparency as an internal decision, and sustainability as an outcome triggered by a strategy. 4. How do the three concepts relate to each other?  <pre> graph LR SS([Sustainability Strategy]) --> T([Traceability]) SS --> TR([Transparency]) T <--> TR T --> SO([Sustainability Outcome]) TR --> SO SS -.-> SO </pre> 5. What are the key stakeholder groups, drivers and barriers that foster or hinder their implementation in practice? Stakeholders: Retailers, trade unions, regulators and mass-media (acting as pressuring actors); suppliers and retailers (acting as collaborative actors) Drivers: Collaboration between companies and stakeholders; corporate mission, vision, values and culture; "reliable" certifications; and protocols, ISO norms and quality systems Barriers: Lack of regulations/enforcement; lack of standardization; and reluctance to disclose

Chapter 4. Traceability, Transparency and SC Collaboration - Combining Forces for SC Sustainability – An Empirical Analysis (QUAN1)

4.1. Background and Objectives

Following the outline of this doctoral project, this chapter describes the research carried out, building on the findings from QUAL1 and QUAL2, to operationalise and test the relational model coproduced and validated by fashion-apparel experts. The qualitative studies have provided support to consider SC collaboration capable of directly influencing sustainability whilst, at the same time, fostering traceability and transparency which act as (partial) mediators of such relationships. Specifically, in QUAL 2's model, traceability and transparency were unveiled as mediators between sustainable strategy (CSR/(S)SCM) and sustainability as an outcome. Its findings also pointed to SC collaboration between companies and stakeholders as key to assist traceability and transparency towards sustainability.

Now, the objective is to test these relationships, an objective that can be further broken down into five research questions (RQs):

QUAN1.RQ1: How does collaboration relate to traceability in fashion-apparel SCs?

QUAN1.RQ2: How does collaboration relate to transparency in fashion-apparel SCs?

QUAN1.RQ3: How does collaboration contribute to TBL performance in fashion-apparel SCs?

QUAN1.RQ4: How does traceability contribute to TBL performance in fashion-apparel SCs?

QUAN1.RQ5: How does transparency contribute to TBL performance in fashion-apparel SCs?

This research (QUAN1) addresses the objective of proposing and testing an explanatory theory that may contribute to the development of traceability and transparency in favour of sustainability.

SC traceability and transparency have already been deeply discussed and contextualised in the previous chapters as they constitute, together with sustainability, the primitive focus of this research project. However, as typically occurs in sequential mixed-method studies, SC collaboration stood out only later as playing a crucial role for the phenomena under analysis. On the one hand, collaboration appeared as one of the three dimensions enabling the emergence of TfS (QUAL1) and, on the other, collaboration between companies and stakeholders was highlighted by fashion-apparel experts as the key practice in deploying traceability and transparency for sustainability (QUAL2). Thus, before entering the hypothesis development section, a more in-depth overview regarding SC collaboration in the CSR/(S)SCM fields is merited, as well as clarifying its understanding and adaptation for the scope of this work.

As already mentioned, collaboration is the backbone of SCM (Chen & Paulraj, 2004b; Ellram & Cooper, 1990) and has been generally defined as “two or more autonomous actors that form long-term relationships and work closely to plan and execute SC operations to achieve common goals, thereby reaping more benefits than if acting independently” (Cao et al., 2010; Garcia-Torres et al., 2019, p. 91,92). Ellram and Cooper’s work represents a starting point for the expansion and importance given to collaboration in SC research and practice (Ellram & Cooper, 1990). In their study, collaboration takes the form of a “strategic partnership relationship”, defined as “a type of channel relationship” that intends “to yield differentiated and intermediate or long term benefit to the parties involved in the relationship” (Ellram & Cooper, 1990, p. 4). They further characterize these relationships as being “forward looking, tak[ing] place over an extended period of time and involv[ing] trust, and the associated sharing of information, risks and rewards” (Ellram & Cooper, 1990, p. 4). Although their work focuses on a dyadic relationship between shippers and third parties and in a particular context (logistics), they claim that SC collaboration (i.e., SC partnerships) can take multiple forms, as they might “differ in the number of parties involved, duties performed, nature of the duties treated and so on” (Ellram & Cooper, 1990, p. 9). Four can be highlighted as the defining (interlinked) characteristics of SC collaboration: (i) participants; (ii) time period; (iii) content and aims; and (iv) mechanisms. A countless number of SC collaboration types have been developed around these characteristics both in practice and theory, especially since SC collaboration constitutes an important research topic that has received increased attention since 1990 (Soosay & Hyland, 2015).

Regarding participants, the (traditional) SCM domain commonly distinguishes between: (i) vertical collaboration (i.e., collaboration amongst different echelons pertaining to the same SC, such as manufacturers/distributors, logistic third parties/retailers, buyers/suppliers, etc.); (ii) horizontal collaboration (i.e., collaboration amongst contractually unrelated or competing actors, such as two or more retailers, two or more logistic companies, etc.); and (iii) lateral collaboration, which combines vertical and horizontal efforts (Simatupang & Sridharan, 2002). Regarding the time period, SC collaboration can be divided into short, medium and long-term timeframes and is intrinsically related to the relationship content and aims. Whilst short-term collaboration seeks to solve concrete needs regarding products/services, long-term collaboration strives to “create superior service capabilities” (Simatupang & Sridharan, 2002, p. 20). Thus, (traditional) SCM understands SC collaboration’s ultimate aim as building “collaborative advantages” (i.e., competitive advantages grounded in a collaborative paradigm) thanks to economic, managerial and strategic improvements (Chen & Paulraj, 2004a, p. 122; Ellram & Cooper, 1990; Simatupang & Sridharan, 2002). Finally, with regards to the mechanisms for SC collaboration, (traditional) SCM

authors most frequently refer to trust/collaboration as based on cooperation (willingness) rather than on compliance (requirement) (Chen & Paulraj, 2004b), as well as information and resource sharing, joint decisions and even SC integration (Cao et al., 2010; Soosay & Hyland, 2015).

As already made explicit in QUAL1, SC collaboration also constitutes the backbone of (S)SCM, where its importance is increasingly growing as “it is widely accepted that sustainability cannot be achieved in isolation, and requires the involvement of SC members” (Soosay & Hyland, 2015, p. 621). What is more, SC collaboration for sustainability compels the participation of non-traditional SC actors (Seuring & Müller, 2008b; Touboulic & Walker, 2015b), fostering the emergence of new types of collaborative formulas that extend the boundaries of vertical, horizontal and lateral efforts to include non-traditional SC actors in the relationships (Pagell & Wu, 2009; Selsky & Parker, 2005; Touboulic & Walker, 2015a). Thus, within (S)SCM, SC collaboration emphasises collaborative practices between peers/competitors (e.g., between focal firms or between suppliers) and between traditional and non-traditional SC actors such as NGOs, private institutions and foundations forming multi-stakeholder collaborations (Doorey, 2011; O’Rourke, 2006; Plambeck et al., 2012). These multi-stakeholder collaborations constitute what is understood as cross-sector collaboration: multiple organisations (private-sector partners and competitors, government, NGOs, etc.) working together to pool their expertise and resources and engage in inclusive, collaborative decision-making to tackle a complex problem (i.e., SC sustainability) (Chen et al., 2016; Hardy et al., 2006; Koschmann et al., 2012). Cross-sector collaboration is considered to play a relevant role in the development of and transition to sustainable business models (Rey-Garcia et al., 2020), increasingly involved in addressing sustainability issues in SCs (Johnson et al., 2018). It has a preponderant presence in CSR literature and practice (Austin & Seitanidi, 2012a; Seitanidi & Crane, 2009; van Tulder et al., 2016) where cross-sector collaboration is frequently referred to as cross-sector partnerships or alliances (Austin & Seitanidi, 2012b; van Tulder et al., 2016). Hereafter in this study, the terms collaboration, partnerships and alliances will be used as synonyms, and only the first of the four defining characteristics mentioned above (i.e., participants) will be used to further unfold SC collaboration (as it will be explained below and in the building survey subsection). This will serve to provide a better understanding about how collaboration works in fashion-apparel SCs (e.g. to further investigate the surprising fact found through the Delphi study, namely, that NGOs did not achieve high consensus as critical actors for Tfs deployment amongst the consulted experts), as well as to ease the data gathering. No other distinction will be made (i.e., regarding the time period, content and aims or mechanisms). Consequently, any relationship with duration beyond one-off

transactions established to achieve common goals will be consider SC collaboration (i.e. collaborative relationships).

Moreover, there is a stream of collaboration literature that points to alliance portfolios (i.e., the aggregate number of alliances a company takes part in) as a unit of analysis in and of itself, deserving its own consideration regarding various dimensions: dispersion (i.e., represented industries); intensity (i.e., strength and participation over time), redundancy (i.e., degree of overlapping) or size (i.e., number) (Gutiérrez et al., 2016; Hoffmann, 2007; Wassmer, 2010). Regarding the latter (i.e., size), there is a corpus of research that links it (although many times not in isolation and dependent on the type of alliances) to positive outcomes in the form of innovation outputs or technological performance (Ahuja, 2000; Baum et al., 2000; Wassmer, 2010). These aloutcomes would translate within the scope of this doctoral research into improved SC traceability, transparency (and sustainability). This would be the result, for instance, from new tracking and tracing techniques/systems that these associations can foster; from greater mutual knowledge and trust amongst members; or from the collective awareness and pressure (implicit CSR) that belonging to associations may generate. Given the growing number of alliances (i.e. associations) in the form of multi-stakeholder initiatives, campaigns and coalitions (ZDHC, SAC, Global Fashion Agenda, Fashion Pact, etc.) in which fashion-apparel actors are taking part, it might be relevant to study this potential link in this research.

Thus, the queries about SC collaboration will be unfolded into questions about collaborative relationships (between different participants) and about the size of the alliances' portfolio (i.e. the degree of associationism that will be measured through the participation in associations).

4.2. Hypothesis Development

As discussed in the sections dedicated to QUAL1 and QUAL2, the relational model to be tested here is based on postulates from a dynamic compilation of the resource based, relational, practice and SC practice views, as well as stakeholder theory. The theoretical underpinnings that ground each of the hypotheses in the model are reviewed in detail below.

The information and resource sharing inherent to SC collaboration together with its pairing with communication suggest a positive association between collaborative relationships and SC traceability and transparency (Beske & Seuring, 2014; Cao & Zhang, 2011; Chen & Paulraj, 2004a).

Regarding traceability, improvements may be achieved from collaborative practices between suppliers and retailers when sharing the origin of the products (Closs et al., 2011), conjoint technological investments between SC members and associations (Florea et al., 2016; Soosay &

Hyland, 2015) or consortium audits carried out by joint initiatives such as the Bangladesh Accord on Fire and Building Safety or the RMG Sustainability Council (Huq et al., 2016; <https://www.rsc-bd.org/en>), initiatives that constitute remarkable examples of collaboration between brands, suppliers and trade-unions in the fashion-apparel industry.

Collaboration is also expected to provide a higher degree of transparency insofar as collaborative relationships provide technical, operational or financial assistance amongst actors and the willingness to collaborate implies the determination to share information (Marshall et al., 2016; Soosay & Hyland, 2015). Industry associations and NGOs (e.g., Sustainable Apparel Coalition with the Higg Index or Fashion Revolution with the Transparency Index) also play a much relevant role in fostering transparency by providing tools and platforms to ease disclosure and promote transparent behaviour (Brun et al., 2020).

Thus, the following hypotheses are posited:

H1: SC collaboration is positively related to SC traceability,

H1a: Collaborative relationships are positively related to the deployment of SC traceability.

H1b: The number of associations a company belongs to is positively related to the deployment of SC traceability.

H2: SC collaboration is positively related to SC transparency.

H2a: Collaborative relationships are positively related to the deployment of SC transparency.

H2b: The number of associations a company belongs to is positively related to the deployment of SC transparency.

Besides promoting SC traceability and transparency, SC collaboration is also assumed to have a direct and positive relationship with respect to SC sustainability (Gold et al., 2010; Sancha et al., 2016). This assumption builds on the relational view and SC practice view and their understanding of collaborative relationships as critically valuable organizational/SC assets (Carter et al., 2017; Hoffmann, 2007; Rey-García et al., 2019) since they point to interorganizational practices and stakeholder relationships as drivers of competitive advantages and outperformance (Carter et al., 2017; Dyer & Singh, 1998; Freeman, 2010). Doorey (2011) has even asserted that sharing information about sustainability aspects, even with competitors, would bring greater business value than hindering it (Doorey, 2011).

Austin and Seitanidi (2012) differentiated four sources or types of value: associational, transferred resource, interaction and synergistic (Austin & Seitanidi, 2012b). Associational value refers to reputation or projected credibility, simply for being in a collaborative relationship with another partner. Transferred resource value appears when receiving a resource (tangible or intangible) for another partner as part of this collaboration. Interaction value refers to those intangibles that derive (or improve) from collaboration processes themselves (e.g., trust, relational capital, learning, knowledge, joint problem solving, communication, coordination, transparency, accountability, and conflict resolution). Finally, synergistic value arises when the combination of resources from the collaboration partners allows them to accomplish more together than separately. One example is seen when, in a partnership, economic value is generated by creating social and environmental benefits (Austin & Seitanidi, 2012b).

Furthermore, through the stakeholder theory lens, the sustainability goal may act as the purpose or common interest which fosters SC relationships to achieve excellence through performance (Freeman, 2010; Hörisch et al., 2014).

As collaboration between traditional SC actors is at the core of (traditional) SCM, the examples linking collaboration to operational and economic outperformance are countless (related to efficiency, quick delivery, customer satisfaction, etc.). Just to cite some, Toyota's 'Just-in-Time' system is used as a paramount example of collaboration with suppliers to achieve resource efficiency and the minimum time to customer; similarly, fashion retailer Zara and its mobilizing of information from customers to suppliers to meet market demands in record time thus enhances customer satisfaction or logistic alliances to meet customer service objectives without increasing the number of warehouses (Dyer & Nobeoka, 2000; Ellram & Cooper, 1990; Irani et al., 2017). Examples illustrating the positive effect on the environmental and social dimension have recently taken off, as well as the number of cross-sectorial initiatives created to this end (Johnson et al., 2018). Besides the action of broader partnerships between traditional and non-traditional SC actors, buyer-supplier or peer-to-peer collaboration have also demonstrated to bring about TBL outperformance, mainly through improved efficiency, knowledge sharing and development practices (Chen et al., 2016).

Along these lines, the following hypotheses are postulated:

H3: SC collaboration is positively associated to TBL performance.

H3a: Collaborative relationships are positively associated to TBL performance.

H3b: The number of associations a company belongs to is positively associated to TBL performance.

Regarding SC traceability, it is positively related to economic performance for being an instrument for total quality or just-in-time systems (Alfaro & Rábade, 2009; Aung & Chang, 2014), process quality and security which in turn, protect brand reputation and allow for product differentiation (Kamann et al., 2019; Roth et al., 2008), as well as for flexibility, inventory performance and operational agility improvements (Kamann et al., 2019; Marconi et al., 2017). Regarding the environmental and social dimensions, SC traceability is reported to play a key role in ensuring environmental and social management along the SC. From the saying, "you cannot measure what you cannot detect; you cannot control what you cannot measure; you cannot manage what you cannot control", we could assume that SC traceability should be a precondition for environmental and social sustainability, especially since misuse and breaches cannot often be ascertained from the final products (Cheng & Simmons, 1994, p. 5; Wilhelm et al., 2016). Regarding the environmental dimension, the positive association may come from optimizing resource use by reducing raw material spoilage and returns, their better use and improved control over pesticides, chemicals or CO² emissions along the SC (Alfaro & Rábade, 2009; Mirzabeiki & Sjöholm, 2012; Wilhelm et al., 2016), as well as its indispensable contribution to circular models and reverse SCs (Kumar et al., 2016). Regarding the social aspect, SC traceability is highly relevant as a tool to prevent labour abuse, such as child labour, excessive overtime or modern slavery practices that cannot be traced in the end products (Cole & Aitken, 2019; Wilhelm et al., 2016).

Thus, it follows:

H4: SC Traceability is positively associated to TBL performance.

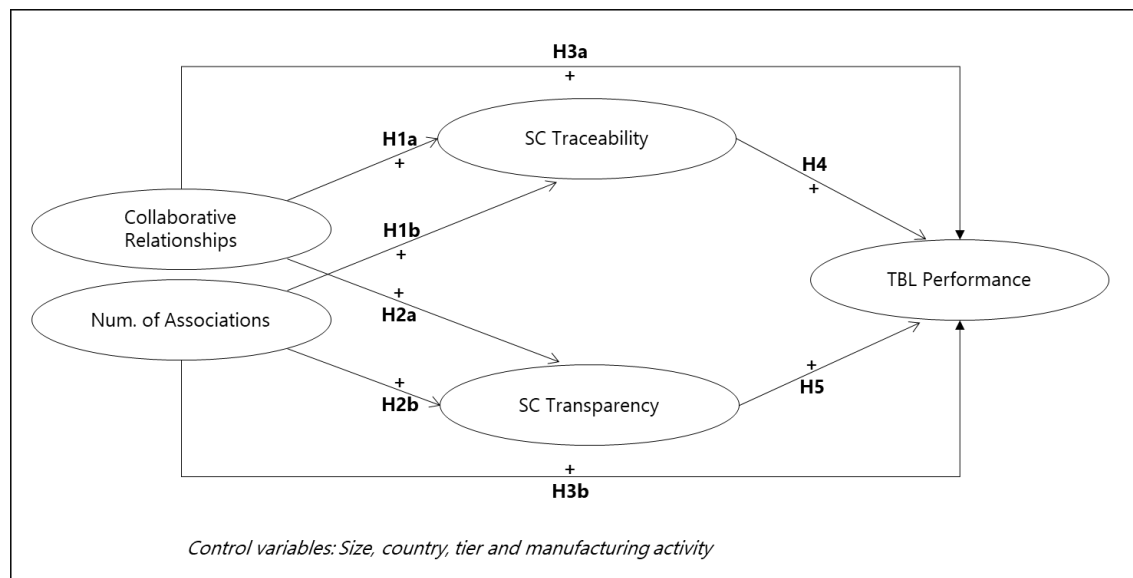
As previously discussed, SC transparency can be pivotal for the sustainability of global and complex SCs if treated as a means rather than as an end (Egels-Zandén et al., 2015; Mol, 2015). This is, on the one hand, thanks to being a marketing tool capable of transforming tracked and traced information into customer trust, "attach[-ing] value to the social and ecological consequences of the products" and influencing consumers' purchasing intentions (Dubbink et al., 2008, p. 392; Egels-Zandén et al., 2015; Gupta, 2010). On the other, it can provoke institutional learning and behavioural changes both by making best practices manifest and by encouraging managers to ameliorate the aspects that need to be reported and disclosed (Doorey, 2011). Regarding the environmental dimension, the literature associates transparency, especially its disclosing/reporting side, to improved environmental performance since it provides an inside-out insight into what is happening in the SC, thus fostering internal and external surveillance and pressure (Pagell & Wu, 2009; Wognum et al., 2011). The latter also impacts on the social side, as it safeguards any SC actor from being abused in any way, becoming a "strong element of social

responsibility” (Pagell and Wu, 2009, p. 49). Thus, transparency and its capacity to encourage environmental commitment is now being extended to social domains (Doorey, 2011). Furthermore, and even if the empirical literature has not reached a definitive conclusion (Mol, 2015), transparency is frequently associated to improved economic performance, serving as a tool for differentiation that increases reputation and credibility, ultimately building costumer trust (Dubbink et al., 2008; Egels-Zandén & Hansson, 2016; Stohl et al., 2016), as an opportunity to reduce costs over the long term thanks to a better knowledge of SC cost factors and actors (Wognum et al., 2011; Plambeck et al., 2012) or as promoting efficiency and avoiding errors throughout the SC, since transparency is associated to the absence of mistakes or rapid remediation when they occur (Fernie et al., 2010). Therefore, the subsequent hypothesis is posited:

H5: SC Transparency is positively associated to TBL performance.

Figure 9 depicts the research model.

Figure 9: QUAN1. Research model



4.3. Research Methods

4.3.1. Sample Definition and Survey Instrument Development

The starting population of this study was made up of Portuguese and Spanish apparel, fabric or yarn suppliers. The focus was Europe and, to minimize cultural differences that might affect the validity and comparability of the answers gathered by perceptual scales, only two close countries –Portugal and Spain– were chosen. The textile and clothing sector in Europe has undergone radical change in the last decade, moving towards high value-added products. It plays a salient role in the European manufacturing industry and accounts for 3% of value added of total

manufacturing in Europe and a 6% share of total employment (EU, 2013). Both Portugal and Spain rank as the biggest textile and clothing producers, especially when referring to apparel (EU, 2013). As part of the mixed methods design, the author created a survey instrument with specific items to measure the constructs of the TfS framework resulting from QUAL1. For this purpose, and building on the framework and its refinement and adaptation to the fashion-apparel reality, insights from academia and industry were contrasted and blended in search of scientific rigour and to ensure its easy understanding/applicability in the industry, thus ensuring the instrument's validity (Petter et al., 2007). This means guaranteeing both content validity, i.e., that the items forming the construct fully capture the meaning of the latent concept the construct represents (Boudreau et al., 2001; Petter et al., 2007; Straub, Detmar et al., 2004), and face validity, i.e., ensuring that the items are understandable and unambiguous for the target respondents. This is especially relevant when the survey method is used for SC research since, although necessary to advance knowledge, its particular conditions imply two main challenges, especially when gathering information about SC relationships: how to deal with polyadic constructs and how to gather information about companies, not individuals (Flynn et al., 2018; Krause et al., 2018). The author also considered how to best tackle these challenges when designing the ad-hoc questionnaire and the data collection strategy to prevent the common method bias associated to these difficulties (Podsakoff et al., 2003).

Dealing with polyadic constructs

The predictor variables of this study have been purposely designed as polyadic to gather SC states or behaviours as the primary level of analysis. In each case, and given that the information was collected from only one member of the SC (i.e., the respondent companies are suppliers within the fashion-apparel SC), the items in the measuring scales were chosen or composed, when possible, to ensure that the responses informing about other SC actors could be unequivocally ascertained from those responding to the questionnaire.

Aware of the challenges of gathering information about TBL performance for other actors in the chain, the author decided to keep this dependent variable as monodiatic, thus measuring performance just at the company level (i.e., respondent=fashion-apparel supplier). Table 24 summarizes the nature of the information collected and the level of analysis of each construct.

Table 24. Nature of information collected and level of analysis per construct

Construct	Respondent (through Informant)	Informants Surveyed about...	Level of Analysis
Collaborative relationships	Company (direct or indirect fashion brand supplier)	Own company's behaviour (presuming reciprocity)	SC (including traditional and non-traditional SC actors)
Num. of associations		Own company's behaviour (implying the existence of associations with other actors)	SC (including traditional and non-traditional SC actors)
SC traceability		Own company's product and components	SC (traditional SC actors)
SC transparency		Own company's behaviour ¹ & disclosure Supplier's behaviour & disclosure	SC (including traditional and non-traditional SC actors). The company's and the supplier's actions and disclosures have implications regarding the whole SC (traditional and non-traditional SC actors are the beneficiaries of transparent actions and disclosures)
TBL performance		Own company's behaviour (performance)	Company

¹ As it will be seen in the items forming the SC transparency scale, the measurement of '*own transparent behaviour*' in the survey (TRANSP6) is the most debatable one and will be reported as one of the limitations of this study, calling for further research in which the perception of transparent behaviour of SC members can be contrasted with other traditional or non-traditional SC actors.

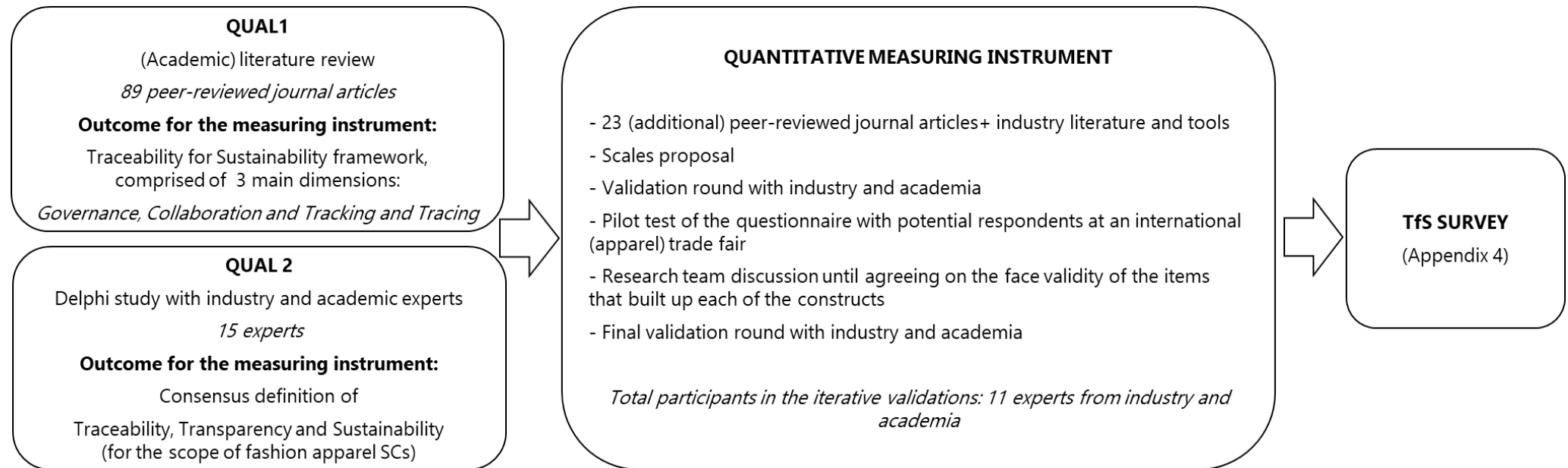
Gathering information regarding companies by surveying individuals

In order to avoid the potential bias associated to inferences to the company (i.e., respondent) from responses from individuals (i.e., informants), an effort was made to carefully select the key informants within the surveyed companies per their knowledge regarding the surveyed topics. Multiple informants within one company were also welcome (although this only occurred for two of the respondent companies).

Furthermore, aware of the impossibility of completely eliminating the mentioned biases, statistical control for common method bias was carried out as detailed in the *Statistical Analysis* section.

Figure 10 summarizes the survey building process. First, the author carried out an extensive review of the literature of the scales and indexes measuring the constructs. Industry literature and traceability, transparency and sustainability initiatives were also scanned to search for relevant items that might help to complement and adapt the academic scales. Second, a preliminary instrument was distributed to experts from academy and industry for validation. Third, a pilot test

Figure 10: Development of the survey instrument



of the questionnaire with potential informants/respondents was conducted at an international trade fair (Modtissimo, Porto, September 2018). Next, the research team discussed the insights until agreeing on the face validity of the items that build each of the constructs. Finally, a final round of validation was conducted. A total of 11 experts from industry and academia participated in the instrument's validation.

The survey contained the items to measure the variables underlying the three dimensions of the TfS framework. In this dissertation however, only the measurements used for the research model in Figure 7 will be presented and discussed (Appendix 4). They comprise 5-point Likert scales, with higher scores denoting higher levels of agreement with a particular statement, except for the number of associations (directly queried in the survey) and the information regarding size which was obtained from secondary sources (i.e., SABI data base).

SC collaboration

Taking the definition of collaboration as "two or more autonomous firms that form long-term relationships and work closely to plan and execute SC operations to achieve common goals, thereby reaping more benefits than if acting independently" (Cao et al., 2010; Garcia-Torres et al., 2019, p. 91, 92) as a starting point, there are different forms and degrees of collaboration that are likely to be associated to traceability, transparency and SC sustainability, as seen in QUAL1.

As a result, a myriad of scales to measure the different types and degrees can be found in the literature, each with its own nuances that make it relevant for the particular context. Some authors (e.g., Carter (2000); Paulraj et al. (2015); Sancha et al. (2016); and Vachon & Klassen (2008)) limit collaboration to traditional SC actors such as just customers and suppliers and delve into particular collaborative mechanisms (achieving collective goals, making joint decisions, training activities, etc.), or to the timeframes of the relationships (occasional transactions, long-term contracts, partnerships, etc.). Others (e.g., Cao et al. (2010); Cao & Zhang (2011)) open the focus to analyse collaboration amongst the generic term, 'SC partners', going into detail about what they define as the sub-components (mechanisms) of collaboration (goal congruence, resource sharing or collaborative communication, amongst others), but without disaggregating 'SC partners' any further. As a matter of fact, there is a lack of research about SC collaboration from the perspective of non-traditional SC stakeholders and competitors (Chen et al., 2016). This is in line with the absence (to the best of this author's knowledge at the time of creating the survey) of validated scales that measure collaboration at the disaggregated level. Thus, to adapt the measurement instrument to the particular context of this work and the insights from the QUAL1 and QUAL2 sequence which highlighted the new types of SC collaboration between SC actors and non-

traditional stakeholders as key enablers of collaboration (for sustainability) (Garcia-Torres et al., 2019), ad-hoc scales were developed to measure collaboration by means of two variables: Collaborative relationships (COLLRP) and Number of associations (ASSOC). COLLRP refers to the extent to which there is collaboration with the different traditional and non-traditional SC actors. ASSOC serves to gather the number of associations (i.e. alliances) in which the company responding to the questionnaire takes part.

Collaborative Relationships

Please rate the extent (1 = not at all; 5 = completely) to which:

COLLRP1 – Your company collaborates with its supplier

COLLRP2– Your company collaborates with its peers/competitors

COLLRP3– Your company collaborates with its client

COLLRP4– Your company collaborates with NGOs or other stakeholders without contractual relationships

Num. of Associations (as proxy for alliances)

ASSOC1- Please state the number of associations your company belongs to

SC traceability

Consistent with the lack of empirical development in the academic literature, it has been difficult to find validated scales that might serve as proper proxies to measure traceability, as understood after QUAL1 and QUAL2. The examples found (e.g., Green et al. (2017); S. Stranieri et al. (2016, 2017); Whitaker et al. (2007); Zelbst et al. (2010)) inform about specific aspects of traceability understood as a quasi-synonym for tracking and tracing systems (i.e., depth, breadth and precision of the information traced) or refer to its technical side (i.e., RFID adoption). However, they fall short in terms of informing about the ability to “identify and control the trajectory and conditions of each component, material, process and human resources related to its products, from its initial conception until the end of its lifecycle.” Thus, the scale used to measure traceability in this work stems from the operationalisation of the definition derived from QUAL1 and QUAL2, which is disaggregated as per the typology used in the EU Regulation on food security and traceability (a sector that constitutes, together with pharma, the most advanced industry in terms of traceability regulations). Such typology divides the tracking and tracing between ‘initial conception until the end of the lifecycle’ into three phases: production, processing and distribution. For the sake of clarity for the respondents, this was then translated into ‘internal upstream’, ‘internal and external downstream’ during the survey building triangulations. Accordingly, the scale is established as follows:

Please rate the extent (1 = not at all; 5 = completely) to which your COMPANY is ABLE to:

TRACE1 – trace the origin of the product upstream, outside your company

TRACE2 – track and trace the destination and origin of the product within the boundaries of your company

TRACE3 – track the destination of the product downstream, outside your company

SC transparency

In the literature, different scales can be found that measure SC transparency (see Awaysheh & Klassen (2010) or Morgan et al. (2018) for some examples). However, their understanding of the concept differs from the one developed here. This is not surprising as Bernstein (2017) already highlighted the difficulty of measuring transparency in a meaningful way ("meaningful defined as correlated with actual behaviour and performance", Bernstein, 2017, p. 229). Thus, the items used in this survey stemmed from the supported transparency definition in this study (Gold & Heikkurinen, 2018) and were complemented with the one created by Egels-Zandén et al. (2015) for the disclosure side. These were also validated in the survey validation process. They consist of five-point Likert scales (1= not at all; 5= completely) in which information regarding the company and the supplier was gathered.

Please rate the extent (1 = not at all; 5 = completely) to which:

TRANSP1– the supplier acts in a way that enables others to perceive and understand what the company does

TRANSP2– the supplier discloses supplier's names

TRANSP3– the supplier discloses supplier's sustainability conditions

TRANSP4– the supplier discloses internal sustainability conditions

TRANSP5– the supplier discloses own codes of conduct and internal policies (including buying practices)

TRANSP6– your company acts in a way that enables others to perceive and understand what the company does

TRANSP7– your company discloses supplier's names

TRANSP8– your company discloses supplier's sustainability conditions

TRANSP9– your company discloses internal sustainability conditions

TRANSP10– your company discloses own codes of conduct and internal policies (including buying practices)

Measured this way, SC transparency provides information about the company's (i.e., tier-1 supplier's) and its suppliers (i.e., tier 2 or +) with consequences/inferences at the SC level.

Sustainability

There are a myriad of measures and vast academic work dealing with how to measure sustainability performance. For the sake of simplicity and to keep the length of the survey instrument to an acceptable level, the author decided to measure the three dimensions with a unique item (Hair et al., 2016). Perceptual five point Likert scales were used, enquired as follows:

Please rate the performance of your company compared to its competitors (1 = much worse than competitors; 5 = much better than competitors) in regards to:

ENVPF –Environmental Performance

SOC PF –Social Performance

ECPF –Economic Performance

In this case, the information was gathered at the company level.

For 'Economic Performance', there was the possibility of using secondary information from the SABI database, which was indeed considered. However, that option was rejected as it would prevent comparing the economic dimension with the other two (environmental and social) as well as hindering the integration of the three items into the same TBL performance construct.

Control variables

Four control variables (size, country, tier and manufacturing activity) were considered for their potential capacity to influence the dependent variables in the model and the research model relationships.

Size was measured as the natural log of total assets. Country refers to the place where the respondent company (i.e., fashion-apparel supplier) has its headquarters, i.e., Spain (code 1) or Portugal (code 0). Tier refers to the position within the SC: the companies are classified as direct—i.e. tier 1—suppliers of fashion brands (code 1); or indirect—i.e. tier 2 or more—suppliers (code 0). Manufacturing activity relates to the company being a manufacturer (code 1), or having no manufacturing activity (code 0). The information regarding the two former control variables was obtained from the SABI database, and the one for the two latter was enquired in the questionnaire.

4.3.2. Data Collection

The SABI Bureau Van Dijk Database was used to map out and search the target population by NACE code. In addition, key textile associations/clusters in both countries collaborated to the recruit respondents by sending out the survey to their associates. Also, two workshops were given to members of these associations to inform them about the project and encourage their

participation. Two fashion brand companies and one specialized fashion-business newspaper were also involved in sharing the questionnaire. Table 25 lists all the industrial actors actively involved in the data collection process. Finally, the author visited international trade fairs in Portugal (Modtissimo; <https://modtissimo.com/en/>) and Spain (ITMA; <https://itma.com/>) where additional companies meeting the NACE code requisites were invited to take part in the study. Only two companies from the final sample do not appear in the SABI Bureau Van Dijk Database.

Table 25. QUAN1: Industrial actors involved in data collection

Name	Type	Country
AICEP- Agência para o Investimento e Comércio Externo de Portugal	Industry association/cluster	Portugal
ATEVAL- Asociación de Empresarios Textiles de la Comunidad Valenciana	Industry association/cluster	Spain
ATP- Associação Têxtil e Vestuário de Portugal	Industry association/cluster	Portugal
COINTEGA- Confederación de Industrias Textiles de Galicia	Industry association/cluster	Spain
Grupo Tendam	Retail company/fashion brand	Spain
Gk Green Fashion- Clúster de la Moda Sostenible de Gipuzkoa	Industry association/cluster	Spain
Moda Bizkaia- Cebek- Confederación Empresarial de Bizkaia	Industry association/cluster	Spain
SKFK- Skunkfunk	Retail company/fashion brand	Spain
TEXFOR- Confederación de la Industria Textil	Industry association/cluster	Spain
Modaes	Fashion business mass-media company	Spain
We Jane	Retail company/fashion brand	Spain

A total of 7,761 companies were contacted. Data was collected between January 2019 and January 2020 by telephone, email, personal interviews or directly online with the support of 'SociSurvey' and 'Acrobat Forms'. The questionnaire was developed in English and translated to Portuguese and Spanish (Appendix 4).

There were 141 total collected observations. For an observation to be susceptible to enter the final sample, the informant had to have completed at least 70% of the items. There were two companies (i.e., respondents) for which more than one answer was collected (i.e., multiple informants). In one of the cases where all the informants corresponded to the same department, the average response was used. In the other, as only one of the informants dealt with fashion products, the decision was made to only keep that informant's. After analysing the 141 observations in search of possible data entry errors and suspicious patterns, comparing maximum, minimum and mean values, the author removed two additional observations, leaving a total of

139 valid cases for the analysis. Table 26 shows the sample structure. Regarding the informants, due to the companies' small or medium size, they were mainly owners/CEOs of the companies or employees with multi-departmental responsibilities (57.55%); followed by buying/sourcing, sales/marketing and sustainability/CSR's department professionals (10.07%, 7.19% and 6.45%, respectively). The complete profile of the informants is shown in Table 27.

Table 26. Sample composition - Respondents

Number of Employees	%	Position in the SC	%
0-25	64.44%	Tier 1	68.35%
25-50	14.07%	Tier 2 or +	31.65%
51-100	9.63%		
101-250	8.15%		
>250	3.70%		
Annual Turnover (Thousands €)	%	Manufacturing	%
0-500	28.47%	Manufacturing companies	72.66%
>500-1,000	7.30%	Non-manufacturing	27.34%
>1,000-5,000	34.31%		
>5,000-10,000	10.95%	Company's Country	%
>10,000	18.98%	Spain	48.20%
		Portugal	51.80%

Table 27: QUAN1. Sample Composition - Informants

Informants	%
CEO	63
Multi-department	9
Buying/Sourcing	17
Sales/Marketing	14
Sustainability/CSR Department	10
Administrative tasks	8
Quality	6
Finance/Accountancy department	4
Production/Operations/SC	4
R&D	3
Design Department	1

4.3.3. Statistical Analysis

Partial Least Squares Structural Equation Modeling (PLS-SEM) is a second generation variance-based multivariate technique that combines principal component analysis for construct measurement (measurement model) and regressions to determine the relationships amongst constructs (structural model) (Henseler, Ringle, et al., 2016; Kaynak et al., 2015).

PLS-SEM is useful for exploratory and explanatory purposes (as opposed to covariance-based SEM (CB-SEM) which aims to confirm existing theories), as is the case of this study: testing an explanatory theory still at an early stage where exploratory goals are very present (Hair et al.,

2016). Therefore, the focus is on finding significant path coefficients linking the predictors and the dependent variable(s) and explaining the variance of the latter (Hair et al., 2016).

The constructs or latent variables forming the model can be classified into behavioural or designed conceptual variables, i.e., between factors and composites. The former represent ontological entities that exist in nature, irrespective of scientific investigation (Henseler, 2017, p. 178) and are normally modelled using reflective (i.e., common factor) or causal-formative measurement models (Henseler, Ringle, et al., 2016; Sarstedt et al., 2016). The latter (i.e., composites) are human-made conceptual artefacts, resulting from theoretical thinking and thus related to constructivist epistemology (Henseler, 2017). In composite measurement models, the constructs (i.e., composites) are fully (i.e., without error term) defined by their indicators, which are coefficients of composition not of causality (i.e., they are *formed by* not *caused by* their indicators (Henseler, Ringle, et al., 2016; Sarstedt et al., 2016), thus being approximations of the reality under study and proxies of the latent concept they represent (Hair et al., 2016). This is the case with the variables in this study, which have been defined through a process of theoretical reasoning to represent the different concepts under analysis: collaborative relationships, SC traceability, SC transparency and TBL performance. Each of these is a (linear) combination or aggregation of their indicators, which can be seen as the ingredients in a recipe and the researchers as the cooks (or designers) who have chosen those specific indicators (Henseler, 2017).² Thus, the four concepts are a weighted linear combination of their indicators, each indicator with a specific weight (Sarstedt et al., 2016).

When the variables in the model are composites, the PLS-SEM method and not CB-SEM is considered the appropriate technique (Henseler, Hubona, et al., 2016; Peñalba-Aguirrezabalaga et al., 2020; Sarstedt et al., 2016), thus making PLS-SEM the right choice for this study.

A two-stage PLS-SEM analysis is carried to ensure that conclusions regarding variable relationships were only drawn after the measurement model had been validated and proved reliable (Barclay et al., 1995). Thus, in a first stage, the measurement model was tested (i.e., the validity and reliability of the indicators), while, in the second stage, the structural model was assessed (i.e., the postulated hypotheses regarding patterns amongst variables and the variance explained).

The SmartPLS 3 v.3.3.3 (<http://www.smartpls.com>) statistical software was used to analyse the research model and the means and standard deviations of the sample indicators.

² Constructs with only one indicator (as is the case with ASSOC and the control variables) are set equal to their indicators.

Prior to the measurement and structural models' evaluation, two additional verifications are carried out. The first one to ensure that the sample size is sufficient to analyse the posed model and second, the statistical control to detect potential common method bias.

Following Cohen's recommendation, the size of this study's sample, although limited, can be considered sufficient for a statistical power of 80%, at a significance level of 5% for TBL performance and transparency and at a 10% for traceability (Cohen, 1992). According to Cohen (1992), the minimum sample size depends (in addition to the statistical power and the significance level) on the model's most complex regression (in the case of this research, it would be TBL performance, with nine predictors) and the expected R^2 (in this case >25% for TBL performance, >20% for transparency and <10% for Traceability) (Cohen, 1992). Considering nine predictors, the sample size should not be lower than 84 for $R^2 > 25\%$ at 5% and lower than 143 for $R^2 < 10\%$, which is close to the 139 observations included in this study.

Regarding common method bias, as data was collected through a single method (i.e., survey), this presented the possibility of what is known as common-method bias (e.g., the influence of the instructions given in the survey or social desirability) (Kock, 2015; Podsakoff et al., 2003). To determine the extent of method variance in the dataset, a full collinearity test specially conceived for PLS-SEM (Kock, 2015). This test includes both vertical (predictor-predictor) and lateral (predictor-criterion) collinearity analyses. According to Kock (2015), if all the variance inflation factors (VIFs) resulting from a full collinearity test are equal to or lower than 3.3, the model can be considered free of common-method bias. The highest VIF in our model (see Table 28) was 1.399, well below the 3.3 threshold.

Table 28. Predictor-predictor and predictor-criterion VIF values

	01 TBLPF	02 TRACE	03 TRANSP	04 COLLRP	05 ASSOC	06 SIZE	07 COUNTRY	08DIRECT/ INDIRECT	09 MANUF
01TBLPF	1.356	-0.031	-0.356	-0.327	-0.101	0.029	0.009	0.319	-0.239
02TRACE	-0.031	1.132	-0.212	-0.070	-0.172	-0.050	-0.108	0.119	0.157
03TRANSP	-0.356	-0.212	1.399	-0.344	-0.041	0.007	0.211	-0.244	0.227
04COLLRP	-0.327	-0.070	-0.344	1.347	-0.142	-0.009	0.162	-0.207	-0.086
05ASSOC	-0.101	-0.172	-0.041	-0.142	1.250	-0.392	-0.048	0.114	-0.111
06SIZE	0.029	-0.050	0.007	-0.009	-0.392	1.176	-0.122	-0.048	-0.131
07COUNTRY	0.009	-0.108	0.211	0.162	-0.048	-0.122	1.110	-0.150	0.060
08DIRECT/ INDIRECT	0.319	0.119	-0.244	-0.207	0.114	-0.048	-0.150	1.149	-0.026
09MANUF	-0.239	0.157	0.227	-0.086	-0.111	-0.131	0.060	-0.026	1.131

Measurement model evaluation

As explained above, composite variables are linear combinations of weighted indicators whose weights can be calculated as single regressions ("Mode A"), i.e., bivariate correlations between each indicator and its construct, or as multiple regressions ("Mode B"), i.e., taking the correlation between each indicator and the construct and between the indicators into account (Hair et al., 2019; Sarstedt et al., 2016, p. 4003). For this research, "Mode A" was used as it is the preferred option when sample size and variables' explained variance are small to medium (Rigdon, 2016; Sarstedt et al., 2016) as is the case in this study. However, this does not allow reaching conclusions regarding the relative contribution of each indicator to the construct's explained variance.

To test the quality of the measurement model when dealing with mode A composites, the convergent validity as well as the significance of the weights and loadings should be analysed (Hair et al., 2019). When Mode B is used, indicator collinearity is analysed to ensure low collinearity between indicators, preventing reverse signs for loading and weights and informing about the relative contribution of each weight to explain the dependent variable variance. However, when using Mode A, calculating this relative contribution is not possible. However, high collinearity does not cause any problems with the measurement model. Thus, it would not be necessary in this case as only Mode A calculations have been made. In any case, the collinearity analysis was also carried out for informative purposes.

Regarding convergent validity (i.e., indicators actually measuring said construct) is normally evaluated by analysing its correlation with another existing measure of the construct by means of a redundancy test (Hair et al., 2019). In this study, no additional indicators were available, so this step could not be completed as per the correlation test. However, convergent validity can be claimed for all the composites in the model, as content and face validity guided the research process. The content validity of the measures in the model refers to the items that form the construct fully capturing the meaning of the latent concept that the construct represents (Boudreau et al., 2001; Petter et al., 2007; Straub, Detmar et al., 2004). Face validity aims to ensure that the items are understandable and unambiguous for the target respondents. Assuring both content and face validity was part of the survey building process design for the research (Petter et al., 2007). The literature review, validation with academic experts, pilot testing and internal discussions within the research team targeted this content validity. Face validity was pursued through individual validations with industry experts and the trade fair pilot test. It was also favoured by the dissertation author's background and extensive experience in the fashion industry.

Collinearity amongst indicators was analysed based on their VIFs which are the reciprocal of the tolerance (i.e., $1/\text{tolerance}$), where tolerance is “the amount of variance of one formative indicator not explained by the other indicators in the same block” (Hair et al., 2016, p. 207). The squared root of the VIF represents “the degree to which the standard error has been increased due to the presence of collinearity” (Hair et al., 2016, p. 208). Thus, the higher the VIF, the higher the standard error. Ideally VIF values should remain below 3, and values equal to or higher than 5 indicate critical collinearity (Hair et al., 2019). However, as mentioned above, high VIF values do not represent any challenge when using Mode A calculation. Thus, although TRANSP3, TRANSP4 and TRANSP5 show values higher than 3 (the former even above 5), they were kept in the model because, given the composite nature of the construct, dropping one of the indicators would mean losing information regarding one of their dimensions.

Finally, the statistical significance of the weights and loadings was assessed by means of bootstrapping techniques using 5,000 samples with replacement. All these were significant at the 1% significance level except for TRACE3, which is not significant even at 10%. Again, the author decided to keep it in the model to not lose one of the three dimensions that form SC traceability.

Table 29 summarizes these results, together with the mean and the standard deviation values which will be discussed in subsection 4.4.

Structural model evaluation

After examining the quality of the measurement model, the structural model is evaluated.

The starting point is confirming the lack of collinearity amongst the constructs to discard bias in the regression results (Hair et al., 2019). Collinearity, following the same explanation and criteria as with the measurement model, was evaluated by analysing the inner model's VIFs. In this case, as shown in Table 30, all the VIF values lie well above 3; thus no collinearity issues should be expected.

Next, the quality of the model, which provides insights regarding how much it contributes to answer the posited research questions, beyond merely supporting or rejecting the hypotheses, is analysed through the amount of explained variance (R^2) amongst the dependent variables. R^2 also represents a measure of the model's (in-sample) explanatory power. Its expected magnitude depends on the phenomenon investigated and the stage of the research (exploratory first-stage research should expect much lower R^2 than confirmatory one). Hair and colleagues (2019) suggest using a guideline which considers 0.75, 0.50 and 0.25 values to be substantial, moderate and weak

Table 29: Measurement Model Evaluation

Constructs and measures	Item Wording	N	Mean	STDEV	VIF	Weights	Loadings
Collaborative Relationships (COLLRP) <i>Mode "A" composite</i>	Rate the extent (1 = not at all; 5 = completely) to which:						
COLLRP1	Your company collaborates with its supplier	139	4.031	1.161	2.279	0.349***	0.794***
COLLRP2	Your company collaborates with its client	139	4.258	1.091	2.214	0.271***	0.760***
COLLRP3	Your company collaborates with its peers/competitors	139	2.299	1.263	1.505	0.321***	0.741***
COLLRP4	Your company collaborates with NGOs or other stakeholders without contractual relationships	139	2.306	1.341	1.470	0.371***	0.751***
Number of Associations (ASOCC)							
ASSOC1	Please state the number of associations your company belongs to:	139	0.763	1.381	1.000	1.000	1.000
SC Traceability (TRACE) <i>Mode "A" composite</i>	Rate the extent (1 = not at all; 5 = completely) to which:						
TRACE1	Trace the origin of the product upstream. outside your company	139	3.700	1.141	1.197	0.571***	0.798***
TRACE2	Track and trace the destination and origin of the product within the boundaries of your company	139	4.617	0.802	1.172	0.648***	0.853***
TRACE3	Track the destination of the product downstream. outside your company	139	3.513	1.288	1.039	-0.102 ^{not}	0.081 ^{not}
SC Transparency (TRANSP) <i>Mode "A" composite</i>	Rate the extent (1 = not at all; 5 = completely) to which:						
TRANSP1	The supplier acts in a way that enables others to perceive and understand what the company does	138	3.910	0.924	1.356	0.121***	0.455***
TRANSP2	The supplier discloses supplier's names	138	3.060	1.480	1.934	0.132***	0.708***
TRANSP3	The supplier discloses supplier's sustainability conditions	137	3.133	1.334	5.098	0.136***	0.857***
TRANSP4	The supplier discloses internal sustainability conditions	138	3.226	1.379	4.997	0.16***	0.868***
TRANSP5	The supplier discloses own codes of conduct and internal policies (including buying practices)	138	3.031	1.415	3.791	0.161***	0.829***
TRANSP6	Your company acts in a way that enables others to perceive and understand what the company does	139	4.390	0.782	1.364	0.125***	0.545***
TRANSP7	Your company discloses supplier's names	139	3.234	1.527	1.733	0.097***	0.573***
TRANSP8	Your company discloses supplier's sustainability conditions	139	3.424	1.424	2.944	0.139***	0.74***
TRANSP9	Your company discloses internal sustainability conditions	139	3.626	1.337	2.993	0.153***	0.782***
TRANSP10	Your company discloses own codes of conduct and internal policies (including buying practices)	139	3.318	1.485	2.928	0.149***	0.786***

Constructs and measures	Item Wording	N	Mean	STDEV	VIF	Weights	Loadings
TBL Performance (TBLPF) <i>Mode "A" composite</i>	Rate the performance of your company compared to its competitors (1 = much worse than competitors. 5 = much better than competitors) in regards to:						
ENVPF	Environmental Performance	134	3.664	0.917	2.343	0.474***	0.904***
SOC PF	Social Performance	134	3.604	0.901	2.492	0.464***	0.921***
ECPF	Economic Performance	134	3.451	0.785	1.183	0.248***	0.580***
Control Variables							
SIZE	Natural logarithm of total assets.						
COUNTRY	1= Spain; 0= Portugal	137	7.168	1.925	1.000	1.000	1.000
POSITION IN SC	1= Direct suppliers; 0= Indirect suppliers	139	0.518	0.501	1.000	1.000	1.000
MANUFACTURING		139	0.683	0.467	1.000	1.000	1.000
ACTIVITY	1= Yes; 0= No	139	0.727	0.447	1.000	1.000	1.000

Not: Not statistically significant, *p < 0.10, **p < 0.05, ***p < 0.01, one-tailed test

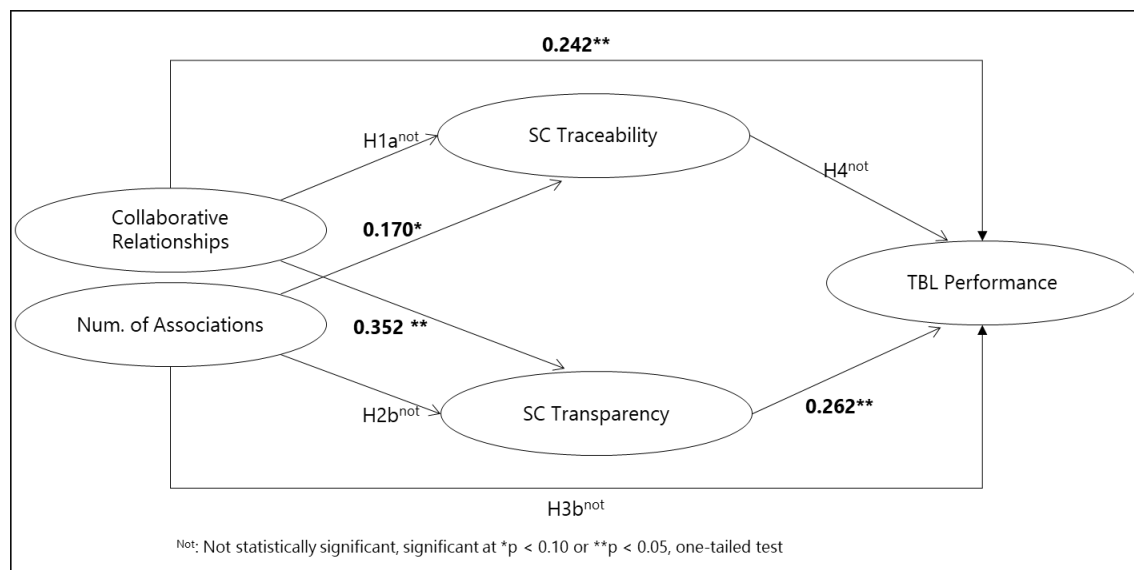
Table 30. Inner VIF values

	01TBLPF	02TRACE	03TRANSP
02TRACE	1.131		
03TRANSP	1.306		
04COLLRP	1.268	1.106	1.106
05ASSOC	1.242	1.207	1.207
06SIZE	1.176	1.174	1.174
07COUNTRY	1.110	1.070	1.070
08DIRECT/INDIRECT	1.074	1.046	1.046
09MANUF	1.089	1.039	1.039

R², respectively, though taking into account that, depending on the context and the discipline, “an R² value as low as 0.10 is considered satisfactory.” (Hair et al., 2019, p. 11). The analysis returned an R² of 26.2%, 8.6%, and 20.8% for TBL performance, SC traceability and SC transparently, respectively. Especially for the former and the latter values, this can be regarded as acceptable given the state-of-the art that, thus far, has shown inconsistencies and even contradictory views.

Finally, the strength and statistical significance of the relationships between the variables were tested to show (or not show) support for the posed hypotheses responding to the RQs. For this, the path coefficients and their statistical significance (at the 0.1 and 0.05 level) were assessed by means of bootstrapping techniques (one-tailed bias-corrected and accelerated (BCa) bootstrap) using 5,000 samples, with replacement (Hair et al., 2019). Table 31 summarizes the results of the structural model analysis, and Figure 11 depicts the supported and unsupported hypotheses.

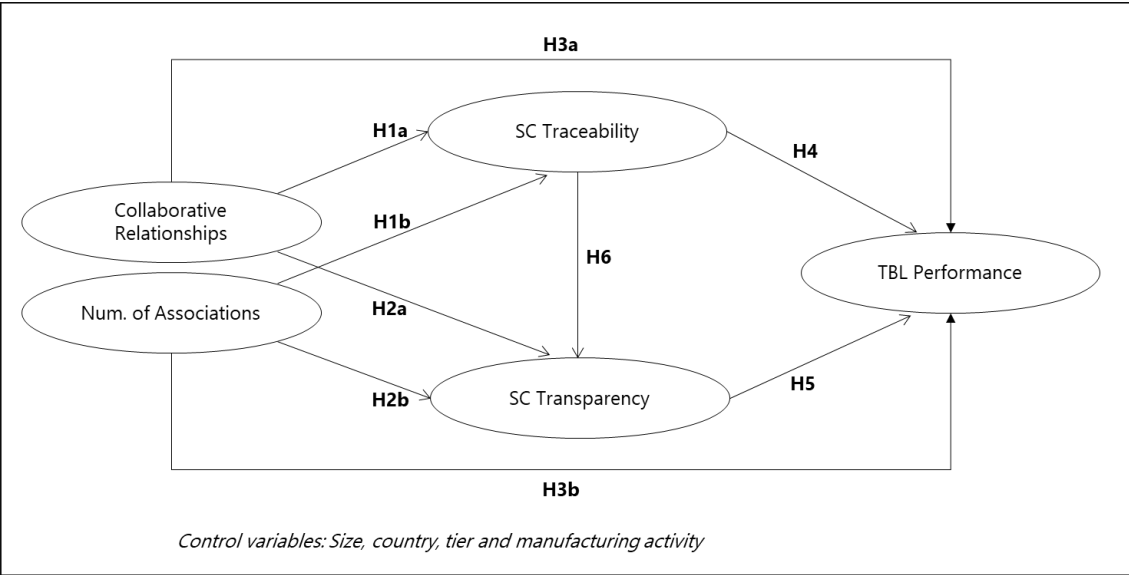
Figure 11: Hypotheses testing



Surprisingly, hypothesis 4, which predicted a positive association between SC traceability and TBL performance, was not supported, as no linear effect was found significant. This counterintuitive result, together with the ‘mutually reinforcing relationship’ between traceability and transparency suggested in QUAL1 and more specifically in QUAL2, allows for the possibility that SC traceability might have a significant role in the posited model by fostering SC transparency (i.e., a significant indirect effect through the mediation of SC transparency).

To test this, the author carried out a post hoc analysis in which this new hypothesis was added as illustrated in Figure 12.

Figure 12. QUAN1. Research model - Post hoc analysis



The author then applied the same procedure to run the *new* model and analyse the results from the values shown in Table 32, supporting H6 and showing a significant indirect effect on TBL performance. Figure 13 summarizes the definitive results which are discussed next.

Figure 13: Hypotheses testing with post hoc analysis

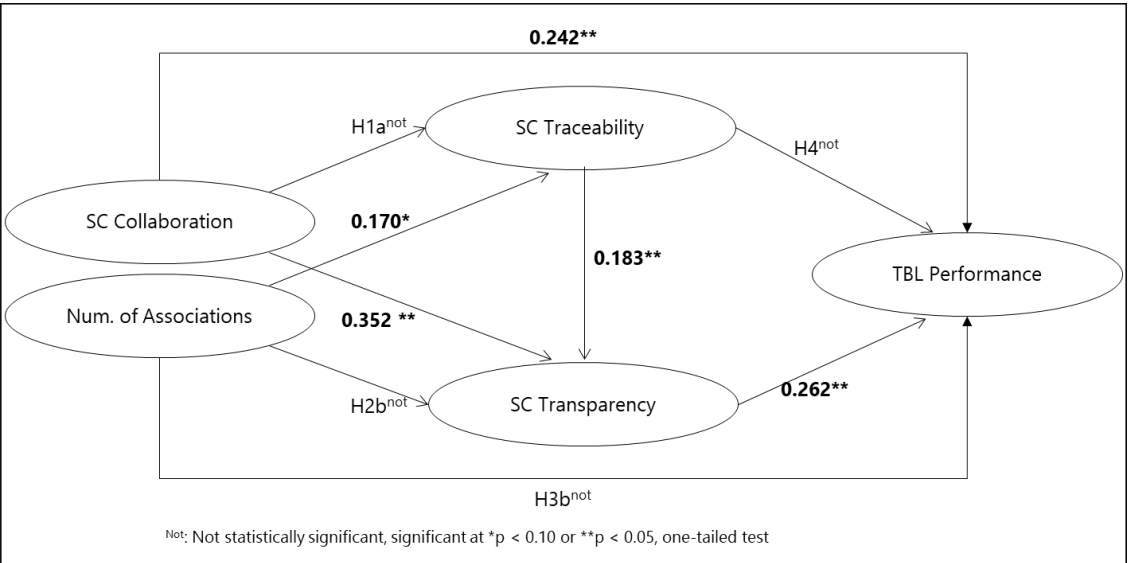


Table 31. Structural model evaluation

	Effects	STDEV	t statistics	p-values	5%	95%
<i>Direct effects on TBL Performance (R2 = 26.2%)</i>						
SC TRACEABILITY	0.023	0.096	0.235	0.407	-0.137	0.179
SC TRANSPARENCY	0.262	0.097	2.705	0.003	0.101	0.419
COLLABORATIVE RELATIONSHIPS	0.242	0.075	3.212	0.001	0.120	0.369
NUMBER OF ASSOCIATIONS	0.075	0.089	0.834	0.202	-0.077	0.211
SIZE	-0.021	0.086	0.247	0.403	-0.164	0.119
COUNTRY	-0.006	0.081	0.078	0.469	-0.142	0.128
POSITION IN SC	-0.235	0.079	2.972	0.001	-0.360	-0.099
MANUFACTURING ACTIVITY	0.177	0.080	2.220	0.013	0.042	0.303
<i>Direct effects on SC Traceability (R2 = 8.6%)</i>						
COLLABORATIVE	0.137	0.119	1.150	0.125	-0.047	0.337
RELATIONSHIPSNUMBER OF	<u>0.170</u>	<u>0.122</u>	<u>1.395</u>	<u>0.081</u>	<u>-0.052</u>	<u>0.318</u>
ASSOCIATIONSSIZE	0.043	0.096	0.444	0.329	-0.121	0.197
COUNTRY	0.066	0.103	0.637	0.262	-0.124	0.214
POSITION IN SC	-0.090	0.126	0.715	0.237	-0.249	0.170
MANUFACTURING ACTIVITY	<u>-0.163</u>	<u>0.102</u>	<u>1.599</u>	<u>0.055</u>	<u>-0.294</u>	<u>0.037</u>
<i>Direct effects on SC Transparency (R2 = 20.8 %)</i>						
COLLABORATIVE	0.352	0.098	3.589	0.000	0.214	0.537
RELATIONSHIPSNUMBER OF	0.080	0.078	1.027	0.152	-0.052	0.206
ASSOCIATIONSSIZE	-0.004	0.091	0.040	0.484	-0.149	0.148
COUNTRY	-0.152	0.088	1.738	0.041	-0.293	-0.006
POSITION IN SC	<u>0.108</u>	<u>0.077</u>	<u>1.391</u>	<u>0.082</u>	<u>-0.022</u>	<u>0.231</u>
MANUFACTURING ACTIVITY	-0.153	0.080	1.908	0.028	-0.286	-0.020
<i>Indirect and total effects of Collaborative Relationships on TBL Performance</i>						
Indirect Effect Via SC TRACEABILITY (1)	0.003	0.017	0.186	0.426	-0.027	0.029
Indirect Effect Via SC TRANSPARENCY (2)	0.092	0.044	2.101	0.018	0.033	0.176
Total Indirect Effect (1+2)	0.096	0.044	2.149	0.016	0.034	0.178
Total Effect (Direct + Indirect)	0.337	0.072	4.655	0.000	0.227	0.461
<i>Indirect and total effects of Number of Associations on TBL Performance</i>						
Indirect Effect Via SC TRACEABILITY (1)	0.004	0.019	0.202	0.420	-0.021	0.040
Indirect Effect Via SC TRANSPARENCY (2)	0.021	0.024	0.893	0.186	-0.013	0.064
Total Indirect Effect (1+2)	0.025	0.029	0.843	0.200	-0.019	0.076
Total Effect (Direct + Indirect)	0.099	0.091	1.088	0.138	-0.055	0.246

In bold: effects significant at $p < 0.05$;

Underlined: effects significant at $p < 0.10$;

Not: not statistical significant effects

Table 32. Post hoc analysis: Direct and Indirect effects of SC Traceability

	Effects	STDEV	t statistics	p-values	5%	95%
<i>Direct and indirect effects of SC Traceability:</i>						
Direct effect on SC TRANSPARENCY	0.183	0.084	2.179	0.015	0.033	0.310
Direct effect on TBL PERFORMANCE	0.003	0.089	0.039	0.485	-0.139	0.152
Indirect effect on TBL PERFORM. (Via SC TRANSPARENCY)	0.049	0.029	1.695	0.045	0.005	0.098
Total Effect (Direct + Indirect)	0.052	0.090	0.581	0.281	-0.096	0.199

4.4. Findings and Discussion

Brief Descriptive Analysis at the Item Level

Even though an in-depth analysis showing the level of development of the TfS dimensions exceeds the aims of this dissertation, it is worth analysing the descriptive information that the mean and standard deviations of the different indicators shown in Table 29 can provide.

Regarding collaborative relationships, the results indicate that the highest mean belongs to collaboration with clients (4.258 out of 5), followed by collaboration with suppliers (4.031). The mean of collaboration with NGOs or other stakeholders is almost half (2.306) (supporting the surprising finding from the Delphi study). This is closely followed by collaboration with competitors (2.299), in the last place. These last two types also show the highest standard deviations. Regarding the number of associations that respondent companies' belong to, the mean is below 1 (0.763), with a standard deviation of 1.381.

With regards to traceability, the most developed 'phase' (i.e., the part of the SC where the products can be tracked and traced) corresponds to the internal one: tracking and tracing the destination and origin of the product within the boundaries of the company (mean=4.617 out of 5), followed by external upstream traceability (tracing the origin of the product upstream, outside the company) with a mean of 3.7 and, in last place, external downstream traceability with a mean of 3.513 and the highest standard deviation (1.288). This anticipates great challenges for closing the loop and circular models in fashion-apparel SCs.

Turning to transparency, the items regarding the respondents were ranked higher than the ones about the suppliers, in line with the literature and reports alerting about opacity beyond the first and second tiers. In both cases, the behavioural items (i.e., acting in a way that enables others to perceive and understand what the company does) surpass the disclosure-related ones. For these behavioural items, the respondent companies earned a mean of 4.39 (out of 5), and the suppliers 3.91. Amongst the items informing about disclosure, the highest means were obtained in both cases from "disclosing internal sustainability conditions" (3.626 for respondent companies and 3.226 in the case of their suppliers). For the respondent companies, the lowest mean value corresponded to "disclosing suppliers' names" (3.234), and, in the case of suppliers, to "disclosing own codes of conduct and internal policies (including buying practices" (3.031), followed very closely by "disclosing suppliers' names" (3.060). Although the responses to the behavioural items could suffer from desirability bias and the above-mentioned 'relationship bias', measuring

disclosure with such level of detail about the content of the disclosure allows this author to rely on the values obtained.

Finally, regarding TBL performance, the three means achieved similar values, with economic receiving the lowest value (3.451), followed by social (3.604) and very closely by environmental (3.664).

Discussion on these results and hypothesis testing

The statistical analysis carried out allows to respond to the posited RQs and to refine and empirically test the postulates and relational models derived from QUAL1 and QUAL2.

Regarding the direct effects (the direct path relationships described in the hypotheses), collaborative relationships were found to have a positive and significant effect on SC transparency and TBL performance, but not on SC traceability, whose effect does not show statistical significance. Thus, hypotheses H2a and H3a are supported, whilst H1a is not. Regarding the number of associations, it was found to positively and significantly affect SC traceability, but not SC transparency or TBL performance whose effects, although positive, do not show statistical significance. Therefore, hypothesis H1b is supported, whilst H2b and H3b are not. With regards to SC traceability, its (very weak) effect on TBL showed no statistical significance, thus suggesting a mediated relationship through SC transparency. It was after running the subsequent post hoc analysis that a positive and significant effect on SC transparency was confirmed. Thus, whilst hypothesis H4 was not supported, hypothesis H6 which was added during the post hoc analysis was supported. Finally, the positive relationship between SC transparency and TBL performance was found to be statistically significant, thus supporting H5.

As a result of the mediating variables (SC traceability and SC transparency), the results revealed additional indirect and total effects. These are the positive and significant indirect effect of collaborative relationships on TBL performance via SC transparency, and also the positive and significant effect of SC traceability on TBL performance via SC transparency. Consequently, the total positive effect of collaborative relationships on TBL performance is reinforced, but the indirect effect of SC traceability is not sufficient to make its total effect on TBL performance significant.

Regarding the control variables, size showed no significant effect on any of the dependent/mediating variables, whilst country had significant effects on SC transparency. Portuguese companies achieved statistically significant higher values for SC transparency than their Spanish peers. This result may be due to cultural differences between the two countries and

reinforces the importance of company culture (as part of the mission, vision, values and company culture factor) already mentioned as a key transparency driver in QUAL2. Regarding the position in which the respondent company is situated (its tier), the results revealed that it has a statistically significant impact on TBL performance, and a positive effect (significant at 10%) on SC transparency. The negative results for TBL performance imply that, the lower the tier (=direct suppliers), the lower the TBL performance, which merits further analysis at the sustainability dimension disaggregate level. Regarding environmental and social performance, this result could be explained by the effective pressure exerted upstream by retailers and first-tier suppliers (at least in countries such as Portugal and Spain where environmental and social laws/rights and their enforcement are not under suspicion). In terms of economic performance, the results can be explained by the greater dependence on few (or even one) big fashion retailer(s) capable of exerting high price pressure. Finally, manufacturing activity showed a statistically significant impact on the three variables. TBL performance revealed to be significantly higher for manufacturers versus traders or designing companies, but the opposite was true for SC traceability and transparency (traders and designing companies achieved higher values here than manufacturing companies). This result is counterintuitive to the underlying hypothesis of this research, as it may contest the hypothesis of SC traceability and transparency as TBL enablers, thus urging further research on the postulates of contingent RBV (Aragón-Correa & Sharma, 2003) or which other mechanisms foster TBL performance when SC traceability and transparency are not present.

4.5. Conclusions and Implications

QUAN1 has thus empirically confirmed and refined the postulates from QUAL1 and QUAL2. Regarding collaboration, the positive association between collaborative relationships and SC transparency and TBL performance was supported as was the fact that belonging to industry associations fosters SC traceability. The SC traceability and transparency tandem were able to provoke positive TBL performance. Specifically, SC traceability fosters SC transparency and thus has an indirect effect on TBL performance. This needs to be added to the direct effect that SC transparency has.

Thus, the QUAL2 relational model was further refined, proposing an approximation to an explanatory theory of TFS (Figure 14).

Figure 14: An approximation to an explanatory theory of TfS

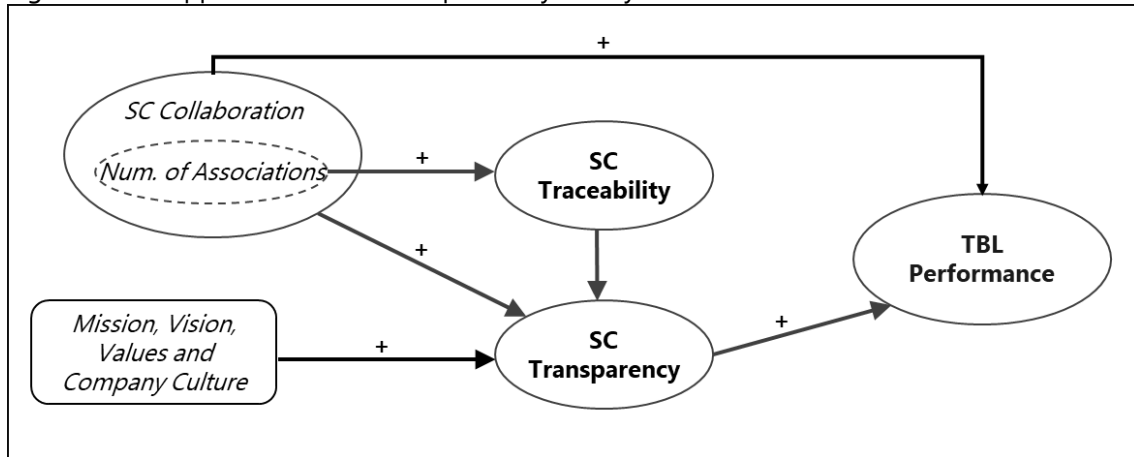


Table 33 below summarizes the RQ answers and highlights in bold the part of the main objective to which QUAN1 contributed.

Table 33. QUAN1. Objectives and RQs

Main objective: To understand traceability and transparency (definitions, boundaries and interrelations) when converging in the CSR/(S)SCM field and in the particular fashion-apparel SC context and to propose and test an explanatory theory that may contribute to their development in favour of sustainability.	
Detailed Objectives QUAN1	Research Questions
Test SC collaboration as an antecedent of traceability and transparency	QUAN1: 6. How does SC collaboration influence traceability in fashion-apparel SCs? The higher the number of associations the company belongs to, the greater traceability has been developed. 7. How does SC collaboration influence transparency in fashion-apparel SCs? Collaborative relationships showed a positive and significant effect. 8. How does SC collaboration contribute to TBL performance in fashion-apparel SCs? Collaborative relationships showed a positive and significant influence, reinforced by an indirect effect through SC transparency. 9. How does traceability contribute to TBL performance in fashion-apparel SCs? SC traceability has a positive and significant effect on TBL performance but only indirectly through SC transparency. 10. How does transparency contribute to TBL performance in fashion-apparel SCs? SC transparency showed a positive and significant influence.
Test the effects of SC collaboration, traceability and transparency on TBL performance	

In the next section, the author discusses the cumulative academic and practical contributions of the three studies.

Chapter 5. Conclusions, Contributions, Limitations and Further Research Avenues

The fashion-apparel industry constitutes a sector that is especially sensitive to sustainability issues, with pressing challenges such as its negative contribution to climate change, micro-plastic pollution and the risk of unequal/abusive working conditions, all of which call for immediate action (Vijay Kumar et al., 2017; Moretto et al., 2018; Seuring & Müller, 2008a). Due to the distribution of its activities along dynamic and complex SCs with numerous production steps, vast geographic and cultural distances and a lack of visibility beyond direct suppliers (Boström et al., 2012; Busse et al., 2016; Pedersen & Andersen, 2015), the need to advance strategic (S)SCM traceability and transparency mechanisms and key antecedents to sustainability (Khurana & Ricchetti, 2016; Pagell & Wu, 2009) and thus ensure the application of CSR principles in this sector is evident. This contrasts, however, with the little attention scholars have paid to traceability and transparency in this industry compared to in more regulated sectors (as food or pharmaceutical) (Kamann et al., 2019), as well as the important breaches that are still found in practice. The latter has been made patently clear with the production of so-called "organic" cotton and the accusations of forced labour by minority Uighurs in Xinjiang (China) (November 2019) and this product's fraudulent and massive production in India (October 2020) (<https://global-standard.org/news/gots-press-release-gots-detects-evidence-of-organic-cotton-fraud-in-india>; "Xinjiang issues place US firms in a difficult position", 2021).

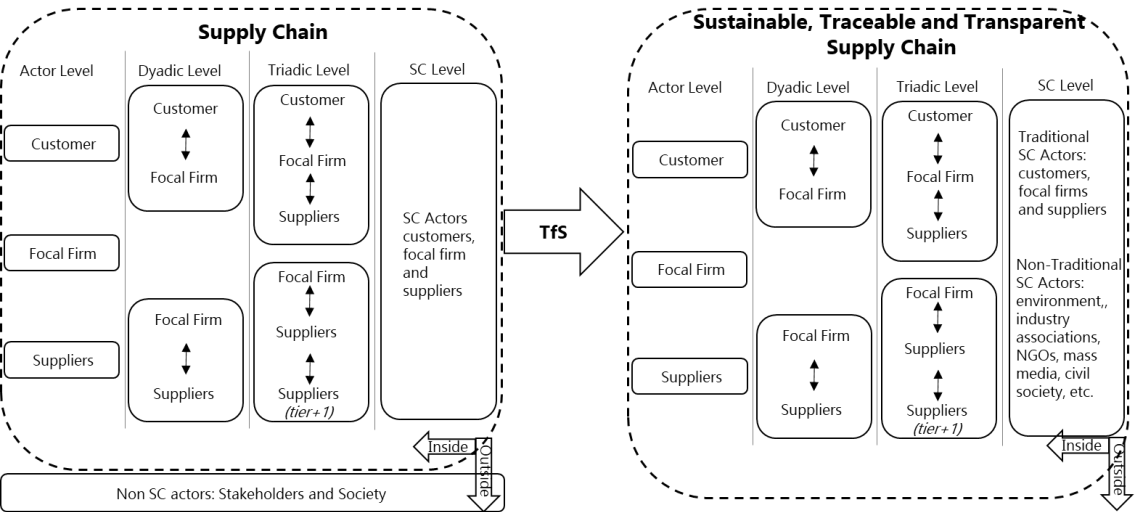
Aware of the conceptual and blurred boundaries between SC traceability and transparency and that they are currently acting as sustainability barriers instead of as enablers in fashion-apparel SCs (Borit & Santos, 2015), this doctoral research has aimed to unravel them and advance their understanding and deployment using a mixed-methods approach.

Through three differentiated research studies (QUAL1, QUAL2 and QUAN1), this work has responded to the ten RQs posited and addressed the twofold main objective proposed: to understand traceability and transparency (definitions, boundaries and interrelations) when converging in the CSR/(S)SCM field and in the particular context of fashion-apparel SCs, and to propose and test an explanatory theory that may contribute to their development in favour of sustainability.

The study began by proposing a TFS framework (QUAL1), conceived as a meta-capability built on advanced levels of incremental and renewing DCs (as, inter alia, traceability systems and transparency). This refers to a virtuous cycle in which the DCs distributed amongst the three dimensions (governance, collaboration and tracking and tracing) interact and become more

complex, ultimately framing the emergence of a new ecosystem: the sustainable, traceable and transparent SCs already introduced in the Key terms section (Figure 2) and revisited below. In this revised version, non-traditional SC actors/stakeholders are integrated within the reconfigured SC boundaries as enablers and beneficiaries of SC traceability, transparency and sustainability. Sustainability is understood with a TBL approach and for the different actors (traditional and non-traditional) integrated in the system. Figure 2 from the introductory Key terms section graphically summarizes this reconfiguration.

Figure 2. SC reconfiguration: Supply chain vs. proposed sustainable, traceable and transparent supply chain



With regards to the understanding of traceability and transparency for sustainability within the CSR/(S)SCM fields, this study has also transubstantiated their existing/initial concepts and definitions, as already advanced in Table 1 in the Key terms section (revisited below). Traceability explicitly incorporates a triple objective: (i) operations/decision-making; (ii) track and trace processes and products; and (iii) ensure the reliability and the capacity to tackle sustainability claims regarding products and processes. For its part, transparency limits the information to "relevant" data (i.e., material) and its recipients to "legitimate partners or stakeholders" whilst incorporating a behavioural dimension that goes beyond "mere" information disclosure.

Table 1. Main existing/initial definitions versus new/proposed/operationalized definitions (i.e., this doctoral project's outcomes)

Definitions	Existing/initial definitions	New/proposed/operationalized definitions
Sustainability	"Sustainability refers to the need to address and manage issues across economic, social, and environmental dimensions in a balanced and integrated manner" (Reefke and Sundaram, 2017, p. 195).	(Positive) outcome of optimizing and managing the economic (including governance), social and environmental dimensions of any activity with a strategic, integrated and transversal approach. The above definition gives rise to the 'sustainability strategy' concept. In this research, both CSR and (S)SCM are understood as the two broad interrelated sustainability strategies.
(Traditional) traceability	"The ability to trace the history, application or location of a product in relation to the origin of its materials and parts; the processing history; and the distribution and location after delivery" (International Organization for Standardization, 2000).	
Traceability (with a sustainable aim)	"The ability to identify and trace the history, distribution, location and application of products, parts and materials to ensure the reliability of sustainability claims in the areas of human rights, labour (including health and safety), the environment and anti-corruption" (United Nations Global Compact Office, 2014, p. 6).	An organization's ability to identify and control the trajectory and conditions of each component, material, process and human resource related to its products, from the initial conception until the end of its lifecycle, with a triple objective: (i) operations/decision-making; (ii) track and trace processes and products; and (iii) ensure the reliability and the capacity to tackle sustainability claims regarding products and processes.
(Traditional) transparency	"Extent to which information is readily available to [. . .] other firms in the supply chain" (Awaysheh and Klassen, 2010, p. 1249).	
Transparency (with a sustainable aim)	"The corporate disclosure of: (i) the names of the suppliers involved in producing the firm's products; (ii) information about the sustainability conditions within these suppliers' facilities; and (iii) the buying firms' purchasing practices" (Egels-Zandén et al., 2015, p. 96).	An organization's decision to reveal all the relevant information regarding its products and internal policies and practices to legitimate partners or stakeholders, ensuring its intellectual property rights are not at risk. "Acting in a way that enables others, both internal and external stakeholders to perceive and understand what the company does, as well as the quality disclosure of the information needed for this" (Gold & Heikkurinen, 2017, p. 5).
SC	Business structures that "encompasses all activities associated with the flow and transformation of goods from raw materials stage (extraction), through to the end user, as well as the associated information flows" both up and down the supply chain linking "suppliers, focal companies and customers" by the "information, material and capital flows" (Seuring & Müller, 2008b, pp. 1699, 1700). Focal companies are "those companies that usually (1) rule or govern the supply chain, (2) provide the direct contact to the customer, and (3) design the product or service offered" (Seuring & Müller, 2008b, p. 1699).	SC models in which traditional and non-traditional SC actors are integrated into the same ecosystem: the sustainable traceable and transparent SC (see Figure 2 below).

Adjusting the definitions to practices in fashion-apparel SCs (as done in QUAL2) allowed further characterizing the three concepts as an ability (traceability), an internal decision (transparency) and an outcome triggered by a strategy (sustainability), thus establishing boundaries between them. In turn, this helped model their relationships: a circular relationship that departs from a sustainability strategy (for the scope of this study, represented by CSR and/or (S)SCM) aiming to achieve a sustainability outcome which then reinforces the initial strategy. This relationship is mediated by SC traceability and transparency, also in a mutually reinforcing relationship. In addition, the insights provided by fashion-industry experts, in dialogue with academic literature, led to SC collaboration being highlighted as a strategic enabler of TfS for its potentially simultaneous impact on SC traceability, transparency and sustainability. Other enablers of TfS appeared, including protocols, ISO norms and quality systems, corporate mission, vision, values and business culture and “reliable” certifications. The former help to promote SC traceability for sustainability, while the last two foster SC transparency. Finally, this study also revealed the key current barriers to TfS deployment as well as the main traditional and non-traditional stakeholders involved. The main barriers were the lack of regulations/enforcement, the lack of standardization and a reluctance to disclose. Regarding stakeholders, suppliers and retailers were shown to be the main collaborative actors, while retailers, trade unions, regulators and mass media were key in their pressuring role. Surprisingly, NGOs were not described as key significant actors, whether as collaborators or as pressuring agents.

The survey carried out on a sample of fashion-apparel suppliers (QUAN1) enabled translating these outcomes into an exploratory theory that, building on postulates from the dynamic resource base, relational and SC practice views as well as stakeholder theory, advances our knowledge about how traceability, transparency and sustainability are deployed in (fashion-apparel) SCs and how they interact for improved sustainability. SC collaboration proved to precede traceability (revealing a positive relationship with the number of associations a company is involved in), transparency and sustainability. Traceability is positively associated with transparency and, through the latter, with sustainability (the direct effect has not been confirmed). Transparency is shown to significantly and positively impact sustainability.

Table 34 summarizes the main outcomes of this study, representing a final conclusion for this research project.

Next, the author explores the academic contributions and managerial implications of each of the studies, followed by an overview of this doctoral project’s main limitations and proposals for further research avenues.

Table 34. Main objectives and outcomes

Main objectives: To understand traceability and transparency (definitions, boundaries and interrelations) when converging in the CSR/(S)SCM field and in the particular context of fashion-apparel SCs, and to propose and test an explanatory theory that may contribute to their development in favour of sustainability.
Main outcomes
QUAL1: Conceptual proposal of the TfS framework: (i) Conceived as a meta-capability capable of provoking positive TBL performance for the different SC actors. (ii) Proposal of key variables (capabilities, practices and processes) distributed amongst three dimensions (governance, collaboration and tracking and tracing). (iii) Proposal of a sustainable, transparent and traceable ecosystem in which traditional and non-traditional actors are integrated both as enablers and (TBL) beneficiaries. QUAL2: (i) Down-to-earth definitions for traceability, transparency and sustainability, setting boundaries and suggesting interconnections. (ii) Relational model that begins with the sustainability strategy to achieve SC sustainability via the traceability and transparency tandem conceived as both antecedents and mediators of a virtuous cycle in favour of sustainability. It is hindered by barriers such as a lack of standardization and laws/enforcement or reluctance to disclose; contrarily, it is fostered by drivers such as SC collaboration and suppliers' and retailers' actions. (iii) Comprehensive list of fostering and hindering factors (including stakeholders) that play a key role in TfS deployment (or not). QUAN1: Empirical evidence obtained, supporting: (i) Positive relationship between SC collaboration and SC traceability and transparency, as well as between SC collaboration and TBL performance, both directly and indirectly through SC transparency. (ii) Positive relationship between SC traceability and SC transparency and indirectly (via SC transparency) between SC traceability and TBL performance. (iii) Positive relationship between SC transparency and TBL performance.

5.1. Academic Contributions

Stemming from these outcomes, and in addition to the transubstantiated definitions in Table 1 and the sustainable traceable and transparent ecosystem in Figure 2 which can be considered the initial conceptual contributions, this doctoral project can claim to have contributed to academic knowledge in several ways throughout the three sequential researches carried out.

First is the coined macro-concept of traceability and transparency for sustainability (TfS or TTfS). The author has positioned TfS as a core enabler of CSR/(S)SCM which incorporates new applications that include not only economic and operational efficiency aspects but also social and environmental implications, as well as including transparency behaviours beyond 'mere' disclosure. Thus, this study addresses the gap regarding the definition of traceability that

simultaneously integrates environmental, social and economic sustainability claims, as well as representing the first attempt to map the capabilities, practices and processes that interact with traceability systems and transparency for TBL sustainability. In this way, it contributes to the DCs and related views by revealing concrete capabilities, practices, processes and tools that may act as enablers of or barrier to TfS deployment, as presented in Table 35.

Table 35. TfS-related DCs, practices and processes

Type	Level	TfS DCs, practices and processes
Resources and capabilities	Resource base	Physical (including technology), human and organizational capital
Dynamic capabilities, i.e., firms' ability to create, adapt and reconfigure resources and capabilities	Incremental DCs	Formal control Trust SC collaboration Visibility Transparency Traceability systems Traceability-related innovation
	Renewing DCs <i>or</i> First-order DCs	Knowledge sharing Interorganizational learning Interorganizational transparency Information sharing Strategic collaboration Integration
	Regenerative DCs <i>or</i> Meta-capabilities <i>or</i> Higher order DCs	TfS, understood as the enabling cycle that leverages and integrates renewing DCs deployed by (and generating TBL for) traditional and non-traditional actors

Thus, the proposed framework conceives TfS as a meta-capability arising from the interaction of six renewing DCs and practices and tools alongside three broad dimensions (governance, collaboration and tracking and tracing) and between traditional and non-traditional SC actors. Consequently, it represents an initial approach to the operationalization of traceability and transparency as truly coupled with responsible and sustainable SCs.

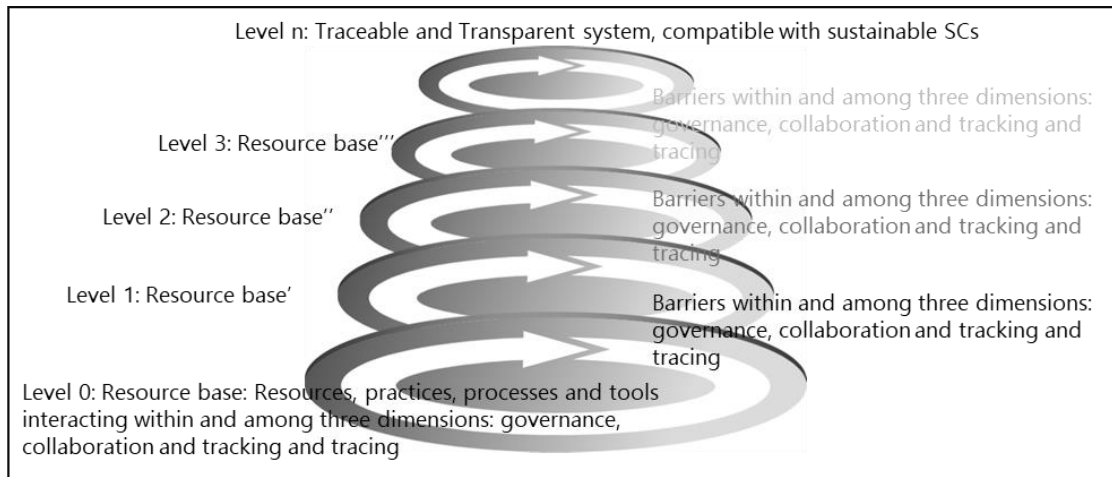
This operationalization also serves as a proposal that can conceptually illustrate the 'how to' of traceability and transparency with a TBL orientation which is missing to-date, consequently helping to advance knowledge about how to approach sustainability as demanded by CSR and (S)SCM scholars.

In addition, this study contains elements (i.e., the interaction between traditional and non-traditional SC actors and the TBL orientation) that contribute to the debate on value creation, distribution and appropriation for stakeholders (Austin & Seitanidi, 2012b; Freeman, 2010; Hörisch et al., 2014), and the trade-offs and tensions both amongst the actors and the sustainability

dimensions which are central to stakeholder theory (de Brito et al., 2008; Freeman, 2010; Rey-Garcia et al., 2020). Integrating traditional and non-traditional actors within the new ecosystem that are TfS enablers and TBL beneficiaries simultaneously may help (more) equitably created and distributed value throughout the SCs, as the search for TfS can act as a new “source of mutual interest for all stakeholders” (Hörisch et al., 2014, p. 338). Addressing sustainability might not be in apparel companies’ core interests (Moretto et al., 2018), but adapting to customers’ needs in a timely fashion and being able to respond to their rising demands is crucial for the profitability of all SC actors (Rai, Patnayakuni, and Seth, 2006; Rajala, Hakanen, Mattila, Seppälä, and Westerlund, 2018). Thus, this integrated approach understands TfS as a self-reinforcing mechanism that is not only demanded by non-traditional SC actors; it is also pursued within the SC as a core business tool, a meta-capability potentially enhancing the SC actors’ competitive advantage and allowing for TBL performance within and beyond SC boundaries. Once TfS has been incorporated as a core business activity, the self-sustained cycle of renewing DCs that focal firms promote to diminish traceability barriers can arise, providing indirect benefits to traditional and non-traditional SC actors in terms of learning from training and other developmental practices. TfS can be seen as a tool to put value creation and distribution for stakeholders at the core of management, which is represented in this doctoral research by CSR and (S)SCM (Hörisch et al., 2014; Parmar et al., 2010).

TfS as a meta-capability can be envisioned as the helix depicted in Figure 15 below in which, starting from the resource base, resources and capabilities are reinforced and reconfigured in each loop, allowing them to contribute to traceability and transparency deployment and TBL performance and to blur the barriers that were preventing them from the next level. In each of the levels, traditional and non-traditional actors are involved, interacting to push for the next level as well as benefitting from the TBL outcomes derived. The loops continue until reaching a traceable and transparent system that is compatible with sustainable SCs (Garcia-Torres et al., 2019, p. 97) or go on *ad infinitum* as an infinite wave (Ambrosini et al., 2009, p. S12; Collis, 1994). Traceability, transparency and sustainability are not “static stages, but something that needs to work towards” (Fraser et al., 2020, p. 17).

Figure 15: TfS meta-capability: Eliminating barriers and climbing to the next level



These contributions represent the starting point for QUAL2 in which, combining academic and industrial knowledge, the TfS framework is refined and brought down to earth and the current reality of fashion-apparel SCs, further contributing to the general CSR/(S)SCM literature and the fashion-specific area.

First, traceability, transparency and sustainability are given context-specific operational definitions with clear boundaries, insights and nuances specific to the fashion-apparel industry and thus directly applicable to the latter. The three concepts—traceability, transparency and sustainability—are coherently defined for coexistence (and mutual reinforcement), and their nuances, boundaries and relationships are clearly set. This contributes to solve the lack of conceptual clarity that jeopardized their advancement and, thus, hindered SC sustainability in the fashion-apparel industry, as well as providing the basis for further research on this imperative topic.

Considering transparency as an internal decision, in contrast to the most frequent conception as an outcome or an external attribute, provides new insights on one of the most under-researched topics in the SCM field (Wieland et al., 2016). Under the performative/behavioural stream of transparency, the consensual definition restricting the recipients of 'transparent information' to 'legitimate partners or stakeholders' answers the question, "transparency for whom?" (Gupta, 2010), and sets boundaries that helps to prevent the reluctance to disclose which has been shown to be in place to protect company's competitiveness. Transparency seems to be the connecting point where CSR and (S)SCM converge and where stakeholder theory is explicitly interpellated. Setting clear boundaries about what and whom to disclose eases the transition from 'stakeholder management' as manipulating others (Hörisch et al., 2014) towards 'managing stakeholder relationships' as identifying which stakeholders need to be involved in each business activity (Hörisch et al., 2014), thus helping to foresee and manage undesirable outcomes in value

(re)distribution (Rey-Garcia et al., 2020).

Second, QUAL2 model connects the three variables and the key fostering and hindering factors for the practical deployment of traceability and transparency as preconditions for sustainable fashion-apparel SCs. This provides a deeper analysis of industry-specific fostering and hindering factors (including actors) for traceability and transparency for sustainability and highlights the importance of traceability and transparency as the necessary though insufficient path to achieve sustainable SCs (Pagell and Wu, 2009). It also reinforces their condition as relevant mechanisms for collaboration and coordination in SCs that were mostly absent in previous CSR and fashion-specific (S)SCM discourse (Aguinis & Glavas, 2012; Moon et al., 2017). The model has also shown how, through a new virtuous relationship, these mechanisms are also dependent on collaboration. In other words, traceability and transparency move from being antecedents of CSR and (S)SCM to mediate and strengthen the sustainability outcome, serving as key mechanisms for SC collaboration also in a mutually reinforcing loop. The closed loop model also suggests that, although beginning with the sustainability strategy (i.e., the managerial decisions and actions towards sustainability, represented in this research by CSR/(S)SCM), the better the sustainability performance (outcome), the stronger the sustainability strategy's development.

The continuous appearance of reinforcing loops (or closed loop models) and virtuous circles are a new signal regarding the interrelated character of the phenomena under study and how their deployment needs to go hand in hand, with mutual help towards the different levels represented in Figure 15. Aware of the impossibility of disentangling these 'chicken-and-egg problems', this work embraces them and, although suggesting a primary direction for the relationship, it does not deny it but also welcomes the reciprocal approach.

Finally, QUAN1 served to further refine, explain and empirically test the claims of TfS as conducive to TBL performance, as well as depict the impact of collaboration on the deployment of traceability and transparency for sustainability. Thus, it contributes to CSR and (S)SCM literature with empirical evidence on how to be sustainable. Furthermore, QUAN1 has shed some light on how traceability, transparency and collaboration interact for sustainability.

In line with extant research of a theoretical nature (Beske & Seuring, 2014; Wu et al., 2014), SC collaboration has proven to be associated with profound (S)SCM as it improves SC traceability and transparency and results in SC outperformance.

First, regarding the impact of SC collaboration on SC traceability: Whilst collaborative relationships did not significantly affect SC traceability, the degree of associationism (number of associations)

did. This may be explained by the high amount of organizational and monetary resources that traceability demands (Cheng & Simmons, 1994; Stranieri et al., 2017), making volume (i.e., the number of associations) relevant in achieving its deployment. This study thus contributes with concrete examples and empirical evidence regarding how synergetic value is created in partnerships (Austin & Seitanidi, 2012b).

Second, regarding SC transparency, the statistical significance of the connexions worked the other way round, providing support for collaborative relationships but not for the number of associations. The positive relationship between collaborative relationships and SC transparency is not really revelatory as both share similar antecedents and enablers (e.g., information sharing, trust, etc.) (Cao & Zhang, 2011; Chen & Paulraj, 2004b). The fact that the positive relationship between the degree of associationism (number of associations) and transparency has not been supported reinforces the 'internal' and 'behavioural' character of transparency as suggested in QUAL2, whilst being a process that is built in (SC) relationships (Lamming et al., 2004; Rebs et al., 2018).

Finally, regarding the impact on TBL performance, both collaborative relationships and associationism showed a positive relationship, although only the former (both for direct and indirect effects) was found to be statistically significant. This might reflect the downsides of SC collaboration and, especially, of associationism, where sometimes conflicting objectives need to coexist, giving rise to different levels of paradoxes and challenging governance and long-term existence (Hoffmann, 2007; Rey-Garcia et al., 2020). Thus, seeing SC collaboration as a key enabler of SC sustainability (measured here through TBL performance), we can understand that these trade-offs (or tensions) demand appropriate governance (in line with the findings from the TfS framework) that cannot be ignored. This *appropriate governance* should aim to transform those trade-offs or tensions into positive outcomes for the different traditional and non-traditional SC actors (Rey-Garcia et al., 2020). In this way, this dissertation, although biased toward the positive side of collaboration, contributes to the debate on the tensions and paradoxes in sustainability and stakeholder management, urging a deeper analysis of how to prevent these tensions from destroying the positive advancements (mentioned below as imperative for further research).

Regarding the relationship between SC transparency and TBL performance, this study contributes to shed light on the unclear, contradictory or theoretical TBL consequences reported thus far in the literature (Wognum et al., 2011; Mol, 2015; Gardner et al., 2019), as QUAN1 results concluded regarding its positive association to TBL performance. The difference with the inconclusive evidence found in previous research may stem from the behavioural side of transparency and

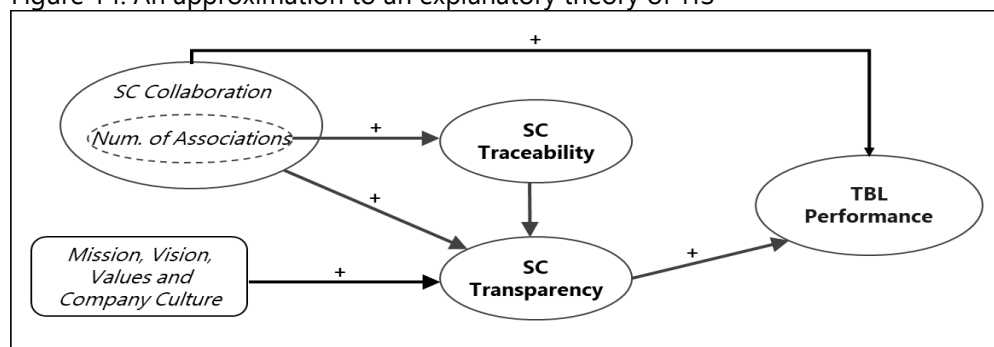
delimited disclosure which seems to prevent the ‘transparency paradox’ (i.e., the opacity caused by large but irrelevant disclosure) (Stohl et al., 2016), whilst advancing transparency far enough (with the assistance of SC collaboration and traceability) to significantly and positively affect TBL performance (Wognum et al., 2011; Mol, 2015). These results add to Gupta et al. and their call urging to go beyond “collecting and presenting data” and working in conjunction with other practices in order to unlock the transformative potential of transparency (Gupta, 2010; Gupta et al., 2020; p.92). This study shows that understanding SC transparency as not only disclosing but also acting transparently and embedding its deployment within the SC collaboration and traceability cycle allows associating it to this transformative potential in the form of TBL performance.

Regarding SC traceability, this study provides some light on how, despite its high monetary and organisational costs (Cheng & Simmons, 1994; Wognum et al., 2011; Macchion et al., 2015), it can bring about improved TBL performance (Alfaro & Rábade, 2009; Kumar et al., 2016; Mirzabeiki & Sjöholm, 2012). This is due to its indirect effect stemming from its role as an SC transparency antecedent.

QUAN1 has also contributed to add some light to the endless debate regarding traceability and transparency and which comes first. The empirical evidence gathered in this study supports that, at least when TBL performance is the final aim, traceability precedes transparency although leaving, as mentioned above, the door open for bidirectional relationships and interaction effects. This result would support Egels-Zandén et al. (2015) and Stranieri et al. (2017) who argue that traceability is necessary to guarantee SC transparency (despite the mutually reinforcing and *ad infinitum* virtuous relationship that is supported for the variables in this research) (Egels-Zandén et al., 2015; Stranieri et al., 2017). This can be explained by the negative association to the economic dimension of sustainability and the high organizational and monetary costs associated to traceability (or tracking and tracing tools) (Cheng & Simmons, 1994; Stranieri et al., 2017).

Figure 14, revisited below, depicts the explanatory theory of TfS derived from QUAN1 analysis.

Figure 14: An approximation to an explanatory theory of TfS



5.2. Managerial Implications

Several implications for the industry and regulators can be derived from this doctoral research, even from QUAL1's rather theoretical findings from which practical implications can also be discerned.

Specifically, the TfS framework provides guidance about how to approach four main features that are currently underdeveloped in the CSR and (S)SCM fields (Busse, Meinschmidt, et al., 2017; Carter & Rogers, 2008; Laudal, 2010; Pagell & Wu, 2009; Seuring & Müller, 2008a): (i) building transparency between SC partners in order to have direct and detailed TBL information about the processes and the final products, including multiple variables in sustainability-related areas that focal firms and suppliers have assumed explicitly in their codes of conducts; (ii) generating the information that makes it possible to align the entire SC system, including focal firms and suppliers, to achieve the key sustainability performance goal; (iii) developing sustainability-related risk and uncertainty management anywhere in the SC based on the updated information; and (iv) facilitating collaboration between focal firms, suppliers and non-traditional SC actors on TBL performance issues.

From the different practices and tools involved in TfS deployment, the enabling technologies associated to the tracking and tracing dimension deserve special attention due to their potential to leverage TfS beyond SC boundaries. These technologies can only operate systemically, when all the actors are connected in a single ecosystem (Rad and Ahmada, 2017; Rajala et al., 2018). Thus, focal companies should be interested in supporting other actors in the SC, whilst governments in developing countries can leverage this upgrading to offset the potential risks that enabling technologies may pose in the near future (Siddivo, 2017). Suppliers and their workers will also benefit from training and from the creation of qualified products provided by the spread of TfS along the SC. This disruptive change in power relations within the SC can set the conditions to truly transform (S)SCM with TBL impact beyond SC boundaries. Rai et al. (2006) who suggest that firms which leverage and develop IT integration for SCM to create a higher-order SC integration capability may profit from performance gains. Adding to the latter, this study proposes that this is the case with disruptive changes that affect (S)SCM in connection with traceable systems and enabling digital technologies (Kshetri, 2018). This research shows how the systemic orientation of the enabling technologies associated to TfS blurs boundaries and integrates non-traditional SC actors into the same ecosystem (Rad and Ahmada, 2017; Rajala et al., 2018).

Also, this study acknowledges that both traditional and non-traditional (initially external) SC partners participate in the virtuous cycle associated to traceable, transparent and sustainable SCs.

Thus, all SC actors need to strive to build trusting relationships within the chain and understand the strategic value of cross-sector partnerships (also with competitors). This means being ready to transparently share information that is accurate, trusted, timely and useful for SC actors and end customers (and consumers), whilst protecting privacy so competitive advantages are not threatened and TBL benefits can be achieved (Stevenson and Cole, 2018). The incorporation of the information materiality notion (that is, information that is "accurate, trusted, timely and useful") aims to overcome concerns regarding inefficient data processes and the disclosure of sensitive information that should not be revealed publicly in relation to the eternal dilemma between transparency and protecting privacy/competitiveness (Kache and Seuring, 2017).

On its own, SC collaboration may not be a solution for sustainability and, as already mentioned, it brings along challenges that require tension management and governance (Rey-Garcia et al., 2020). However, SC transparency has started to move from the *explicit* CSR domain into the *implicit* one, where responsibilities start to appear at the collective/industry level (Matten & Moon, 2008) as do the risks. This can be seen in the recent case of the organic cotton controversy as well as the 2013 Rana Plaza tragedy (Sinkovics et al., 2016; "Xinjiang issues place US firms in a difficult position", 2021). Thus, SC collaboration for traceability and transparency is no longer an option for fashion-apparel actors given that not only the environmental and social sustainability dimensions are at risk: the economic dimension at the industry level is also threatened (Gestal & Riaño, 2021; "Xinjiang issues place US firms in a difficult position", 2021). Relevant business associations are called to articulate the responsibilities in this regards as well as to arbitrate between the transparency and competitiveness dilemma so as to avoid undesirable outcomes such as innovation disincentives or unfair competition (Matten & Moon, 2008; Rey-Garcia et al., 2020). This links with a second block of practical implications, this time for institutions. There is a need for governments and institutions to respond to demands for global standards and supervision (perhaps in the form of a public agency that substitutes non-governmental systems and avoids audit fatigue and the public disclosure of rather useless information, as well as acting as an information arbitrator to provide transparency whilst protecting secrecy when needed). The coordinated advancement in initiatives already taken by some governments (the UK Modern Slavery Act or the French Due Diligence Law) may help to eradicate many of the TfS barriers and foster sustainability industry-wide. In addition, with the nascent application of many enabling technologies, the increase in benefits and productivity currently stems from the changes promoted in processes and practices rather than from the technology itself (Rad and Ahmada, 2017; Rajala et al., 2018). This reinforces TfS' TBL value creation in today's global SCs.

Finally, recent calls for circular models add a disruptive component to traditional linear systems, according to which companies will only be able to respond with disruptive changes in the way they operate (Kache and Seuring, 2017). TfS, as a meta-capability capable of disruptively changing (S)SCM processes, can be seen to play a key role in the new configuration, as it requires bringing together the different SC actors within the same ecosystem and equipping them with the capabilities, practices and processes needed to move towards traceable and transparent SCs and facilitating the desired circularity.

Whilst some scholars claim that reshoring is one of the opportunities that has arisen with disruptive technologies and that it is the solution to mend sustainability breaches and meet demands for transparency (Busse et al., 2017; Foerstl, Kirchhoff, and Bals, 2016), the author of this dissertation claims that TfS is the way forward. This is due not only in terms of the responsibility that focal firms, big traders, governments and consumers have assumed as regards producing countries but also due to the economic and environmental point of view, as current production areas are expected to be the biggest markets in a few decades (Siddivo, 2017).

Regarding QUAL2, the main practical implications are detailed below.

One relates to where those actors (and SCs) walking the sustainability path should focus and allocate results. Based on results from the proposed relational model, priority should be given to traceability and transparency and SC collaboration, as their nurturing element. Whilst traceability demands financial resources and collaboration that encompasses human resources throughout the whole lifecycle, transparency (as defined in this work) mainly entails organizational and SC-level changes that may result in cultural shifts; this may also imply initiating collaborative practices with actors throughout and alongside the SC. In order to off-set these investments, the gradual adoption of so-called affordable solutions for traceability (and transparency) such as product lifecycle management (PLM) (Conlon, 2020) may ease the transition towards traceable and transparent fashion-apparel SCs. Also, the thinking that key SC stakeholders (as represented by participating experts) apply when approaching sustainability in the fashion-apparel industry -with their novel emphasis on transversality- suggests that the potential effect of SC collaboration on traceability's and transparency's deployment should be better leveraged. One way would be to explore the possibility of creating an impartial third party to arbitrate and store sensitive information whilst the demands to public administrations to do so are still not met.

Second, transparency is the most contested definition in the Delphi study. This underscores the importance of cross-sectoral actors (as well companies and the entire SC) reflecting and agreeing on a common understanding of the concept. This is particularly true when, as is the case, a gap

exists between the benefits the academic literature expects and the threats to competitiveness (related to privacy) that the industry perceives. Such discussion can be guided by the questions proposed by Gupta (2010): Why, what, for whom and to what end? As already mentioned with regards to the TfS concept, the 'restrictive' approach proposed in the definition of transparency in QUAL2 further helps to solve the "Reluctant to disclose" barrier, soften the trade-offs derived from transparency's "relationship with secrecy", and prevent the 'corporate narratives of self-praise' that do not end in increased SC sustainability (Gold and Heikkurinen, 2018). Also, once transparency is defined as an internal decision sitting clearly on the behavioural side, it can no longer be used as an irremediable barrier (or excuse) associated to sustainable breaches along fashion-apparel SCs (Borit and Santos, 2015).

Third, reinforcing the rather theoretical call from QUAL 1, this study's results reveal a call from the industry for regulations and enforcement by public administrations at the global level, as well as standards —similar to those for the food or pharmaceutical industries. Public administrations should also act as the top-level impartial third party that academy, industry and other stakeholders have long called for (Bhaduri & Ha-Brookshire, 2011).

Finally, regarding QUAN1, besides empirically validating the above practical implications, it has revealed additional ones. On the one hand, it sheds light on the contribution that collaborative relationships and associations make to deploy traceability, transparency and sustainability. The study also highlights items regarding collaboration that are less developed (peer-to-peer collaboration and collaboration with non-traditional actors), as well as the number of associations the respondent companies belong to which, on average, is below one. SC collaboration has proven to be directly and positively associated to SC transparency and TBL performance, whilst industry associations are enablers of SC traceability and, even though not statistically significant (possibly due to the limited sample size), with a positive relation to TBL performance. These results leave room to nurture collaboration with other actors in the SC (in addition to suppliers and customers), thus leveraging collaboration's potential for dismantling the identified barriers and filling the mentioned gaps: the lack of regulations/enforcement, the lack of a common culture/values, the lack of impartial third party, etc.

5.3. Limitations and Further Research

This doctoral work presents a number of limitations that are presented below. Some of them serve to open new research avenues that will be subsequently described.

First, some methodological issues are examined, highlighting some which stem from the unavoidable research choices and constraints.

Regarding the qualitative studies (QUAL1 and QUAL2), the first limitation relates to the potential biases commonly associated to exploratory and qualitative research (Durach et al., 2017; Wieland et al., 2017). In order to neutralize any possible subjectivity, the author designed and implemented a transparent and systematic process when selecting the corpus of the sample (QUAL1) and interpreting the results with iterative analysis and triangulation between the literature and the research team (QUAL1 and 2). The snowball sampling carried out in QUAL2 ensured that all the key fashion-apparel SC stakeholders were represented in the sample to avoid potential bias towards one particular stakeholder's point of view.

Second, the results from QUAL1 and QUAL 2 studies cannot be claimed to be generalizable and, although their insights may inform other industries, they have been distilled for the particular fashion-apparel SC context. Also, a bias towards the analysis of the technological side of TfS can be declared despite the fact that, as per QUAL1's literature review, the non-technological side might be considered (at least) as key as the technological element for TfS deployment.

Also, approaching reality through a DC (and related views) and stakeholder theory transformational lens, though providing insightful results for the aim of this research project, implies a somewhat normative approach to the literature review and the analytical phases. This is also the case regarding the analysis of traceability and transparency to achieve sustainability (TfS) and the posited hypotheses in QUAN1.

For its part, one of the main limitations of the quantitative study comes from being restricted to the fashion-apparel industry which, although relevant for the purpose of this study, might jeopardize the generalization of the results. In addition, even though the data collected inform at the SC level, the unit of data collection is only one company (a fashion-apparel brand supplier). Although the questionnaire and data collection have been developed and carried out to ensure the best possible inference to the SC level, the item regarding the company's (fashion-apparel brand supplier) transparent behaviour (TRANSP6) would benefit from the contrast with another actor of the SC.

Furthermore, the quantitative research has adopted the understanding of TBL performance or sustainability performance as the aggregate result of sustainability's three dimensions—environmental, social and economic—, which represents a simplified version of the

understanding of sustainability in this work as the 'simultaneously positive result on each of the three dimensions' and measures it at the single company level (i.e., a fashion-apparel supplier).

The latter, together with a relative focus on the positive side (TBL enablers and beneficiaries) of the phenomena under analysis, constitute the main limitation regarding this doctoral research' contribution to the CSR and (S)SCM debate. However, it also opens valuable research avenues to move this investigation forward by: (i) measuring sustainability performance as an integration (not a balance), where negative results for the different stakeholders cannot be balanced out, and, (ii) incorporating the management of the stated barriers and the tensions and paradoxes both amongst actors and sustainability dimensions.

Some concrete future research avenues are outlined below.

First, the TfS framework should be interpreted as a theoretical proposal that opens future research avenues regarding its operationalization and empirical testing (beyond the relational model proposed by the experts in QUAL2 and tested in QUAN1). Also, how to operationalize the variables within each dimension of the TfS and empirical research testing the enabling cycle and its TBL impact would very much help advance the phenomena both at the theoretical and practical levels, as already claimed by Fraser et al. (2020). Contrasting the validity of this framework in other global industries (such as food) would also provide valuable insights on understanding TfS and its application in practice. In the above-mentioned work, Fraser et al. already operationalised the tracking and tracing dimension of the framework, proving to be valid for the automotive industry (Fraser et al., 2020).

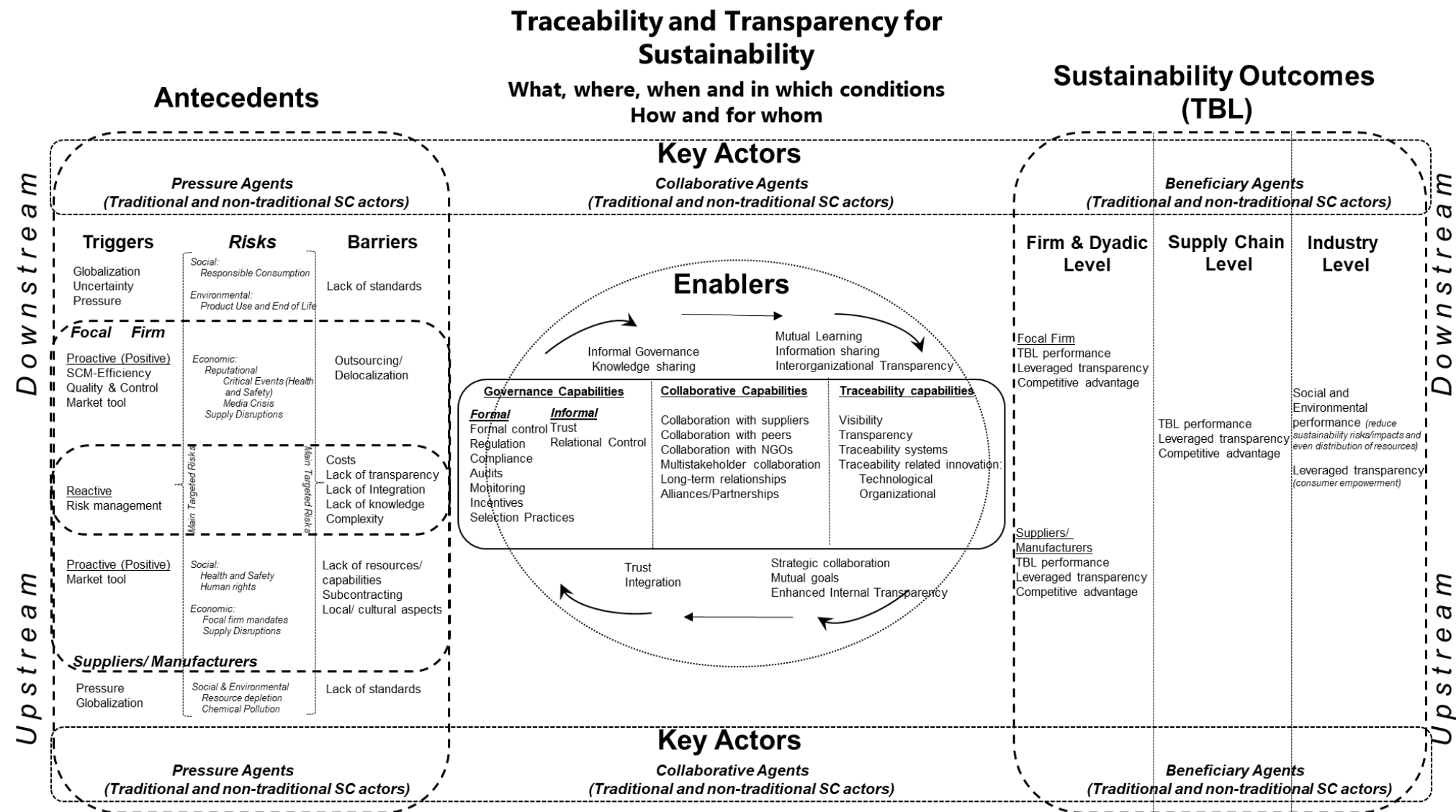
Regarding the theory, an in-depth understanding of the relationships amongst the variables conforming each of the conceptualised dimensions in the TfS framework would be crucial to move forward. Together with the dynamic capabilities (and related) views and stakeholder theory, institutional, paradox and information processing theories stand out as the most appropriate options to ground future studies' explanations. Moreover, analysing TfS under the postulates of contingent RBV (Aragón-Correa & Sharma, 2003) may provide insightful insights.

Finally, with the hope of encouraging future research that may advance and complement this study's aim of deploying and leveraging traceability and transparency in favour of (fashion-apparel) SC sustainability, understood as creating and (re)distributing value for traditional and non-traditional stakeholders integrated in the new ecosystem, Figure 16 below provides a guide for future research avenues. This figure arose from the discussions carried out on the literature review in QUAL1 and highlights the different focuses that TfS research may (and may need to)

adopt to advance towards 'sustainable traceable and transparent SCs'. These future studies can assume a multilevel approach to measure performance at the SC level, disaggregate performance into the three TBL variables or contrast performance with risk management measures, to mention just a few examples.

Despite the seemingly insurmountable challenges of developing (fashion-apparel) SCs that "could, customers willing, continue to do business forever" (Pagell & Wu, 2009, p. 38), this dissertation aims to inspire work in this direction. Any step taken towards it would mean starting the ascending path in the meta-capability helix.

Figure 16. TFS - Extended version



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Appendices

Appendix 1. Interview protocol (QUAL2)



Protocol Interview-Validation Conceptual Framework Traceability and Transparency for Sustainability in the Apparel Supply Chain

Context of the study: This interview is part of a doctoral work that aims to understand in depth the concepts of traceability and transparency in the supply chain of the textile sector, and their consequences on the sustainability (economic, social and environmental impact) of the industry.

This doctoral work is being carried out at the University of Deusto by doctoral candidate Sofía García Torres under the direction and supervision of professors Marta Rey García (University of A Coruña, Spain) and Josune Sáenz Martínez (University of Deusto, Spain). The doctoral project is funded by the University of Deusto through a research staff training grant (FPI).

Main aim of the interview: Understand why and how traceability is deployed in the supply chain of the textile sector, and its relationship with the sustainability (economic, social and environmental) of the sector and the concept of transparency.

Confidentiality: All researchers participating in this project commit to guarantee anonymity and confidentiality at all times, both of the interviewees and of the data obtained in the process. They also ensure that the analysis of the information will be carried out for use exclusively associated with the development of the doctoral work, and that any publication of the conclusions resulting from this interview process will be carried out in an aggregate manner, thus making it impossible to identify the people interviewed. Likewise, the researchers recognize the right of the interviewees to decline to answer any of the questions and / or end the interview or its recording at any point during the interview.

Expert opinion: The interviewees who participate in the project do so on a personal basis and for being experts in the textile sector and in the field of sustainability and / or traceability. Thus, their opinions are personal, without necessarily reflecting the reality or strategy of the company in which they currently carry out their professional activity.

Interviewer profile:

Role and seniority.

Company profile: main activity, number of workers, annual turnover, exporter profile.

Total years of experience in the textile sector.

Total years of experience in traceability.

Academic background in traceability: Yes / No.

Interview data:

Interview code:

Interviewer:

Start / end date and time:

Place:

Collection method:

Interview Guide

Q1: How do you define sustainability in the supply chain of the textile sector? Would you define it as an outcome, a process, a strategy, or all of them?

Q1.1: Do you agree with the following definition? Is it missing any aspect? Would you remove any aspect?

Sustainability in business environments refers to the need to address and manage issues on economic, social, and environmental dimensions in a balanced and integrated manner.

Q2: How do you define traceability in the supply chain of the textile sector? What inputs, outputs, processes and SC echelons should be included or excluded?

Q2.1: Do you agree with the following definition? Is it missing any aspect? Would you remove any aspect?

"The ability to identify and trace the history, distribution, location and application of products, parts and materials, to ensure the reliability of sustainability claims, in the areas of human rights, labour (including health and safety), the environment and anti-corruption."

Q3: How do you define traceability in the supply chain of the textile sector? What inputs, outputs, processes and SC echelons should be included or excluded?

Q3.1: Do you agree with the following definition? Is it missing any aspect? Would you remove any aspect?

The corporate disclosure of: i) the names of the suppliers involved in producing the firm's products, ii) information about the sustainability conditions at these suppliers, and iii) the buying firms' purchasing practices.

******* Hereafter, we delimit the textile supply chain: upwards to the first component of the final product that involves some manufacturing transformation (including weaving and accessories); and downwards to the floor of the retail store.*******

Q4. Bearing in mind your own definitions of Sustainability, Traceability and Transparency, what would be the relationship between them?

Q5. Taking into account the proposed definitions of the below elements:

- a) Triggers/drivers: Elements (reasons or events) that cause the appearance of or search for a certain process or action. They would answer "why" a phenomenon occurs or is needed.*
- b) Enablers/sources: Methods, actions, practices or systems that make the existence of something possible. They would respond to 'how' a phenomenon is achieved.*
- c) Barriers: Circumstances or obstacles that keep people or things apart or prevent communication or progress.*
- d) Outcomes: Effect and consequence of an event, operation or deliberation.*

Q5.1. Focusing on the phenomenon of Sustainability, and from the point of view of the activity of your company, what would be the main triggers, enablers, barriers and outcomes?

Q5.2. Focusing on the phenomenon of Traceability, and from the point of view of the activity of your company, what would be the main triggers, enablers, barriers and outcomes?

Q5.3. Focusing on the phenomenon of Transparency, and from the point of view of the activity of your company, what would be the main triggers, enablers, barriers and outcomes?

Q5.4. If we were to relate Sustainability, Traceability and Transparency around the elements defined in this section (triggers, enablers, barriers and outcomes), and from the point of view of the activity of your company, what would be the main phenomenon and where would the other two be located?

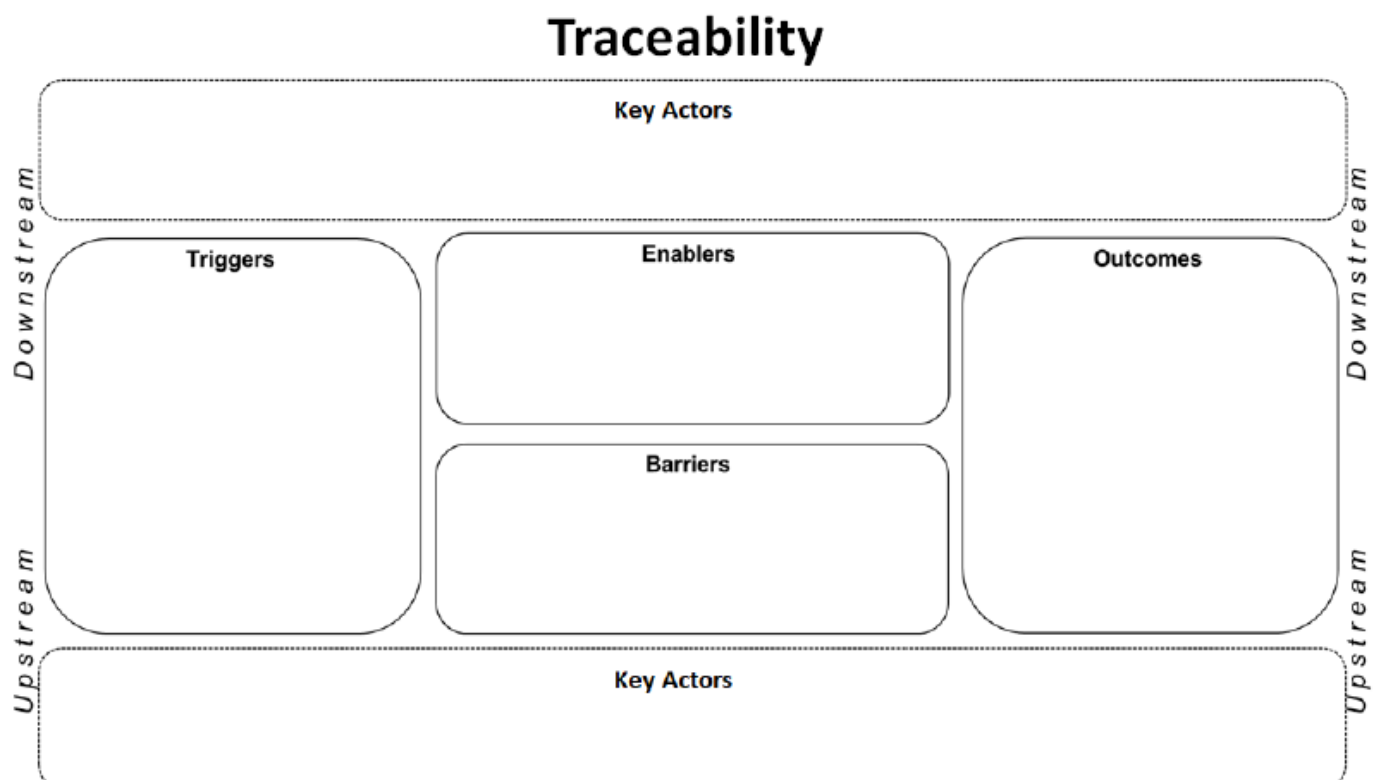
Q5.5. Assuming Traceability as the main phenomenon:

Q5.5.1. How would you fill in the below framework?

Q5.5.2. Would Sustainability and Transparency appear as triggers, enablers, barriers or outcomes?

Q5.5.3. What actors (inside or outside the supply chain) are involved in achieving Traceability?

Q5.5.3.1. How would you define your role: as pressuring, collaborative or beneficiary agents?



Appendix 2. Interim list of stakeholder groups, drivers and barriers (QUAL2)

Interim list of stakeholder groups, drivers and barriers

(extracted from the in-depth interviews)

SC Stakeholder Groups

Fashion-apparel SC Stakeholder Groups
Auditing Companies
Brands/Retailers
Certifying Companies
Clients
Mass Media
NGOs
Public Administration and Regulatory Institutions
Sector Associations
Society
Suppliers
Unions
Universities

Drivers and barriers

Type of Mechanism	Mechanism	Phenomenon fostered/hindered
Drivers	Audits	Sustainability and Traceability
	Collaboration Companies-Stakeholders	Sustainability; Traceability and Transparency
	Collective consciousness	Sustainability
	Honesty	Transparency
	Innovation; R&D	Sustainability; Traceability and Transparency
	Integration with upstream suppliers and downstream clients	Traceability and Transparency
	Internal codes and policies	Sustainability
	Legislation	Sustainability; Traceability and Transparency
	Long-term relationships	Transparency
	Mission, vision, values, company culture	Sustainability and Transparency
	Protocols, ISO norms, quality systems	Transparency and Traceability
	Public/Governmental aid	Sustainability
	"Reliable" certifications	Sustainability; Traceability and Transparency
	Risk management	Sustainability and Traceability
	SC trade union knowledge	Traceability
	Search for management improvements (cost optimization, recall management, etc.)	Traceability
	Search for Sustainability	Traceability and Transparency
	Technology/ IT systems	Sustainability and Traceability
	Traceability	Sustainability
	Training and awareness campaigns	Sustainability and Traceability
	Trust (among SC actors and stakeholders)	Transparency

Type of Mechanism	Mechanism	Phenomenon fostered/hindered
Barriers	Complexity- Number of intermediaries	Transparency and Traceability
	Complexity-Number of activities/echelons	Traceability
	Costs/ Lack of monetary resources	Sustainability and Traceability
	Hyper consumerism	Sustainability
	Inability of stakeholders to verify information	Transparency
	Inappropriate patent policy	Transparency
	Lack of a single verification body ("Infomediary")	Transparency
	Lack of information and awareness	Sustainability
	Lack of regulation/enforcement	Sustainability, Traceability and Transparency
	Lack of standardization (certifications, measurement indicators)	Traceability and Sustainability
	Lack of technological resources	Sustainability and Traceability
	Lack of trained human resources	Traceability and Sustainability
	Lack of visibility upstream- subcontracting and intermediaries	Traceability
	Non-reliable/green washing certifications	Transparency
	Opacity within the chain	Traceability
	Reluctance to disclose	Transparency
	Short-term relationships	Traceability
	Time and price pressure	Sustainability and Traceability
	Unsustainability "Incentives": Low Cost of Human and Natural Resources	Sustainability

Appendix 3. Questionnaire-2nd Round Delphi study (QUAL2)

Welcome to the phase of validation of the Conceptual Framework of Traceability and Transparency for Sustainability in the Textile Supply Chain! Thank you again for your participation in the previous steps of this research.

The information that you will be provided constitutes the crossing and / or combination of the opinions issued by experts in the sector with the information obtained from the review of academic literature regarding why and how traceability appears in the supply chain of the textile sector, and its relationship with the sustainability (economic, social and environmental) of the sector and the concept of transparency. This crossing and combination is the result of an iterative analysis carried out by the doctoral student Sofía García Torres, under the direction and supervision of professors Marta Rey García (University of A Coruña, Spain) and Josune Sáenz Martínez (University of Deusto, Spain).

The main objective of this final phase is to validate the definitions and the model that resulted from this analysis.

Secondly, we try to advance the driving elements, facilitators, barriers and results of Sustainability, Traceability and Transparency; as well as the actors involved in their deployment.

The form of data collection guarantees the total anonymity of the respondents and the organizations to which they belong. However, we ensure that the analysis of the information will be carried out for use exclusively associated with the development of the doctoral work, and that any publication of the conclusions resulting from this process will be carried out in an aggregate manner, thus making it impossible to identify the participants.

Thank you very much in advance for completing the questionnaire!

Q1. Does the following definition represent your understanding of SUSTAINABILITY in the textile supply chain?

"Outcome of the optimization and management of the economic (including governance), social and environmental dimensions of any activity, with a strategic, integrated and transversal approach."

Answer1: Yes

Answer2: No, I disagree with

Q2. Does the following definition represent your understanding of TRACEABILITY in the textile supply chain?

"Ability of an organization to identify and control the trajectory and conditions of each component, material, process and human resources related to its products, from its initial conception until the end of its lifecycle, with a triple objective: (i) operations/decision-making; (ii) track and trace processes and products; and (iii) ensure the reliability and the capacity to tackle sustainability claims regarding products and processes."

Answer1: Yes

Answer2: No, I disagree with

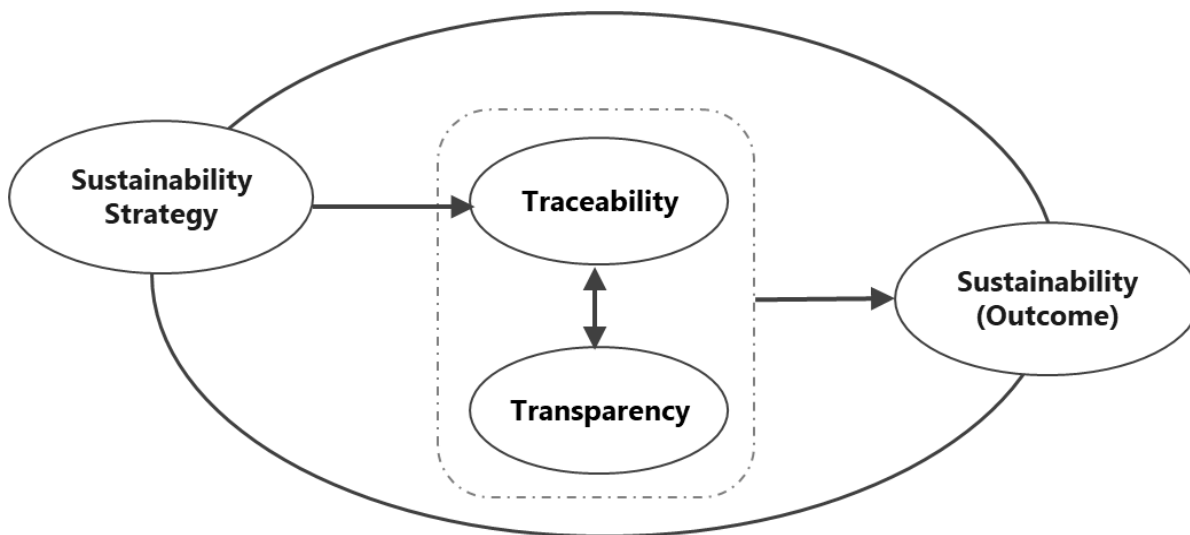
Q3. Does the following definition represent your understanding of TRANSPARENCY in the textile supply chain?

"Decision of an organization to reveal all the relevant information regarding its products and internal policies and practices to legitimate partners or stakeholders, so intellectual property rights are not at risk."

Answer1: Yes

Answer2: No, I disagree with

Q4. Do you agree with the relationships between the key concepts shown in the following image?



Answer1: Yes

Answer2: No, I disagree with

Taking into account the proposed definitions of the below elements:

Triggers/drivers: Elements (reasons or events) that cause the appearance of or search for a certain process or action. They would answer "why" a phenomenon occurs or is needed.

Enablers/sources: Methods, actions, practices or systems that make the existence of something possible. They would respond to 'how' a phenomenon is achieved.

Barriers: Circumstances or obstacles that keep people or things apart or prevent communication or progress.

Outcomes: Effect and consequence of an event, operation or deliberation.

With regards to **SUSTAINABILITY**:

Q5. In your opinion, what elements drive and enable the definition and deployment of a SUSTAINABILITY strategy?

	Audits
	Collaboration Companies-Stakeholders
	Collective consciousness
	Innovation; R&D
	Internal codes and policies
	Legislation
	Mission, vision, values, company culture
	Public/Governmental aid
	"Reliable" certifications
	Risks management
	Technology/ IT systems
	Traceability
	Training and awareness campaigns
	Other:

Q6. In your opinion, what elements hinder the definition and deployment of a SUSTAINABILITY strategy?

	Costs/ Lack of monetary resources
	Hyperconsumerism
	Lack of information and awareness
	Lack of regulation/enforcement
	Lack of standardization (certifications, measurement indicators)
	Lack of technological resources
	Lack of trained human resources
	Time and price pressure
	Unsustainability "Incentives": Low Cost of Human and Natural Resources
	Other:

Q7. In your opinion, what kind of results could be achieved thanks to a SUSTAINABILITY strategy?

	Competitive Advantage
	Resource optimization
	Risk management
	TBL performance
	Other:

With regards to **TRACEABILITY**:

Q8. In your opinion, what elements drive and enable SC TRACEABILITY?

	Audits
	Collaboration Companies-Stakeholders
	Innovation; R&D
	Integration with upstream suppliers and downstream clients
	Legislation
	Protocols, ISO norms, quality systems
	"Reliable" certifications
	Risks management
	SC trade union knowledge
	Search for management improvements (cost optimization, recall management, etc.)
	Search for Sustainability
	Technology/ IT systems
	Training and awareness campaigns
	Other:

Q9. In your opinion, what elements hinder the deployment of SC TRACEABILITY?

	Complexity- Number of intermediaries
	Complexity-Number of activities/echelons
	Costs/ Lack of monetary resources
	Lack of regulation/enforcement
	Lack of standardization (certifications, measurement indicators)
	Lack of technological resources
	Lack of trained human resources
	Lack of visibility upstream- subcontracting and intermediaries
	Opacity within the chain
	Short-term relationships
	Time and price pressure
	Other:

Q10. In your opinion, what kind of results could be achieved thanks to SC TRACEABILITY?

	Certificates
	Competitive Advantage
	Risk Management
	Transparency
	Other:

With regards to **TRANSPARENCY**:

Q11. In your opinion, what elements drive and enable SC TRANSPARENCY?

	Collaboration Companies-Stakeholders
	Honesty
	Innovation; R&D
	Integration with upstream suppliers and downstream clients
	Legislation
	Long-term relationships
	Mission, vision, values, company culture
	Protocols, ISO norms, quality systems
	"Reliable" certifications
	Search for Sustainability
	Trust (among SC actors and stakeholders)
	Other:

Q12. In your opinion, what elements hinder the deployment of SC TRANSPARENCY?

	Complexity- Number of intermediaries
	Inability of stakeholders to verify information
	Inappropriate patent policy
	Lack of a single verification body ("Infomediary")
	Lack of regulation/enforcement
	Non-reliable/green washing certifications
	Reluctance to disclose
	Other:

Q13. In your opinion, what kind of results could be achieved thanks to SC TRANSPARENCY?

	Competitive Advantage
	Improved customer satisfaction and emotional linkage
	Risk Management
	Sustainability
	Other:

Q14. Which of these actors do you consider to have a relevant role in achieving Sustainability, Traceability and Transparency in the textile supply chain? Please indicate if their role is as pressuring, collaborative, or beneficiary agents, or any combination of them.

You can choose all the actors that you consider relevant, and in all the possible roles.

	Pressuring agents	Collaborative agents	Beneficiary agents
Auditing Companies			
Brands/Retailers			
- Owners and / or Top Management			
- Department of Sustainability / CSR			
- Quality Department			
- Purchasing department			
- Design Department			
- R&D department			
- Factory Workers			
Certifying Companies			
Clients			
Mass Media			
NGOs			
Public Administration and Regulatory Institutions			
Sector Associations			
Society			
Suppliers			
- Owners and / or Top Management			
- Department of Sustainability / CSR			
- Quality Department			
- Purchasing department			
- Design Department			
- R&D department			
- Factory Workers			
Unions			
Universities			

Thank you very much for participating in this study!

We will keep in touch to inform you of the next steps we are taking and send you the results that we will obtain from the aggregate analysis of all the information. Do not hesitate to contact us for any questions that may arise or any additional information you wish to know.

Appendix 4. Questionnaire (English) (QUAN1)



Traceability and Sustainability in the Textile Industry. Research Aim and Questionnaire for Suppliers

The fashion/textile sector constitutes one key industry globally in terms of wealth and work generation and particularly in the Iberian Peninsula.

With the aim of moving towards the economic, social and environmental sustainability of the industry and thus protecting its potential, this doctoral work pursues 2 specific research objectives:

- How to ensure real traceability.
- How to balance the tensions among the economic, social and environmental aspects, and the different actors within the SC.

It is for these aims that we kindly request your collaboration, by filling in the present questionnaire.

This doctoral work is being carried out at the University of Deusto by doctoral candidate Sofía García Torres under the direction and supervision of professors Josune Sáenz Martínez (University of Deusto, Spain) and Marta Rey García (University of A Coruña, Spain). The doctoral project is funded by the University of Deusto through a research staff training grant (FPI).

Who is the questionnaire for?

- Target companies (respondents):
 - i. Direct suppliers (garments, tissues, or yarns) of fashion-apparel brands.
 - ii. Indirect suppliers (garments, tissues, or yarns) of fashion-apparel brands (i.e. suppliers of other suppliers).
- Informants: Employees of the target companies in managerial positions who have a global vision of the product and operations with customers and suppliers, and responsibility for some of its aspects (mainly belonging to purchasing, sales, sustainability / CSR or management departments). Ideally, if possible, responses will be collected from several people per company. Therefore, do not hesitate to send the questionnaire to as many people within your organization as you consider appropriate.

How to answer:

- You may:
 - i. Fill out the questionnaire individually and send it by email once it is complete, or
 - ii. Fill it out online at https://www.soscisurvey.de/T4S_Versionreducida/, or
 - iii. Request a telephone or face-to-face appointment and fill out the questionnaire as if it were an interview.

How much does it take?

- The questionnaire is designed so that it can be answered in 15 minutes.

Confidentiality

All researchers participating in this project commit to guarantee anonymity and confidentiality at all times, both of the interviewees and of the data obtained in the process. They also ensure that the analysis of the information will be carried out for use exclusively associated with the development of the doctoral work, and that any publication of the conclusions resulting from this interview process will be carried out in an aggregate manner, thus making it impossible to identify the people interviewed nor the companies they work for.

Results

Participants who so wish may receive via email a summary of the descriptive results of the questionnaire at the end of the doctoral project.

For questions about the research and the questionnaire, to request an interview to carry out the questionnaire, or to request that the results are sent to your email, please contact:

Sofía García Torres. E-mail: sofiag.torres@deusto.es. Phone: +34605031624. Skype: sofiag_torres

Thank you very much for participating in this survey, which aims to help the fashion industry on its sustainability road.

SECTION 1. KEY CONCEPTS AND INFORMATION REGARDING RESPONDENT COMPANIES AND THEIR INFORMANTS

1.1. KEY CONCEPTS

This questionnaire is targeted to suppliers of garments, tissues and yarns of the fashion-apparel SC:

- (i) If they directly sell their products to fashion-apparel brands, they are direct suppliers.
(ii) If they sell their products indirectly to fashion-apparel brands, they are Indirect suppliers.

Besides that, in this questionnaire we distinguish among:

- (a) **Manufacturers**: To be selected if the products that the company sells are, at least partially, produced in own facilities (they can also subcontract part of the production)
(b) **Design suppliers**: To be selected if the company does not own any production facility but sells its own garment, fabric or yarn designs.
(c) **Traders**: To be selected if the company does not own any production facility and never sells its own garment, fabric or yarn designs.

We will refer to:

- Fashion-apparel brands** (hereafter, **the brand**): the company that sells clothes with a fashion component (hereinafter, **the garment**) under its own brand name, clearly identifiable and recognizable in the market.
- Client**: the company to which your company directly sells the products (i.e., either a fashion-apparel brand, or a supplier of that brand).
- Supplier**: the company from which your company purchases the inputs/raw materials (not including labels or accessories), or the company partially or totally manufacturing the products your company sells.
- End customer**: the person who buys the garment from the brand.
- Peers/Competitors**: companies with the same objectives and / or clients as your company.
- Stakeholders**: companies or groups that, without having a contractual relationship with your company, may affect or be affected by your company's activity (NGOs, government, civil society, etc.).

*To answer each question, please think about the actor with whom you have the highest turnover or the most stable relationship.
Should you prefer, you can answer as per the most habitual approach in your company.*

(*) Please, choose the type of company that better defines your own company :	Please, choose one:		Please, choose one (main activity)	
	☐ Direct Supplier	☐ Indirect Supplier	☐ Manufacturer	☐ Design Supplier
			☐ Trader	

(*) What is the main product that your company sells to its customer?	☐ Garments	(*) Which is its main category ?	☐ Flat knits	☐ Woven
	☐ Fabric		☐ Circular knits	☐ Other
	☐ Yarn		If other, please state:	

(*) What is the name of the department where you are currently working?	Please state:
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SECTION 2. SC PRACTICES AND BEHAVIOURS

2.1. TRACEABILITY

Traceability is defined as *the ability to follow the history (including processes), application and location of what is under consideration: products, parts, materials and services.*

(*) 2.1.1. Please rate the extent to which your company is able to...	(1=Not at all; 5=Completely)				
	1	2	3	4	5
... trace the origin of the product upstream , outside your company.	☐	☐	☐	☐	☐
... track the destination of the product downstream , outside your company.	☐	☐	☐	☐	☐
... track and trace the destination and origin of the product within the boundaries of your company .	☐	☐	☐	☐	☐

2.5. TRANSPARENCY

Transparency (in the SC) is defined as *acting in a way that enables others, both internal and external stakeholders, to **perceive and understand** what the **company does**, as well as the **quality disclosure** of the information needed for this. "Transparency is not merely about sharing information but also about acting transparently."*

(*) 2.5.1. Please rate the extent to which:	(1=Not at all; 5=Completely)				
	1	2	3	4	5
Your company acts in a way that enables others to perceive and understand what the company does	☐	☐	☐	☐	☐
Your supplier acts in a way that enables others to perceive and understand what the company does	☐	☐	☐	☐	☐

(*) 2.5.4. Please rate the extent to which your company discloses:						
	(1= Not at all; 5= Completely)	1	2	3	4	5
Supplier's names		☐	☐	☐	☐	☐
Supplier's sustainability conditions		☐	☐	☐	☐	☐
Internal sustainability conditions		☐	☐	☐	☐	☐
Own codes of conduct and internal policies (including buying practices)		☐	☐	☐	☐	☐
(*) 2.5.5. Please rate the extent to which your supplier discloses:						
	(1= Not at all; 5= Completely)	1	2	3	4	5
Supplier's names		☐	☐	☐	☐	☐
Supplier's sustainability conditions		☐	☐	☐	☐	☐
Internal sustainability conditions		☐	☐	☐	☐	☐
Own codes of conduct and internal policies (including buying practices)		☐	☐	☐	☐	☐

SECTION 3: COLLABORATION AND GOVERNANCE

3.1. COLLABORATION

Collaboration is defined as *two or more autonomous actors that form long-term relationships and work closely to plan and execute supply chain operations towards common goals, thereby achieving more benefits than if acting independently.*

(*) 3.1.1. Please rate the extent to which your company collaborates with...						
	(1= Not at all; 5= Completely)	1	2	3	4	5
... its client .		☐	☐	☐	☐	☐
... its supplier .		☐	☐	☐	☐	☐
... its competitors .		☐	☐	☐	☐	☐
... NGOs or other stakeholders (without contractual relationships).		☐	☐	☐	☐	☐

(*) 3.1.3. Does your company take part in any association/initiative/network/cluster con clients, suppliers, peer/competitors, NGOs or other stakeholders?		Yes	No
		☐	☐

3.1.4. If so:	
In how many?	

SECTION 4: PERFORMANCE

4.1. PERFORMANCE

We define **performance** as *the result of the business activity.*

(*) 4.1.1. Please rate the performance of your company compared to its competitors in regards to...						
	(1 = Much worse than competitors. 5 = Much better than competitors)	1	2	3	4	5
Economic Performance		☐	☐	☐	☐	☐
Social Performance		☐	☐	☐	☐	☐
Environmental Performance		☐	☐	☐	☐	☐