Sustainable procurement drivers for extended multi-tier context

A multi-theoretical perspective in the Danish supply chain

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Sustainable Procurement Drivers for Extended Multi-Tier Context: A Multi-theoretical perspective in the Danish Supply Chain

Abstract

In light of the rising global importance of sustainable procurement (SP) implementation for contributing to sustainable development goals (SDGs), the main aim of this study is to perform an abductive research to analyse the drivers of SP under a Danish extended multi-tier supply chain context. Initially, the expansion of the traditional multi-tier theory to a novel extended multi-tier theory is accomplished by considering three factors: any number of upstream SC entities, the direct customer on the downstream entity, and the focal firm. This study has been done with the intention of implementing SP for the focal firm. Following that, the study develops a research framework to analyse the drivers of SP in an extended multi-tier environment by considering both upstream (1st tier and 2nd tier suppliers) and downstream (direct customer) supply chain entities together with the focal company using multiple theories such as extended multi-tier, triple bottom line (TBL), dynamic capability, institutional theory, and decision theory. Firstly, the relevant SP drivers are categorised (i.e., 7 categories of main drivers and 24 sub-drivers) based on the TBL, dynamic capability, and institutional theory. Secondly, applying the Best Worst Method (BWM), SP drivers were prioritized, and a comparative analysis was performed across the extended multi-tier context. The result shows that the top three priorities of the sub-drivers are "*personal values,*" "*active top management support,*" and *"government regulation and legislation,"* respectively for the focal company. Comparative analysis points to the fact that the sub-driver *"government regulation and legislation"* is considered important for all the SC entities; however, no mandatory government regulation currently exists to implement SP in the private sector context. On the other hand, the sub-driver "*customer pressure / demand*" for the sustainable products has been a low priority for the focal company and 2nd tier suppliers and it has not been considered relevant for the 1st tier supplier and direct customer. Thirdly, applying the Decision-Making Trial And Evaluation Laboratory (DEMATEL), an interrelationship analysis was performed on the key SP drivers that exist from the focal company's perspective. Finally, relevant managerial implications and conclusions were drawn for the focal case company based on the results of the prioritization and interrelationship analysis.

Keywords: Sustainable Procurement; Dynamic Capability; Institutional Theory; Extended Multi-tier theory; Drivers; Abductive; Multiple case study, BWM, DEMATEL, Danish Context.

1. Introduction

Over the past few decades, the concept of sustainability has become a strategic goal for many global organisations (Agrawal and Lee, 2019, Giunipero et al., 2012, Closs et al., 2011, Wang, 2019, Govindan et al., 2020, Govindan et al., 2021a). In response to the global awareness of United Nations (UN) Sustainable Development Goal (SDG) 2030, SDGs are not optional; they are for survival (Van Wassenhove, 2019, Fatimah et al., 2020). With regard to the business context, sustainability goals could be achieved not only by the efforts of an organisation but also by the active engagement of the members of the entire SC. Thus, to achieve the SDGs, it is necessary to properly align strategy formulation with implementation activities along the SC of an organisation (Meehan and Bryde, 2011, Green et al., 1996, Cai and Choi, 2020, Govindan et al., 2020, Govindan et al., 2021a). To drive organisations towards achieving SDGs, one option is to improve their capabilities dynamically in the procurement function, particularly through the implementation of sustainable procurement (SP) practices. Among the various sustainable supply chain (SSC) practices, sustainable procurement (SP) drives not only the focal firm but also its SC entities to move towards the common goal of a sustainability roadmap. This is aligned with the United Nations (2015) statement that SP practices have a great potential to attain the SDG 12 (known as Sustainable Consumption and Production (SCP) in particular) and to positively influence the remaining SDGs as well, since all 17 SDGs are interconnected (Webpage 1, xxxx).

In simple terms, the integration of sustainability concepts – i.e., the triple bottom line (TBL) approach – in the procurement process is called sustainable procurement (SP). According to Walker and Brammer (2009), SP "*is consistent with the principles of sustainable development, such as ensuring a strong, healthy and just society, living within environmental limits, and promoting good governance*" (Walker et al., 2012). Although several definitions of SP exist, the popular definition offered by UK Sustainable Procurement Taskforce in their "Procuring the Future" report defines the term as "*a process whereby organisations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only to the organisation, but also to society and the economy, whilst minimizing damage to the environment*" (DEFRA, 2006, Young et al., 2016). As pointed out by Govindan et al. (2013), it is essential for firms to invest in sustainable practices by focusing their suppliers on the goal of satisfying their stakeholders' requirements for complying with regulations, social commitments, and meeting the customers' demands (Garg and Sharma, 2018, Govindan et al., 2020, Govindan et al., 2021a, Niu and Mu, 2020, Rashidi et al., 2020). Because sustainability issues mostly arise from the upstream members of the focal company (Tachizawa and Wong, 2014), it is important to note that an organisation's decision on SP implementation is largely based on their stakeholders' requirements/pressures and it is highly dependent on the sustainability performance of their suppliers

and sub-suppliers. Considerations of sustainability issues also have a high potential to influence a firm's relationship with their upstream and downstream supply chain members (Ageron et al., 2012). Therefore, as stated by Krause et al. (2009), without the commitment of the supply chain members to the TBL concept, it will be challenging for a focal company to implement SP practices (Ghadimi et al., 2016). Thus, a focal firm who wishes to implement SP practices needs to develop their capabilities and be aware of the preference/commitment of their customers, suppliers, and sub-suppliers to SP implementation. So far, the focus of SP literature is primarily based on the focal firm level or the dyadic relationship context (Ghadimi et al., 2016) that exists between the two supply chain entities. But the performance of the focal firm who tries to implement SP is greatly influenced by the sustainable activities of the upstream suppliers and the customers' requirements. Hence, to encourage a focal firm to move towards the sustainability roadmap, it is highly important to analyse the drivers of the SP concept by focusing on more than the triadic focus and, instead, by including the four supply chain entities of the multi-tier-supply chain network. According to Mena et al. (2013), the multi-tier structure considers the triadic context to be either a buyer–supplier-supplier relationship or a supplier–buyer-customer relationship. Following that, Tachizawa and Wong (2014) mentioned that the multi-tier context includes any number of lower tier suppliers. The concept is further extended by Sauer and Seuring (2019) by developing a new design called cascaded multi-tier that included both upstream and downstream SC members. Although the study considers both the upstream and downstream SC entities, some limitations exist. Specifically, the cascaded multi-tier design is dedicated mainly to the mineral SC which is complex in nature. Such a design is not applicable to other multi-tier SSC contexts in general. Finally, the focal firm is considered at each part of the SC because it emphasizes upstream context by establishing a direct strategic link among the firms that further increase the SC complexity and challenges. In order to reduce the complexity and to generalise the multi-tier context, this study deals with the theoretical expansion of the multi-tier context to the extended multi-tier context. As such, any number of upstream SC members and direct customers from the downstream context of the single focal firm perspective have been included.

Many research works deal with driver analysis of SP (Riikkinen et al., 2017, Walker and Brammer, 2009, Roman, 2017), but no previous research work has addressed SP drivers' analysis either under or beyond a multi-tier supply chain environment. Also, the utilization of organisational theories in the field of SP is limited (Kannan, 2020). Although SP literatures contain works (Delmonico et al., 2018, Foerstl et al., 2018, Grob and Benn, 2014) that focus on single theory usage, literatures dealing with multi-theoretical perspectives are relatively scarce. For an established topic such as SP, gaining more advanced knowledge is not possible through a single theory approach (Zorzini et al., 2015, Schmenner et al., 2009). The application of the MCDM model, Best Worst Method (BWM), is relatively new in the field of SP. Although a lot of SP literature has dealt with analysis of the drivers, the act of finding the interrelationships that exist within the drivers of SP is relatively new. The act

of analysing the interrelationships that exist within the key drivers of SP helps the focal company to ascertain the most influential and influenced drivers in SP implementation efforts. Due to the scarcity of literature that deals with SP in a Danish context (Eriksen et al., 2017, Chkanikova, 2016, Lassen et al., 2016), there is a great need to explore SP in a Danish context. Hence, to bridge the above-mentioned gaps, this study primarily aims to identify the key SP drivers under the multi-theoretical lenses of TBL, dynamic capability, and institutional theory. This work is relevant to a Danish focal company and makes a comparative analysis of the preferences of the four entities (the focal company, supplier, sub-supplier, and direct customer) in the drivers of SP implementation. To the best of the author's knowledge, analysing the drivers of SP for an extended multi-tier supply chain network in a Danish context, using the theoretical lens of TBL, dynamic capability, institutional theory, decision theory, and extended multi-tier theory is relatively new. Accordingly, the main research questions (RQs) addressed in this study are as follows.

RQ1: How to design (extend) the multi-tier SP that contributes to both the upstream and downstream SC entities together with the focal firm consideration?

RQ2: What are the key drivers under the theoretical lens of dynamic capability and institutional theory that encourage the successful implementation of SP practices in relation to the considered focal company?

RQ3: What are the similarities and dissimilarities of top drivers of SP implementation under the theoretical lens of extended multi-tier theory that exist in relation to the focal company?

RQ4: How are the interrelationships determined that exist between the key drivers of SP implementation in relation to the focal company's context?

Overall, the contributions of this paper are as follows. Firstly, the traditional multi-tier theory has been expanded to an extended multi-tier theory that considers the focal company and its upstream and downstream SC entities. This extended multi-tier design is a novel approach that represents the consideration of "any" number of upstream SC members and immediate downstream members (i.e., 1st tier customer) with respect to the focal firm. Following the theory expansion, the new theoretical framework under a multiple case study context (i.e., *focal company* with its *upstream* (1st tier and 2nd tier supplier) and *downstream* (direct customer) SC entities) has been empirically validated for the research framework proposed in this study. That framework, which introduces a real-world Danish context, is the second significant contribution both to the SSCM context in general and to SP-specific literatures. Thirdly, using the multi-theoretical lens of TBL, dynamic capability, and institutional theory, this study helps identify and categorise the drivers of SP in relation to the focal company by employing a systematic literature review combined with opinions collected from a team

of academic and industrial experts. Fourthly, the identified SP drivers specific to the extended multi-tier supply chain network are prioritized using Best Worst Method (BWM), which is followed by a comparative analysis of the SP drivers across the extended multi-tier supply chain context. Fifthly, following the key driver analysis under the extended multi-tier context, an analysis of the interrelationships that exist between the key drivers of SP implementation from the focal company's perspective is done using the DEMATEL technique.

The paper is structured as follows. Following the introduction, section 2 provides the literature review of the sustainable supply chain management (SSCM) works done under the multi-tier context, SP drivers, and theoretical lenses employed under the SP context in general. Section 3 details the theoretical framework done by reviewing the various theories used in this work. Section 4 describes the research design and research framework proposed for the study, the solution methodologies employed (namely, BWM and DEMATEL), and the multiple SC entities considered under the novel extended multi-tier design. The same section also includes details of the data collection and analysis. Results and Discussions are described under 5 Results analysis, 6 Discussion, respectively. Finally, the conclusions of the research study with the limitations and future scope are provided under Section 7.

2. Literature review

The literature review section is divided into three categories related to sustainable supply chain management, including the multi-tier environment, drivers in the SP context and theoretical lenses under the SP context.

2.1. SSCM multi-tier

According to Seuring and Müller (2008), SSCM is defined as "*The management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development,* i.e.*, economic, environmental and social, into account which are derived from customer and stakeholder requirements. In sustainable supply chains, environmental and social criteria need to be fulfilled by the members to remain within the supply chain, while it is expected that competitiveness would be maintained through meeting customer needs and related economic criteria.*" This definition of SSCM establishes that the focal firm that seeks to implement a sustainable practice needs to gain cooperation from the entire supply chain of the multi-tier system (Gong et al., 2018). Following the theoretical development of multi-tier supply chain management by Mena et al. (2013), the work done by Tachizawa and Wong (2014) leads to the management of sustainability in the multi-tier supply chain. They develop a conceptual framework that includes four approaches for lower-tier supplier management, namely: direct, indirect, work with third parties, and don't bother. Owing to the increasing popularity for

sustainability-based multi-tier supply chain management, a great deal of literature focuses on SSCM multi-tier contexts. Grimm et al. (2014) utilizes critical success factors to extend the sustainability analysis from supplier management to sub-supplier management using cases from two food supply chains. Wilhelm et al. (2016a) investigates the strategies and contingencies required for sub-supplier management when a buying firm implements sustainability in their multi-tier supply chain. Wilhelm et al. (2016b) studies the conditions under which first-tier suppliers perform the double agency role of satisfying the focal firm's sustainability demands and implementing those sustainability demands in their own supply base. Awasthi et al. (2018) offers a multi-tier based sustainable global supplier selection applying the integrated fuzzy-AHP-VIKOR-based framework by considering the $(1+n)^{th}$ tier supplier sustainability risks. Gong et al. (2018) proposes a framework for facilitating multinational corporations (MNC) in making their supply chain members learn about sustainability-related knowledge in multi-tier supply chain contexts. As a result of the study, they find that MNCs can facilitate sustainability-related supply chain learning by establishing new functional departments and working with third parties and upstream lower tier suppliers throughout the project lifecycle. Sauer and Seuring (2018) propose a three-dimensional framework that extends the multi-tier SSCM concepts by integrating the sustainability importance of the firm, suppliers, and sub-suppliers. Subsequently, Sauer and Seuring (2019) develop a cascaded multi-tier SSCM approach to link the upstream and downstream SC parts for minerals SC. Jabbour et al. (2019) explore an integrative framework that focuses on the usage of modeling approaches in multi-tier sustainable supply chains through a systematic review.

Despite the emergence of several works in the SSCM multi-tier context, there is a gap in the literature with regard to a specific analysis of SP drivers focusing on the extended multi-tier context. More details about the extension of traditional multi-tier context to the extended multi-tier theory has been provided in section 3.1. Although the work done by Dou et al. (2018) performs an enabler investigation for multi-tier supply chain management, the literature focuses on green aspects but does not consider the TBL-based sustainability approach. Overall, there exists a need for analysis of SP drivers within the context of an extended multi-tier sustainable supply chain with the consideration of both the upstream and downstream members together with the focal company context.

2.2. SP drivers

Many works have addressed the analysis of SP drivers in the context of many countries. The study done by Ramakrishnan et al. (2015) examines SMEs in a Malaysian context; it states that the regulatory pressure from the government, pressure from the customer, and the perceived benefits in terms of financial and operational benefits can positively motivate an organisation towards the implementation of green procurement. Riikkinen et al. (2017) considers the absorptive capacity to be the important driver for including sustainability in the purchasing function in an international study conducted among countries such as Finland, Germany, Ireland, and Italy. The study performed

by Roman (2017) in the context of the U.S. public sector found that organisational culture, pressures from stakeholders, and the transformational leadership style of the company's top executives are the significant drivers towards engagement in SP practices. Walker and Brammer (2009) conducted a research study within the U.K. public sector and stated that top management support is the major facilitator for the implementation of SP in an organisation. Ruparathna and Hewage (2015), through a review of SP practices done for the Canadian construction industry, stated that government regulation is the potential driver for SP implementation when compared to other drivers such as creating a competitive edge in the market, satisfying customer requirements, and total cost of ownership.

As the driving factors for the implementation of sustainability in the organisational functions may vary depending on the type of the sector, the nature of the business, and the geographical location of the organisation, several different drivers for SP implementation practices are available in the literature. Those resources include: top management support and guidance (Reuter et al., 2010, Koster et al., 2017, Walker and Brammer, 2009); government regulation and legislation (Boström et al., 2015, Brammer and Walker, 2011); competitor pressure (Ageron et al., 2012); pressure from NGOs (Boström et al., 2015, Ageron et al., 2012); suppliers' sustainable initiatives (Mosgaard, 2015, Boström et al., 2015); trust towards suppliers and their products (Ageron et al., 2012, Appolloni et al., 2014); demand from customers for sustainable products (Grob and Benn, 2014, Giunipero et al., 2012, Ageron et al., 2012); training and education programs with regard to sustainability (Suresh et al., 2016); desire to mitigate upstream supply chain risk (Ageron et al., 2012); an organisation's commitment to environmental management (Large and Thomsen, 2011, Wong et al., 2016); collaboration capability of the organisation (Mosgaard, 2015, Appolloni et al., 2014, Large and Thomsen, 2011); strategic role of the procurement function in an organisation (Roman, 2017); absorptive capacity (Riikkinen et al., 2017), and policy benefits from the government (Shen et al., 2017). Although there is a great deal of literature under different geographical contexts (i.e., Malaysia, Finland, Germany, Italy, Ireland, U.K., U.S.) that deals with analysis of the drivers of SP implementation, there is a lack of literature particular to the Danish context, along with analysis of the interrelationships among SP drivers.

2.3. Review of theoretical lenses in SP context

In the recent years, the usage of theoretical lenses in the area of operations and supply chain management has seen an increasing trend (Carter and Rogers, 2008, Pagell and Wu, 2009, Carter and Easton, 2011, Pagell and Shevchenko, 2014). Sarkis et al. (2011) presented fourteen different organisational theories in the domain of green supply chain. Touboulic and Walker (2015) reviewed 25 different theories applied in the sustainable supply chain management domain and concluded that resource-based view (RBV), stakeholder theory (ST), and institutional theory (IT) are the most dominant theories in the field. Zorzini et al. (2015) analysed the use of pre-existing theories in the

field of socially responsible sourcing (SRS) and concluded that RBV, ST, and transaction cost economies were the most used theories in the SRS field. Similarly, Johnsen et al. (2017) reviewed different theories used in the field of sustainable purchasing and supply management research, and their findings are similar to those of Touboulic and Walker (2015) with RBV, ST, and IT as the leading theories. Table 1 summarizes the various theoretical lenses used in SP literatures.

Table 1: Theoretical lenses employed in SP context-based literatures

Theories	**References**
Dynamic capability theory	Ghade et al. (2019)
Ecological Modernisation theory	Delmonico et al. (2018)
Information processing theory	Foerstl et al. (2018)
Institutional theory	Roman (2017); Grob and Benn (2019); Laosirihongthong et al. (2019)
Organisational learning theory	De Giacomo et al. (2019)
Resource based view	Laosirihongthong et al. (2019)
Social capital theory	Meehan and Bryde (2014)
Stakeholder theory	Roman (2017); Ghade et al. (2019)
Systems theory	Roman (2017)
Transformational leadership theory	Roman (2017)

Based on the above summary, it is evident that most of the theoretical lens were used in hypothesis development, SP adoption, SP factors identification, SP barriers, and in providing SP insights. However, none of the previous work considers theoretical lenses to categorise the SP drivers using a real case study and an application of MCDM methods. Thus, this study addresses the theoretical gap of utilizing multiple theoretical perspectives (Carter and Easton, 2011) in categorising the SP drivers by considering both micro theory (dynamic capability theory) and macro theory (institutional theory).

3. Theoretical framework

Due to the broad and complex nature of the SSCM, it is not possible to significantly enrich the knowledge base through the usage of one theory (Halldórsson et al., 2015, Zorzini et al., 2015). Usually, on its own, a single theory usage demonstrates limitations to understand the different phenomenon under study. To gain an in-depth knowledge of complex sustainability-related problems requires the usage of multiple theories (Lozano et al., 2015, Walker et al., 2015, Connelly et al., 2011, Zorzini et al., 2015). In order to overcome the limitations of using a single theory, several authors suggested the usage of multiple theories which helps researchers to explore, understand, analyse and make better decisions by knowing the relationships that exist between the various factors

when dealing with complex sustainability-related business practices (Formentini and Taticchi, 2016). Additionally, studies such as those by Zorzini et al., 2015, Schmenner et al., 2009 discussed the fact that usage of multiple theories is more appropriate for the established topic where more advanced, deeper knowledge is needed. Hence, in this work, several theories – namely, extended multi-tier, triple bottom line (TBL), institutional, dynamic capability, and decision theories – are used in order to analyse both the internal and external motivations (i.e., drivers) that normally influence the supply chain entities towards the implementation of SP practices. The pictorial overview identifying the contribution of each theory made to answer the RQs proposed in section 1 has been depicted in Fig. 1. To enhance the understanding behind the multiple theoretical lenses employed in this work, detailed explanations about the contributions made by each theory are presented next.

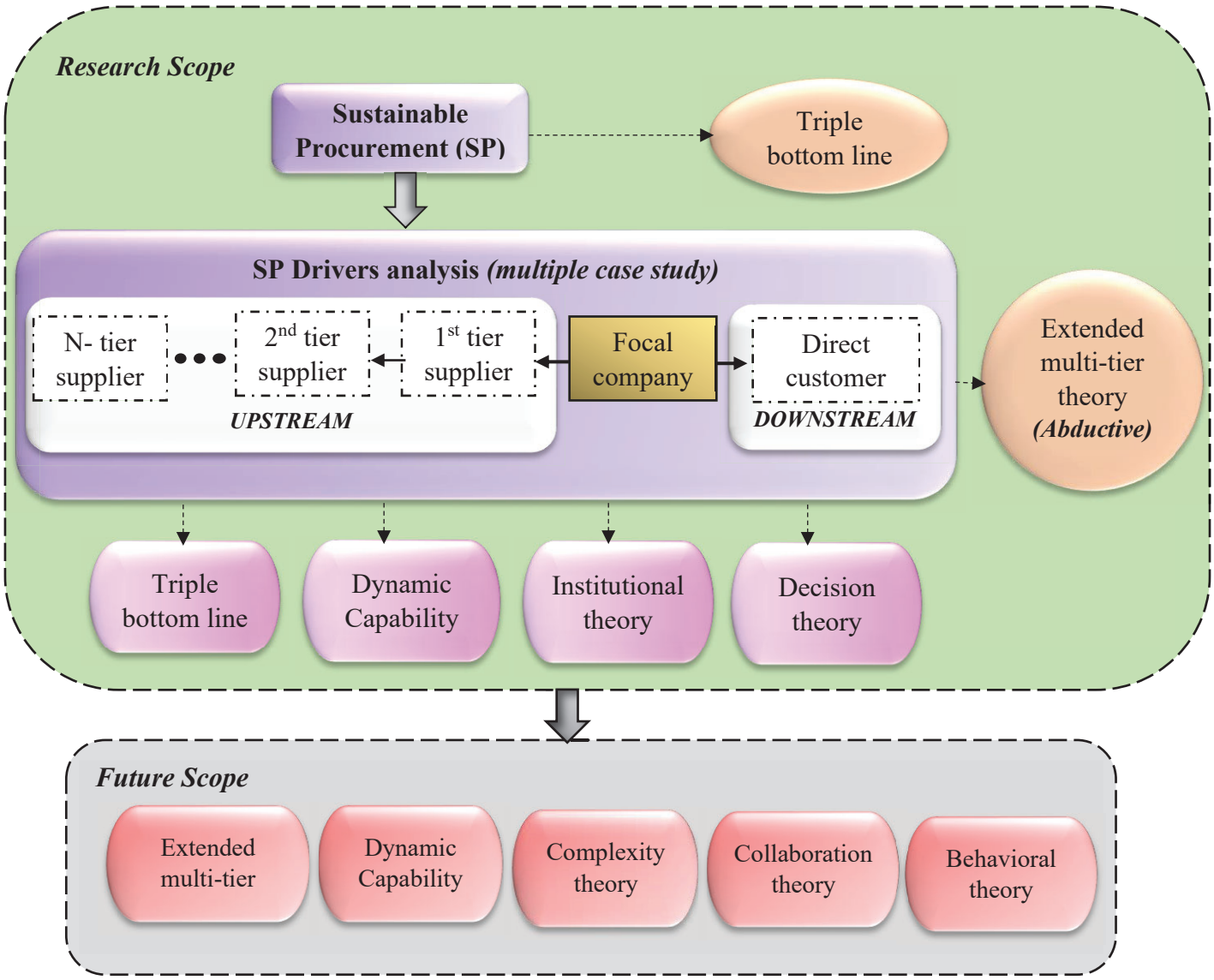

Figure 1: Theoretical framework of the study

3.1. Extended Multi-tier theory

Recently, there has been growing importance in the multi-tier supply chains theory among supply chain management researchers (Choi and Linton, 2011, Mena et al., 2013, Wilhelm et al., 2016a, Sauer and Seuring, 2019). Multi-tier supply chains are better characterized as networks of suppliers, including both vertical and horizontal links among different actors (Choi & Hong, 2002). More often in research, the multi-tier suppliers are simplified to a three-tier supply chain (Mena et al., 2013, Wilhelm et al., 2016a). Mena et al. (2013) proposed three different types of supply chain structures: open, closed, and transitional. In the open multi-tier supply chain, there is no direct interaction between the buyers and tier 2 suppliers. In the closed multi-tier supply chain, a direct interaction between buyers and tier 2 suppliers does exist. The transitional type represents a stage in between open and closed categories; buyers and tier 2 suppliers develop connections that move them towards a closed multi-tier supply chain. In line with the current research, Sauer and Seuring

(2019) proposed a case-specific cascaded multi-tier design to link the upstream and downstream SC parts. The main issues or limitations with the cascaded multi-tier design is case-specific to the mineral SC; it cannot be generalized, and the introduction of the focal firm to an individual part of SC will further increase the complexity of the SC. In order to overcome the above challenges and to generalize the multi-tier context, there is a need for theory development or expansion.

Attending to the main focus of this work, the SP implementation of the focal company is greatly influenced not only by the support provided by the upstream suppliers but also by the need to be justified with a significant amount of customer requirements from the downstream context (especially from 1st tier customers). The traditional multi-tier theory that focuses primarily on the upstream context needs to be extended to include the downstream as well. Moreover, if the focal company is proactive towards the implementation of any new sustainable practices, it is essential that the immediate (1st tier) customer's voice be considered in order to achieve a competitive advantage in today's dynamic globalization context, despite any transition that may be happening inside the focal firm. Theory expansion occurs when the traditional multi-tier supply chain theory (that focuses on the upstream context) moves to the extended multi-tier supply chain version, which considers any number of upstream SC partners and the 1st tier customer of the focal firm's downstream SC partner. Also, it is critical to remember that if a greater number of downstream customers (more than the firm's 1st tier customers), along with the upstream SC entities are needed to be included, then the proposed extended multi-tier SC will become a normal supply chain structure. As shown in Fig. 1, the extended multi-tier SC theory is used in this work to make a comparative analysis of the SP drivers across multiple companies (i.e., the focal company, its supplier, sub-supplier, and customer) that belong to different industries. According to Zorzini et al. (2015), the use of theory can be classified into four types, namely: theory dressing, theory matching, a theory suggesting and explanation, and theory expansion. Among the four types, theory expansion, the strongest and most challenging, has been addressed in this work by extending the traditional multi-tier theory to extended multi-tier theory, which makes a significant contribution to the multi-tier literature. Therefore, to address the RQs, our analysis and discussion are based mainly on the extended multi-tier context.

3.2. Triple bottom line (TBL) approach

The focus of this work is based on the Triple Bottom Line (TBL) context by addressing the three pillars or bottom lines (economic, environment, and social) from the procurement context. SP is grounded in the TBL approach, so in this work, TBL defines the scope of the problem and the analysis and discussions provide importance to all three dimensions of the TBL concept. Because several works have focused the TBL theory in the SSCM context, further details are available in the following literature resources (see Kannan, 2018).

3.3. Institutional theory

"Institutional theory provides an explanation about how external pressures influence an organization to adopt organizational practice" (Sarkis et al., 2011). Since its original development, the institutional theory works on the cause of isomorphism and is defined as the "constraining process that forces one unit of a population to resemble other units that face the same environmental pressure" (DiMaggio & Powell, 1983). There are three types of pressures that lead to isomorphic change: coercive isomorphism, normative isomorphism, and mimetic isomorphism. Coercive isomorphism is defined as the pressure of organisations in which the firm is dependent (DiMaggio and Powell, 1983, Sarkis et al., 2011). Coercive pressure can be imposed by governments through laws and regulations or by pressure from environmentally-aware customers. Normative isomorphism is defined as the pressures coming from media, civil society (such as non-governmental organisations), industry associations, or consumers (Sauer and Seuring, 2018). The last isomorphic driver is mimetic isomorphism; it occurs when one firm imitates another organisation with the goal of being perceived as legitimate (Dimaggio and Powell, 1983). A firm may adopt the same characteristics displayed by nearby or related organisations or successful competitors. In this work, the institutional theory has been used to analyse and discuss the influence of external pressures that drive the focal case company and its upstream (supplier and sub-supplier) and downstream (1st tier customer) considered towards SP implementation.

3.4. Dynamic capability

Touboulic and Walker (2015) argued the importance of using organisational theory in the SSCM area; they concluded that researchers working in SSCM mostly use stakeholder theory, RBV, IT, and NRBV. Hence, there is a need to explore how to use other organisational theories in SSCM research, so this work uses dynamic capability theory as an alternative to the existing theories such as RBV and NRBV.

According to Hart (1995), RBV focuses on creating competitive advantage and improving the performance of the firm through managing resources and competitiveness in the supply chain. Meanwhile, the natural-resource-based view (NRBV) focuses on a firm's competitive advantage derived from the connection between the improved environmental and sustainable performance and the deployment of firm resources (Hart, 1995). In this similar vein, the dynamic capability theory can be viewed as an extension of RBV and NRBV for a changing environment (Teece et al., 1997, Beske, 2012). DCT was first defined by Teece et al. (1997) as a "firm's ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments." Later, Eisenhardt and Martin (2000) define dynamic capabilities as "the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve,

and die." Recently, a few researchers started using DCT in SSCM (see Beske, 2012; Beske et al., 2014; Mathivathanan et al., 2017; Hong et al., 2018; Kırcı and Seifert, 2015). In this work, the dynamic capability theory has been used to categorise the list of SP drivers. Those drivers are then used to analyse and discuss the influence of the internal resources, competencies, and core capabilities as a driver for the focal case company, its upstream (supplier and sub-supplier), and downstream (1st tier customer) components considered in this work towards the SP implementation.

3.5. Decision theory

Decision theory (DT) is widely used in the operations research and operations management literature from the past few years (Hochbaum and Levin, 2006, Uppari and Hasija, 2019, Agrawal and Sharda, 2013). The development of decision theory in business and management fields was initiated by Simon in his seminal work during 1947 (Simon, 1947). Decision theory aims to explain and assist decision-makers in solving complex problems. Decision theory covers three significant domains, such as normative DT, descriptive DT, and prescriptive DT (Bell et al., 1988, Baron, 2004, French et al., 2009). As discussed by French et al. (2009), normative theory offers to explore how a rational individual makes decisions in an ideal environment. The descriptive theory is used to describe and 'explain' the behaviours of real practice (Uppari and Hasija, 2019). Prescriptive theory develops s structured model or system which uses a blend of normative and descriptive theories. DT is successfully applied in different fields such as sustainable supply chain management research (Alexander et al., 2014); supply chains (Uppari and Hasija, 2019); halo effect in purchasing (Boatwright et al., 2004); integrated risk management (Babich and Kouvelis, 2018); quantum mechanics (Agrawal and Sharda, 2013), and environmental sustainability (Saunders et al., 2020). This research uses MCDM techniques that primarily follow a prescriptive theoretical foundation, but which also handle several conflicting attributes for solving complex problems simultaneously considered (Belton & Stewart, 2002).

Apart from the above-mentioned theories, some other theories, such as collaboration theory, behavioral theory, and complexity theory, have been included in Fig. 1. These theories have been addressed under the future scope in Section 7.1.

4. Methodology

This section includes four subsections. Subsection 1 deals with the detailed description of the research design and proposed research framework of the study. Subsection 2 provides details about the multiple case companies considered for the extended multi-tier context. Subsection 3 presents a description of the data collection and analysis done for this study. Finally, subsection 4 focuses on a description of the solution methodologies employed in this study to perform the data collection and analysis, namely BWM and DEMATEL.

4.1. Research Design and framework

This study utilizes abductive (Kovács and Spens, 2005) and multiple case study approach (Yin, 2018) triggered by the deficiencies of current MT SSCM theory to analyse the drivers of SP implementation for the focal company, along with a comparative analysis made with the upstream suppliers (1st and 2nd tier supplier) and downstream direct customer (1st tier customer). As referred to in previous literature (Kovács and Spens, 2005), the abductive approach deals with the theory development/expansion, which is later continued with the deductive research process. With inspiration from the literature (Kovács and Spens, 2005), the abductive research approach employed in this study is depicted in Figure 2.

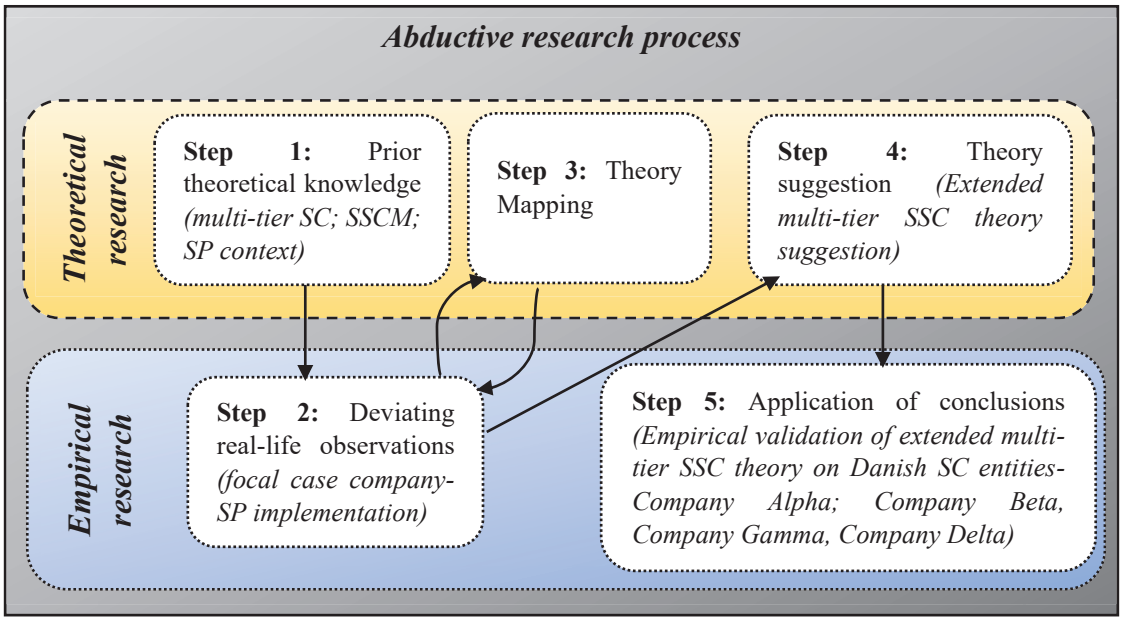

Figure 2: Abductive research process of the study *(Inspired from Kovács and Spens, 2005)*

The abductive research process shown in figure 2 starts with the prior theoretical knowledge or with a real-life observation (which does not match with any existing theory) followed by theory matching. Theory matching proposes a new theory (theory building) or extends the existing theory (theory expansion) along with empirical data collection and concludes with the application (using the deductive approach).

4.1.1. Research process

The research process presented in Figure 2 is detailed in five steps below.

1. ***Prior theoretical knowledge:*** Initially, this study starts with the prior theoretical knowledge close to multi-tier SC theory with a focus on sustainable supply chain and it is specific to SP context.
2. ***Deviating real-life observations***: While discussing with the focal company in regards to the SP implementation, the focal company suggested to investigate the same issues with their upstream and downstream partners because the implementation of SP in the focal company greatly depends on the degree to which their upstream suppliers deliver sustainable products which, in turn, need to be justified by the significant amount of customer demand for the sustainable product.
3. ***Theory matching:*** The current design of the MT–SC theory does not support the SC design structure of real-life observations. So, new theoretical knowledge is searched for the missing design of MT-SC theory by including the immediate downstream 1st tier customer.
4. ***Theory suggestion:*** From the theory matching step, the existing MT-SC theory has been extended. This theory expansion leads to the novel "Extended Multi-Tier SSCM theory."
5. ***Application of conclusions:*** In this study, the extended MT-SSCM theory is validated using a multiple case study based deductive approach. The deductive approach framework used for the empirical validation of this study is shown in Figure 3.

The deductive research framework includes three key stages. The fundamental intention of the deductive research is to analyse the drivers of SP implementation based on the extended multi-tier SSC design. Hence, stage 1 identifies the list of SP drivers based on the multi-theoretical lenses (i.e., TBL, dynamic capability, and institutional theory) in relation to the focal company. This stage is accomplished through the literature review and through discussions with the team of academic and industrial experts from the focal company. Under stage 2, the ranking/prioritization of the SP drivers is done by applying a MCDM tool called BWM based on the extended multi-tier context. To execute a comparative analysis of the SP drivers for the extended multi-tier supply chain, in addition to the focal company (Company Alpha), this study considers the upstream supply chain members, namely the 1st tier supplier (Company Beta) and 2nd tier supplier (Company Gamma), as well as downstream members, the 1st tier customer (Company Delta). Once the prioritization of SP drivers has been completed from the perspective of the four supply chain entities, stage 3 examines the focal company (Company Alpha), and an interrelationship analysis is pursued for the key identified SP drivers using DEMATEL. Case descriptions of the four supply chain entities considered, and the detailed steps of the solution methodologies employed in this study, have been provided under 4.2 Case study companies in an extended multi-tier supply chain, 4.3 Data collection and analysis, respectively.

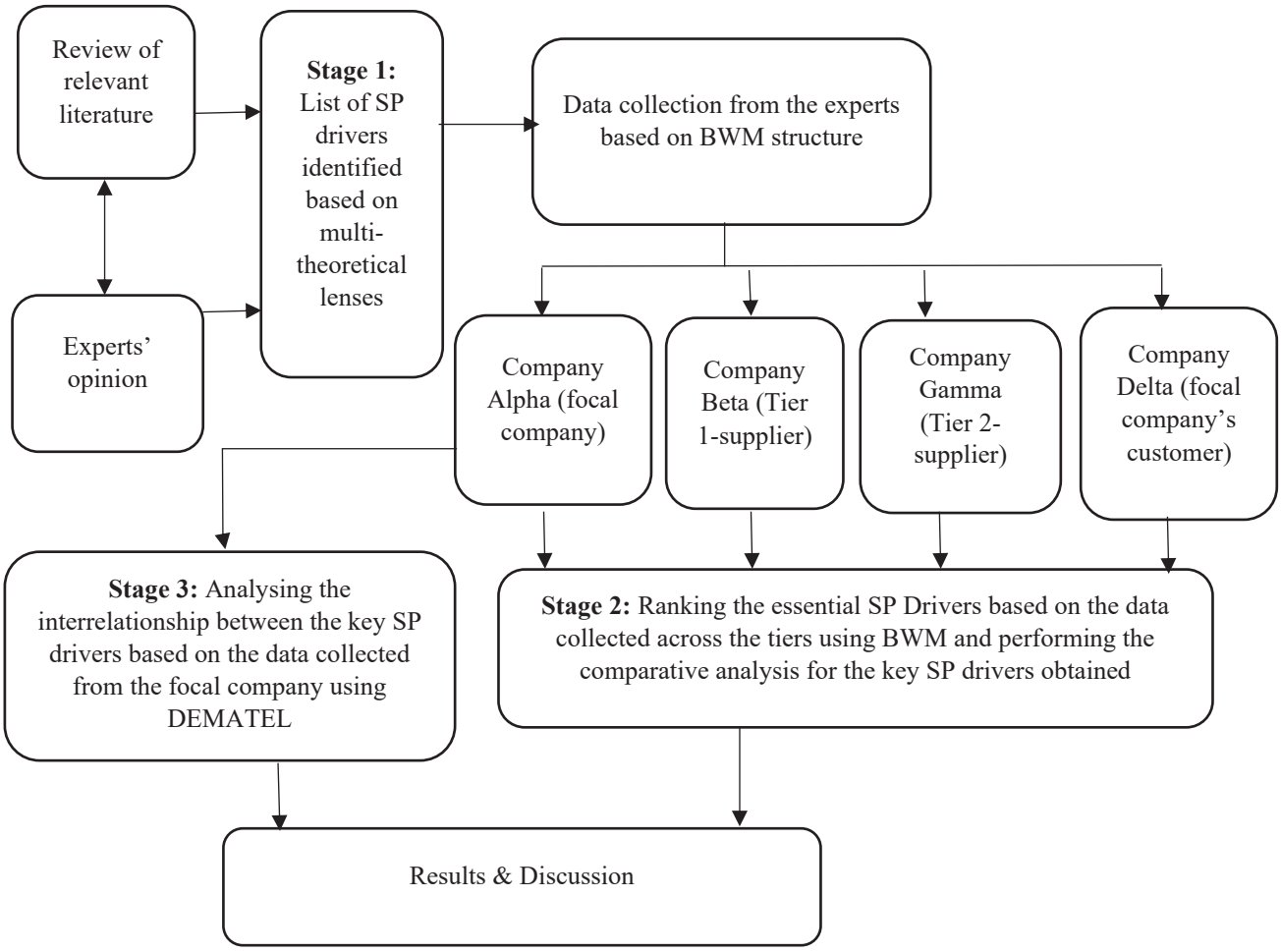

Figure 3: Deductive Research framework

4.2. Case study companies in an extended multi-tier supply chain

The case description for each of the SC entities considered under the novel extended multi-tier design proposed in this study is as follows.

4.2.1. Company Alpha – The focal company

The focal company considered for this study is a Danish remanufacturing company. For confidentiality reasons, the name of the company is disguised as Company Alpha. Company Alpha is an SME-based company that operates in a B2B context in the aftersales market. Company Alpha, ISO 9001 certified, seeks to maintain a green image of their company's DNA by improving their product quality, often beyond the OE standards. The company has suppliers all over the world by maintaining long-term relationships with them. As price and quality are the core objectives of their business strategy, the company creates value by improving their environmental and social performance in addition to achieving an economic advantage. Aligned with their corporate strategy, the company's supply base is managed not only with regard to improving their performance in the economic aspect, but also to how they perform in the environmental and social dimensions. Compared to their competitors, the focal company is proactive towards sustainable value creation and they have a vision of attaining long-term competitive advantage in their business. The company expressed their

interest in conducting this research study by acknowledging the strategic role being played by the procurement function.

4.2.2. Company Beta – The focal company's 1st tier supplier

In this study, the name of the focal company's supplier is disguised as "Company Beta." Company Beta is a small manufacturing company that produces components or parts for their customers. The company has a facility in Denmark and experiences a B2B relationship. On the supplier side, Company Beta normally experiences a long-term relationship through collaborations. Regarding the sustainability concept, the company's top management states that they consider the economic and environmental dimensions to be equally important; they strongly emphasize that the social aspect is already well established in their organisation. Despite the small size of the company, Company Beta has the policy of meeting their suppliers twice a year to discuss issues and to look for improvement solutions required to sustain their market. On the other hand, Company Beta is positive towards development programs initiated by their customers. Company Beta has been certified for ISO 9001. Cost and quality are the key supplier selection criteria, and the company does supplier selection mostly based on experience.

4.2.3. Company Gamma – The focal company's 2nd tier supplier

The name of the focal company's sub-supplier is disguised as Company Gamma. Company Gamma, a supplier of Company Beta, is a large enterprise that belongs to the wholesale sector. Their business concentrates on environmental and social issues with the establishment of a management system/department called Health, Safety, Environment, and Quality (HSEQ). The company is certified for ISO 9001 like Company Beta and Company Alpha. The company usually has a long-term relationship with their suppliers and started their sustainability-based supplier assessment program recently. This is evidence that the company has started working towards the roadmap of sustainability and has expressed their willingness to conduct this research study on the analysis of SP drivers to help the company show more commitment to the global agenda of sustainable development goals.

4.2.4. Company Delta – The focal company's 1st tier customer

The name of the focal company's (i.e., Company Alpha's) customer is disguised as Company Delta. Company Delta is a large automobile player in Denmark whose core values are innovation, value creation for customer needs, and efficient and positive approach to new changes. By establishing environmental and working environment policies, the company gives high priority to an environmental and socially friendly working environment for their employees. Being a wholesale

supplier for the automotive industry, Company Delta focuses on providing only high-quality products to their customers at the best prices. Despite the small organisational size, the focal company's ability to deliver high-quality products to one of the largest players in the automobile industry in Denmark indicates that the focal company is more efficient at improving their performance in the economic and environmental dimensions. Thus, it is highly relevant for the focal company to know about Company Delta's perspective towards the SP implementation process.

4.3. Data collection and analysis

Currently, Company Alpha has neither mandatory regulatory pressure from the government nor demand from their customers towards the implementation of SP. But due to the proactive stance of the company, Company Alpha, its supplier, sub-supplier, and customer, were interviewed to ascertain their priorities regarding the drivers of SP implementation. It is worth mentioning that the companies considered in this research study try to base their input on considering their current business strategies along with some assumptions made about positive changes that may happen in the future. The details about the SC entities considered and the interviews conducted are shown in Table 2.

Table 1: Details of the supply chain entities

#	Name of the Case Company	Size of the company	Respondents involved	No. of interviews
1	Focal company (Company Alpha)	Small and Medium Enterprise	Purchasing manager (> 15 years) & Technical Director (> 15 years)	5 (60-90 mins per interview)
2	1st tier supplier (Company Beta)	Small enterprise	2 Owners (>15 years)	1 (90 mins)
3	2nd tier supplier (Company Gamma)	Large enterprise	Health, Safety, Environment and Quality (HSEQ) Manager (> 15 years) & Project Manager (around 10 years)	1 (120 mins)
4	1st tier Customer (Company Delta)	Large enterprise	Category manager (around 15 years)	1 (90 mins)

The details about the respondents considered under the four supply chain entities are given in Table 2. As shown in Table 2, the respondents demonstrate several years of experience in their business and fields of supply chain management, purchasing, environmental, and social management. Following the proactive attitude of the focal case company (Company Alpha), the supply chain entities are selected based on factors such as being open-minded and positive towards the new initiative, a willingness to take part in the research study, the company's physical presence in Denmark, and the long-term relationship that exists between the companies in their supply chain network. To clarify, Company Alpha has a long-term relationship with both Company Beta and Company Delta. Company Beta has a long-term relationship with Company Gamma. These close relationships between the supply chain entities are very useful in this research study in collecting and analysing the data related to the complex SP context. To determine the prioritization of the four supply chain entities (Company Alpha, Company Beta, Company Gamma, and Company Delta), the data collection and analysis has been done employing the MCDM technique called BWM by conducting semi-structured interviews separately across the four case companies as seen in Table 2. To perform the interrelationship analysis specifically for the key SP drivers identified based on Company Alpha's perspective, using DEMATEL-based questionnaires, semi-structured interviews are conducted to help the focal case company (Company Alpha) to identify the most influential and influenced SP drivers that help the company make decisions about SP implementation.

4.4. Solution methodology

4.4.1 BWM

BWM was developed by Jafar Rezaei in 2015 and is utilised to find the optimum weights and consistency ratio by solving the simple optimisation model generated based on the two comparison vectors. BWM includes five key steps (i.e., adapted from Rezaei, 2015; Rezaei, 2016), which are explained below.

*1. **Selection of a set of decision factors***

During this step, the factors for which the weights need to be calculated are selected. Let C_1, C_2, …, C_n be the factors for which weights are to be determined. In the present study, these are the drivers of SP implementation.

*2. **Selection of the best and worst factors***

In this step, the decision panel will individually select the best factors and worst factors from the list of available factors. This step deals mainly with the selection of the best and worst factors but not the further calculation of the weights. If more than one best or worst criteria needs to be selected, then the selection should be made randomly.

*3. **Assign preference for the best factor over all other factors***

Under step 3, the decision panel will assign the preference for the best factor over all other factors by applying a number from 1 to 9. This results in the Best-to-Others vector, which is denoted as A_B.

$A_B = (a_{B1}, a_{B2}, \ldots, a_{Bn})$,

where, a_{Bj} specifies the preference for the best factor B over factor j. Therefore, it is explicit that $a_{BB} = 1$.

4. ***Assign the preference for all the other factors over the worst factor***

In this step, the decision panel will assign the preference for all the other factors over the worst factor by utilizing a number from 1 to 9. This results in the Others-to-Worst vector, which is denoted as A_W.

$A_W = (a_{1W}, a_{2W}, \ldots, a_{nW})^T$,

where a_{jW} specifies the preference of the factor j over the worst factor W. Therefore, it is explicit that $a_{WW} = 1$.

5. Calculate the final weights

To calculate the final weights of the factors, the maximum absolute differences $\{|w_B - a_{Bj}w_j|, |w_j - a_{jw}w_w|\}$ for all j should be minimized. This condition can be formulated as below (Rezaei, 2016):

Model 1:

Min $\max_j \{|w_B - a_{Bj}w_j|, |w_j - a_{jw}w_w|\}$

Subject to

$$\sum_j wj = 1$$

$w_j \geq 0$. for all j.

The same equation can be solved by converting it into linear programming problem as:

Model 2:

Min ξ

Subject to

$|w_B - a_{Bj}w_j| \leq \xi$, for all j

$|w_j - a_{jw}w_w| \leq \xi$, for all j

$$\sum_j wj = 1$$

$w_j \geq 0$. for all j.

The solution to the above problem is the final weights of the factors and value of ξ^L. The next step in BWM is checking the consistency of the calculated weights.

Table 3: Consistency Index

aBW	1	2	3	4	5	6	7	8	9
Consistency index (max ξ)	0.00	0.44	1.00	1.63	2.30	3.00	3.73	4.47	5.23

To check how consistent a comparison is and to check the consistency of each *j*, a consistency ratio is introduced. To check this, the minimum consistency of a comparison needs to be calculated.

For minimum consistency $a_{Bj} = a_{jW} = a_{BW}$,

$\rightarrow \xi^2 - (1+2a_{BW})\,\xi + (a_{BW}^2 - a_{BW}) = 0$

By taking different values of $a_{BW} \in (1, 2, \ldots..9)$, the maximum ξ^* can be identified, which represents the consistency index. After that, the consistency ratio is calculated using ξ^* and the corresponding consistency index (Table 3). The formula to be used for calculating the consistency ratio is as follows:

$$\text{Consistency Ratio} = \frac{\xi*}{Consistency\ Index}$$

For a linear model like the present study of prioritizing drivers, the value of ξ^L can be directly considered a gauge for the consistency check of the calculated weights and there is no need to use the consistency index, which is usually considered in the application of non-linear BWM (Rezaei, 2016). A value of ξ^L close to zero is considered a high level of consistency.

4.4.2. DEMATEL

The steps involved in DEMATEL (Govindan and Chaudhuri, 2016) are as follows.

Step 1: Initial direct relation matrix (A)

There are five levels for the designed scale, that is: ‘‘0 (No influence), 1 (Very low influence), 2 (Low influence), 3 (High influence), and 4 (Very high influence).’. From the pairwise matrix, the initial data can be gathered, which is $(n \times n)$ positive matrix as $X^k = \left[x_{ij}^k\right]$. Therefore, the initial direct relation matrix ‘a_{ij}’ is developed using Eq. 1.

$$a_{ij} = \frac{1}{H}\sum_{K=1}^{H} x_{ij}^k \qquad \ldots\ldots\ldots\ldots(1)$$

where K = number of respondents with $1 \le k \le H$ and n = number of drivers.

Step 2: Normalization of direct-relation matrix “D”

Composition of the normalized direct-relation matrix (D): The matrix D can be given as follows:

$$\boldsymbol{D = \lambda * A} \qquad \ldots\ldots\ldots\ldots..(2)$$

Where

$$\lambda = \text{Min}\left[\frac{1}{max\sum_{j=1}^{n}|a_{ij}|}, \frac{1}{max\sum_{i=1}^{n}|a_{ij}|}\right] \qquad \ldots\ldots\ldots\ldots..(3)$$

Step 3: Calculation of total relation matrix (T):

The mathematical expression for matrix T is given as in Eq. (4):

$$T = D(I - D)^{-1} \qquad \ldots\ldots\ldots\ldots(4)$$

Where, ‘I’ represents the identity matrix.

Step 4: Computation of prominence $(r + c)$ and relation $(r - c)$ value for each driver using Eqs. (5) and (6).

$$r_{sum} = \left[\sum_{j=1}^{n} t_{ij}\right]_{n\times 1} \quad \text{.....(5)}$$

$$c_{sum} = \left[\sum_{i=1}^{n} t_{ij}\right]_{1\times n} \quad \text{.....(6)}$$

Where r_{sum} is the normalization of t_i and c_{sum} is the normalization of t_j of the (i, j) element of the matrix, *T*. The t_{ij} refers to the influence exerted from factor x_i to factor x_j.

Step 5: Developing a causal diagram

It is noted that the prominence is denoted by $(r_i + c_j)$, which is the horizontal axis vector that has overall control over drivers "i" and similarly the vertical axis vector known as "Relation," which is denoted by $(r_i - c_j)$. If $(r_i - c_j)$ is positive, then it falls under the cause group; otherwise, it falls under the effect group as described elsewhere (Tseng, 2009).

5. Results analysis

In this section, the results obtained from the three-stage deductive research framework is further elaborated.

Stage 1: Identification of the SP driver list

Several drivers affect the implementation of SP practices. Relevant SP drivers are obtained through the systematic literature review by conducting a literature search in the SCOPUS database, focusing on peer-reviewed, English-speaking journal articles with the search scope limited to until 2019 (Kannan, 2020). This was done by a group of academic experts who have more than 5 years of experience in the field of sourcing and SSCM. The identified list was then further improved with the help of the discussions held with the industry experts, each of whom has more than fifteen years of experience in the field to obtain their opinion on finalizing the list of SP drivers. By following the panel consensus technique (Taylor, 1972; Waggoner et al., 2016), there was a discussion among the industrial and academic experts (a total of five experts). The identified list of SP drivers is categorised and their relevance has been confirmed based on the multi-theoretical lenses such as TBL, institutional theory (external factors), and dynamic capability (internal factors). As a result, a final list of the seven main drivers and 24 relevant sub-drivers for sustainable procurement has been identified; that list is shown in Table 4.

Table 4: Drivers for Sustainable procurement

Main Drivers	Sub-Drivers	References
Knowledge & training (D1)	Sustainability-related training programs (D11)	Suresh et al. (2016); Testa et al. (2016b); Walker and Brammer (2009)
	Awareness creation and knowledge accumulation (D12)	Meehan and Bryde (2015); Pacheco-Blanco and Bastante-Ceca (2016); Gazzola et al. (2017)
Economic (D2)	Gaining Business benefits (D21)	Shen et al. (2017); Bag (2017a); Wong et al. (2016); Hoejmose and Adrien-Kirby (2012)

	Competitive advantage (D22)	Giunipero et al. (2012); Mohd Suki (2016); Shen et al. (2017); Ruparathna and Hewage (2015b)
Social & Environmental (D3)	Pro-environmental and positive attitude towards sustainable/green products (D31)	Moser (2015); Akehurst et al. (2012); Yamoah et al. (2016); Tanner and Wölfing Kast (2003)
	Personal Values (D32)	Nadeem et al. (2017); Griffis et al. (2014); Mansi and Pandey (2016); Moser (2015)
	Trust building in suppliers (D33)	Bag (2017a); Ageron et al. (2012); Hoejmose and Adrien-Kirby (2012); Punyatoya (2014); Johnstone and Tan (2015)
	Environmental commitment (D34)	Large and Thomsen (2011); Grob and Benn (2014); Wong et al. (2016); Giunipero et al. (2012)
	Suppliers' sustainable initiatives (D35)	Ageron et al. (2012); Wong et al. (2016)
	Ecological motivations (D36)	Hahnel et al. (2014); Zhu et al. (2013)
Organisational (D4)	Active Top Management (D41)	Reuter et al. (2010); Koster et al. (2017); Walker and Brammer (2009)
	Focal firm's preference towards SP/sustainable development goals (D42)	Prier et al. (2016); Grob and Benn (2014); Brammer and Walker (2011); Walker and Brammer (2009)
	Upstream supply chain risk management (D43)	Bag (2017a); Ageron et al., (2012)
	Sustainable Organisational culture (D44)	Mansi and Pandey (2016); Nadeem et al. (2017); Rejikumar (2016); Salam (2009)
	Middle management support (D45)	Robert et al. (2016); Wong et al. (2016)
	Compliance with contracts, organisational requirements & international standards (D46)	Prier et al. (2016); Giunipero et al. (2012)
	Product supplier availability (D47)	Prier et al. (2016); Brammer and Walker (2011); Walker and Brammer (2009)
	Quality suppliers (D48)	Hsu et al. (2014)
Regulation (D5)	Government regulation and legislation (D51)	Boström et al. (2015); Brammer and Walker (2011); Giunipero et al. (2012)
Capability (D6)	Monitoring capability (D61)	Koster et al. (2017); Grob and Benn (2014); Suresh et al. (2016)
	Collaboration capability (D61)	Koster et al. (2017); Huq et al. (2016); Roman (2017); Wong et al. (2016)
	Innovation capability (D61)	Huq et al. (2016); Islam et al. (2017a); Bag (2017a); Roman (2017)
Pressure (D7)	Customer pressure/demand (D71)	Grob and Benn (2014); Giunipero et al. (2012); Ageron et al. (2012)
	Competitor pressure (D72)	Appolloni et al. (2014); Giunipero et al. (2012); Tachizawa et al. (2012); Ageron et al. (2012)

Stage 2: Determine the rank of the SP drivers using BWM

After finalizing the main drivers and sub-drivers related to SP (Table 4), the next step in this stage is to calculate the global weights of all drivers and rank the twenty-four drivers based on their global weights by obtaining the opinions of Company Alpha, Company Beta, Company Gamma, and Company Delta. To obtain the global weights of all drivers, the weights of main drivers and sub-drivers are multiplied. In this study, the weights of the main drivers are directly given by the experts using the panel consensus technique, and the weights of sub-drivers are determined using BWM. Firstly, the expert team was asked to arrive at the weights of main drivers using the panel consensus technique (see Table 5). Secondly, the experts were asked to identify the best and worst drivers among the sub-driver categories shown in Table 4 through the panel consensus technique. After identifying the best and worst drivers, the next step is to ask the expert team to construct the pairwise comparison for all sub-drivers by considering the following:

1. Preference for best sub-drivers over the other sub-drivers on a scale of 1-9 (Best-to-Others)
2. Preference for all sub-drivers over the worst sub-drivers on a scale of 1-9 (Others-to-Worst)

Table 5: Weights of main drivers for Sustainable Procurement

Main Drivers	Weights (in percentage)
Knowledge & training (D1)	4%
Economic (D2)	5%
Social & Environmental (D3)	36%
Organisational (D4)	31%
Regulation (D5)	9%
Capability (D6)	11%
Pressure (D7)	4%

The ratings/outcomes of Best-to-Others and Others-to-Worst for Knowledge & Training sub-drivers (D11 – D12) are shown in Table 6 and Table 7, respectively.

Table 6: Pairwise comparison for Knowledge & Training sub-drivers (Best-to-Others)

	D11	D12
Best: D12	2	1

Table 7: Pairwise comparison for Knowledge & Training sub-drivers (Others-to-Worst)

	Worst: D11
D11	1
D12	2

Similarly, all the other pairwise comparison for the sub-drivers D2, D3, D4, D6, and D7, but not D5, dealing with the Best-to-Others and Others-to-Worst are shown in Tables 8, 10, 12, 14, and 16, and

in Tables 9, 11, 13, 15, and 17, respectively. Since D5 (the regulation driver) has only one sub-driver (D51), there is no need to construct the pairwise comparison for the regulation driver.

Table 8: Pairwise comparison for Economic sub-drivers (Best-to-Others)

	D21	D22
Best: D22	1,5	1

Table 9: Pairwise comparison for Economic sub-drivers (Others-to-Worst)

	Worst: D21
D21	1
D22	1,5

Table 10: Pairwise comparison for Social & Environmental sub-drivers (Best-to-Others)

	D31	D32	D33	D34	D35	D36
D32-Best	8	1	2	3	4	6

Table 11: Pairwise comparison for Social & Environmental sub-drivers (Others-to-Worst)

	D31-Worst
D31	1
D32	8
D33	4
D34	3
D35	2
D36	2

Table 12: Pairwise comparison for Organisational sub-drivers (Best-to-Others)

	D41	D42	D43	D44	D45	D46	D47	D48
D41-Best	1	9	4	8	8	3	7	6

Table 13: Pairwise comparison for Organisational sub-drivers (Others-to-Worst)

	D42-Worst
D41	9
D42	1
D43	3
D44	2
D45	2
D46	3

D47	2
D48	2

Table 14: Pairwise comparison for Capability sub-drivers (Best-to-Others)

	D61	D62	D63
D62-Best	3	1	5

Table 15: Pairwise comparison for Capability sub-drivers (Others-to-Worst)

	D63-Worst
D61	2
D62	5
D63	1

Table 16: Pairwise comparison for Pressure sub-drivers (Best-to-Others)

	D71	D72
D72-Best	3	1

Table 17: Pairwise comparison for Pressure sub-drivers (Others-to-Worst)

	D71-Worst
D71	1
D72	3

Thirdly, after the construction of the pairwise comparisons for all sub-criteria by the expert teams, the next step is to obtain weights of all sub-criteria. The weights for Knowledge & Training sub-drivers are obtained using model (2) discussed in step 5 of section 4.4.1. and the same is shown in Table 18. From Table 18, the consistency value ξ^L is 0 which also indicates a highly reliable consistency of pairwise comparison.

Table 18: Weights of Knowledge & Training sub-drivers

Sub-drivers	Weights	ξ^L
D11	0.3333	
D12	0.6667	0

Likewise, the weights of Knowledge & Training sub-drivers and the weights of other sub-drivers are also obtained using model (2); the same is shown in Table 19.

Table 19: Weights of main drivers and sub-drivers

Main Drivers	Weights	Sub-drivers	Local weights of sub-drivers	Global weights	Rank
Knowledge & Training (D1)	0.04	D11	0.3333	0.0133	23
		D12	0.6667	0.0267	12
Economic (D2)	0.05	D21	0.4000	0.0200	17
		D22	0.6000	0.0300	10
Social & Environmental (D3)	0.36	D31	0.0482	0.0173	20
		D32	0.4096	0.1475	1
		D33	0.2169	0.0781	4
		D34	0.1446	0.0520	6
		D35	0.1084	0.0390	7
		D36	0.0723	0.0260	13
Organisational (D4)	0.31	D41	0.4694	0.1455	2
		D42	0.0522	0.0162	21
		D43	0.1173	0.0364	8
		D44	0.0587	0.0182	18
		D45	0.0587	0.0182	19
		D46	0.0985	0.0305	9
		D47	0.0671	0.0208	16
		D48	0.0782	0.0243	15
Regulation (D5)	0.09	D51	1.0000	0.0900	3
Capability (D6)	0.11	D61	0.2250	0.0248	14
		D62	0.6500	0.0715	5
		D63	0.1250	0.0138	22
Pressure (D7)	0.04	D71	0.2500	0.0100	24
		D72	0.7500	0.0300	11

Lastly, the importance and ranks of the drivers can be found in Table 19. Once the prioritization of the main drivers and sub-drivers was done based on the Company Alpha's perspective, prioritization of the drivers are also obtained for Company Beta, Company Gamma, and Company Delta respectively by executing the same steps of BWM mentioned above. Thus, the obtained prioritization of the sub-drivers for the four entities is shown in Table 20.

Table 20: Weights of main drivers and sub-drivers across the supply chain entities

Main Drivers	**Sub-drivers**	**Company Alpha**	**Company Beta**	**Company Gamma**	**Company Delta**

Knowledge & Training (D1)	Sustainability-related training programs (D11)	23	15	11	NR
	Awareness creation and knowledge accumulation (D12)	12	19	NR	12
Economic (D2)	Gaining business benefits (D21)	17	3	5	NR
	Competitive advantage (D22)	10	7	8	NR
Social & Environmental (D3)	Pro-environmental and positive attitude towards sustainable/green products (D31)	20	4	17	14
	Personal Values (D32)	1	6	6	NR
	Trust building in suppliers (D33)	4	11	3	8
	Environmental commitment (D34)	6	1	10	11
	Suppliers' sustainable initiatives (D35)	7	14	10	9
	Ecological motivations (D36)	13	9	NR	NR
Organisational (D4)	Active Top Management (D41)	2	8	1	13
	The firm's preference towards SP/sustainable development goals (D42)	21	5	NR	NR
	Upstream supply chain risk management (mitigation of upstream risks) (D43)	8	10	7	7
	Sustainable Organisational culture (D44)	18	18	16	NR
	Middle management support (D45)	19	NR	15	NR
	Compliance with contracts, organisational requirements (e.g., evaluation criteria, green specification, suppliers' ISO 14000 certification) & international standards (D46)	9	12	4	6
	Product supplier availability (D47)	16	NR	NR	NR
	Quality suppliers (D48)	15	20	9	5
Regulation (D5)	Government regulation and legislation (D51)	3	NR	2	1

Capability (D6)	Monitoring capability (D61)	14	17	11	4
	Collaboration capability (D62)	5	13	11	10
	Innovation capability (D63)	22	2	NR	3
Pressure (D7)	Customer pressure/demand (D71)	24	NR	11	NR
	Competitor pressure (D72)	11	16	NR	2

Stage 3: Determine the interrelationship among the SP drivers using DEMATEL

After determining the ranks of all sub-drivers across the extended multi-tier context, the expert team is asked to analyse the interdependencies of the first twenty ranked drivers from Table 19 by considering the Company Alpha perspective. In this stage 3, the interrelationships among the key (twenty) SP drivers are analysed using the DEMATEL methodology. The various steps involved in stage 3 are described below.

Step 1: Direct relationship matrix "A"

In this step, the top twenty ranked sub-drivers identified from stage 2 (Table 19) are utilized. In this step, the sub-drivers are rated by an expert team, ranging from a 0-4 scale depending on the impacts from the '*i*' to '*j*' drivers. From these ratings, the direct relationship matrix among the identified drivers is obtained and tabulated as Table 21.

Step 2: Normalized matrix "S"

The initial direct relationship matrix is normalized through the eqn. (4) and (5) and the normalized matrix is tabulated in Table 22.

Step 3: Total influence matrix "M"

From the normalized matrix, the total influence matrix is calculated using eqn. 6 and is shown in Table 23.

Step 4: Sum of rows "r_i" and columns "s_i"

The total influences received and given by each driver are calculated through eqn. 7 and eqn. 8 and are shown in Table 24.

Step 5: Causal and effect diagraph

Based on the total influences received, the influence map was created, which explains the central role and relation of each driver in relation to others. The influence map is shown in Figure 4.

Table 21: Direct relationship matrix “A”

	D12	D21	D22	D31	D32	D33	D34	D35	D36	D41	D43	D44	D45	D46	D47	D48	D51	D61	D62	D72
D12	0	2	1	1	1	1	1	1	1	1	1	4	3	1	1	1	1	1	1	1
D21	1	0	1	1	1	1	1	1	1	1	1	4	3	1	1	1	1	1	1	1
D22	4	4	0	3	1	1	1	2	3	1	2	4	4	2	4	3	1	3	3	3
D31	3	3	1	0	1	1	1	1	1	1	1	4	3	1	4	1	1	1	1	1
D32	4	4	3	3	0	2	1	2	3	1	2	4	4	2	4	3	1	3	3	3
D33	4	4	3	3	1	0	1	2	3	1	2	4	4	2	4	3	1	3	3	3
D34	4	4	3	3	1	1	0	2	3	1	2	4	4	2	4	3	1	3	3	3
D35	4	4	1	3	1	1	1	0	3	1	2	4	4	1	4	3	1	3	3	3
D36	3	3	1	3	1	1	1	1	0	1	1	4	3	1	4	1	1	1	1	1
D41	4	4	3	3	2	2	2	2	3	0	2	4	4	2	4	3	2	3	3	3
D43	4	4	1	3	1	1	1	1	3	1	0	4	4	1	4	3	1	3	3	3
D44	3	3	1	1	1	1	1	1	1	1	1	0	1	1	4	1	1	1	1	1
D45	3	3	1	1	1	1	1	1	1	1	1	4	0	1	4	1	1	1	1	1
D46	4	4	1	3	1	1	1	2	3	1	2	4	4	0	4	3	1	3	3	3
D47	3	2	1	1	1	1	1	1	1	1	1	4	3	1	0	1	1	1	1	1
D48	3	3	1	3	1	1	1	1	3	1	1	4	3	1	4	0	1	3	1	3
D51	4	4	3	3	1	1	1	2	3	1	2	4	4	2	4	3	0	3	3	3
D61	3	3	1	3	1	1	1	1	3	1	1	4	3	1	4	1	1	0	1	1
D62	4	4	1	3	1	1	1	1	3	1	1	4	4	1	4	3	1	3	0	3
D72	3	3	1	3	1	1	1	1	3	1	1	4	3	1	4	1	1	3	1	0

Table 22: Normalized direct influence matrix “S”

	D12	D21	D22	D31	D32	D33	D34	D35	D36	D41	D43	D44	D45	D46	D47	D48	D51	D61	D62	D72
D12	0.000	0.026	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.053	0.039	0.013	0.013	0.013	0.013	0.013	0.013	0.013
D21	0.013	0.000	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.053	0.039	0.013	0.013	0.013	0.013	0.013	0.013	0.013
D22	0.053	0.053	0.000	0.039	0.013	0.013	0.013	0.026	0.039	0.013	0.026	0.053	0.053	0.026	0.053	0.039	0.013	0.039	0.039	0.039
D31	0.039	0.039	0.013	0.000	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.053	0.039	0.013	0.053	0.013	0.013	0.013	0.013	0.013
D32	0.053	0.053	0.039	0.039	0.000	0.026	0.013	0.026	0.039	0.013	0.026	0.053	0.053	0.026	0.053	0.039	0.013	0.039	0.039	0.039
D33	0.053	0.053	0.039	0.039	0.013	0.000	0.013	0.026	0.039	0.013	0.026	0.053	0.053	0.026	0.053	0.039	0.013	0.039	0.039	0.039
D34	0.053	0.053	0.039	0.039	0.013	0.013	0.000	0.026	0.039	0.013	0.026	0.053	0.053	0.026	0.053	0.039	0.013	0.039	0.039	0.039
D35	0.053	0.053	0.013	0.039	0.013	0.013	0.013	0.000	0.039	0.013	0.026	0.053	0.053	0.013	0.053	0.039	0.013	0.039	0.039	0.039
D36	0.039	0.039	0.013	0.039	0.013	0.013	0.013	0.013	0.000	0.013	0.013	0.053	0.039	0.013	0.053	0.013	0.013	0.013	0.013	0.013
D41	0.053	0.053	0.039	0.039	0.026	0.026	0.026	0.026	0.039	0.000	0.026	0.053	0.053	0.026	0.053	0.039	0.026	0.039	0.039	0.039
D43	0.053	0.053	0.013	0.039	0.013	0.013	0.013	0.013	0.039	0.013	0.000	0.053	0.053	0.013	0.053	0.039	0.013	0.039	0.039	0.039
D44	0.039	0.039	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.000	0.013	0.013	0.053	0.013	0.013	0.013	0.013	0.013
D45	0.039	0.039	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.053	0.000	0.013	0.053	0.013	0.013	0.013	0.013	0.013
D46	0.053	0.053	0.013	0.039	0.013	0.013	0.013	0.026	0.039	0.013	0.026	0.053	0.053	0.000	0.053	0.039	0.013	0.039	0.039	0.039
D47	0.039	0.026	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.053	0.039	0.013	0.000	0.013	0.013	0.013	0.013	0.013
D48	0.039	0.039	0.013	0.039	0.013	0.013	0.013	0.013	0.039	0.013	0.013	0.053	0.039	0.013	0.053	0.000	0.013	0.039	0.013	0.039
D51	0.053	0.053	0.039	0.039	0.013	0.013	0.013	0.026	0.039	0.013	0.026	0.053	0.053	0.026	0.053	0.039	0.000	0.039	0.039	0.039
D61	0.039	0.039	0.013	0.039	0.013	0.013	0.013	0.013	0.039	0.013	0.013	0.053	0.039	0.013	0.053	0.013	0.013	0.000	0.013	0.013
D62	0.053	0.053	0.013	0.039	0.013	0.013	0.013	0.013	0.039	0.013	0.013	0.053	0.053	0.013	0.053	0.039	0.013	0.039	0.000	0.039
D72	0.039	0.039	0.013	0.039	0.013	0.013	0.013	0.013	0.039	0.013	0.013	0.053	0.039	0.013	0.053	0.013	0.013	0.039	0.013	0.000

Table 23: Total influence matrix “M”

	D12	D21	D22	D31	D32	D33	D34	D35	D36	D41	D43	D44	D45	D46	D47	D48	D51	D61	D62	D72
D12	0.026	0.051	0.024	0.030	0.021	0.022	0.021	0.023	0.029	0.021	0.024	0.082	0.063	0.023	0.041	0.027	0.021	0.029	0.026	0.028
D21	0.038	0.025	0.024	0.030	0.021	0.021	0.021	0.023	0.029	0.021	0.023	0.081	0.062	0.023	0.041	0.027	0.021	0.028	0.026	0.027
D22	0.098	0.098	0.019	0.071	0.029	0.029	0.029	0.044	0.069	0.029	0.045	0.110	0.098	0.044	0.103	0.064	0.029	0.067	0.062	0.066
D31	0.068	0.068	0.026	0.019	0.023	0.023	0.023	0.025	0.032	0.023	0.025	0.088	0.068	0.025	0.083	0.029	0.023	0.031	0.029	0.030
D32	0.102	0.102	0.060	0.074	0.017	0.043	0.030	0.046	0.072	0.030	0.047	0.115	0.102	0.045	0.107	0.066	0.030	0.070	0.065	0.068
D33	0.101	0.101	0.059	0.073	0.030	0.017	0.030	0.045	0.071	0.029	0.046	0.113	0.101	0.045	0.106	0.066	0.030	0.069	0.064	0.067
D34	0.101	0.101	0.059	0.073	0.030	0.030	0.017	0.045	0.071	0.029	0.046	0.113	0.101	0.045	0.106	0.066	0.030	0.069	0.064	0.067
D35	0.096	0.096	0.032	0.069	0.028	0.029	0.028	0.018	0.067	0.028	0.044	0.107	0.096	0.030	0.100	0.062	0.028	0.066	0.061	0.064
D36	0.070	0.070	0.027	0.059	0.024	0.024	0.024	0.026	0.019	0.023	0.026	0.090	0.070	0.025	0.085	0.030	0.024	0.032	0.029	0.031
D41	0.106	0.106	0.062	0.076	0.044	0.045	0.044	0.048	0.075	0.018	0.048	0.119	0.106	0.047	0.111	0.069	0.044	0.073	0.067	0.071
D43	0.095	0.095	0.031	0.068	0.028	0.028	0.028	0.030	0.066	0.028	0.018	0.106	0.094	0.030	0.099	0.062	0.028	0.065	0.060	0.063
D44	0.064	0.064	0.024	0.030	0.022	0.022	0.022	0.023	0.030	0.021	0.024	0.033	0.040	0.023	0.078	0.027	0.022	0.029	0.027	0.028
D45	0.067	0.066	0.025	0.032	0.023	0.023	0.023	0.024	0.031	0.022	0.025	0.086	0.028	0.024	0.081	0.029	0.023	0.030	0.028	0.029
D46	0.097	0.097	0.032	0.070	0.029	0.029	0.029	0.044	0.068	0.028	0.044	0.109	0.097	0.018	0.102	0.063	0.029	0.066	0.062	0.065
D47	0.065	0.053	0.025	0.031	0.022	0.022	0.022	0.024	0.030	0.022	0.024	0.084	0.064	0.024	0.029	0.028	0.022	0.029	0.027	0.029
D48	0.076	0.075	0.029	0.064	0.026	0.026	0.026	0.028	0.062	0.025	0.028	0.098	0.075	0.027	0.092	0.019	0.026	0.060	0.032	0.059
D51	0.101	0.101	0.059	0.073	0.030	0.030	0.030	0.045	0.071	0.029	0.046	0.113	0.101	0.045	0.106	0.066	0.017	0.069	0.064	0.067
D61	0.072	0.072	0.027	0.060	0.024	0.025	0.024	0.026	0.059	0.024	0.027	0.093	0.071	0.026	0.087	0.031	0.024	0.019	0.030	0.032
D62	0.092	0.092	0.030	0.066	0.027	0.028	0.027	0.029	0.065	0.027	0.030	0.103	0.092	0.029	0.096	0.060	0.027	0.063	0.020	0.062
D72	0.074	0.074	0.028	0.062	0.025	0.025	0.025	0.027	0.060	0.025	0.027	0.095	0.073	0.027	0.090	0.032	0.025	0.059	0.031	0.019

Table 24: Sum of influences given and received on drivers

Drivers	ri	si	ri+si	ri-si	Cause / Effect
D12	0.633	1.609	2.242	-0.976	Effect
D21	0.612	1.608	2.220	-0.995	Effect
D22	1.205	0.701	1.905	0.504	Cause
D31	0.762	1.130	1.891	-0.368	Effect
D32	1.291	0.523	1.814	0.769	Cause
D33	1.262	0.542	1.804	0.719	Cause
D34	1.262	0.523	1.784	0.739	Cause
D35	1.148	0.645	1.794	0.503	Cause
D36	0.807	1.076	1.883	-0.268	Effect
D41	1.380	0.503	1.883	0.877	Cause
D43	1.121	0.667	1.787	0.454	Cause
D44	0.653	1.937	2.590	-1.284	Effect
D45	0.717	1.601	2.318	-0.884	Effect
D46	1.176	0.624	1.800	0.552	Cause
D47	0.675	1.741	2.417	-1.066	Effect
D48	0.952	0.922	1.874	0.030	Cause
D51	1.262	0.523	1.784	0.739	Cause
D61	0.854	1.023	1.877	-0.169	Effect
D62	1.067	0.873	1.940	0.194	Cause
D72	0.903	0.972	1.874	-0.069	Effect

Table 25: Inner dependency matrix

	D12	D21	D22	D31	D32	D33	D34	D35	D36	D41	D43	D44	D45	D46	D47	D48	D51	D61	D62	D72
D12												0.082								
D21												0.081								
D22	0.098	0.098										0.110	0.098		0.103					
D31												0.088			0.083					
D32	0.102	0.102										0.115	0.102		0.107					
D33	0.101	0.101										0.113	0.101		0.106					
D34	0.101	0.101										0.113	0.101		0.106					
D35	0.096	0.096										0.107	0.096		0.100					
D36												0.090			0.085					
D41	0.106	0.106										0.119	0.106		0.111					
D43	0.095	0.095										0.106	0.094		0.099					
D44																				
D45												0.086			0.081					
D46	0.097	0.097										0.109	0.097		0.102					
D47												0.084								
D48												0.098			0.092					
D51	0.101	0.101										0.113	0.101		0.106					
D61												0.093			0.087					
D62	0.092	0.092										0.103	0.092		0.096					
D72												0.095			0.090					

A 0.077175

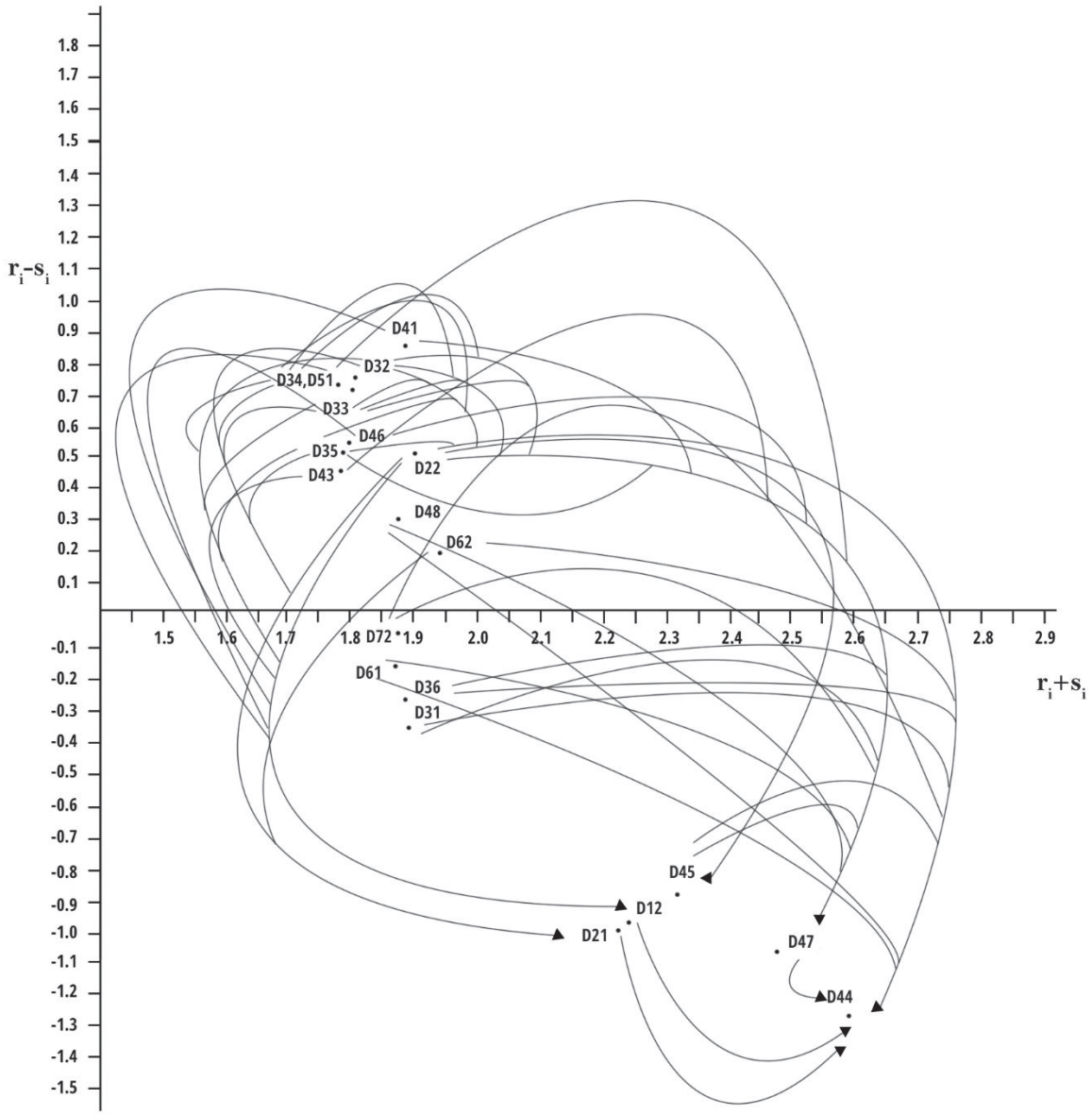

Figure 4: Influence map/Diagraph

6. Discussion

As the focus of this work is to find the motivational factors that greatly influence Company Alpha to implement SP, the opinions of both upstream suppliers (Company Beta and Company Gamma) and the downstream direct customer (Company Delta) are highly essential to be considered; these perspectives hugely impact Company Alpha's act of implementing SP practices. This section includes two main sub-sections. Firstly, a discussion of the results obtained from the prioritization of the SP drivers according to the perspective of Company Alpha, Company Beta, Company Gamma, and Company Delta is discussed in view of the extended multi-tier supply chain theory. Secondly, the top drivers for Company Alpha are analysed with respect to Company Beta, Company Gamma, and Company Delta using an extended multi-tier theory. Thirdly, the results obtained for the

interrelationship analysis performed for the top 20 sub-drivers based on Company Alpha's perspective are discussed.

6.1. Discussions based on extended multi-tier supply chain theory

Company Alpha

Based on Table 5, the results obtained by the main SP drivers are as follows: *Social & environmental (D3) > Organisational (D4) > Capability (D6) > Regulation (D5) > Economic (D2) > Knowledge & Training (D1) = Pressure (D7)*. It is obvious that due to the company's DNA of maintaining a green image and higher quality standards than the OEM specifications, the *Social & Environmental (D3)* driver has obtained the top priority. Owing to the proactiveness of the company towards SP implementation, the *Organisational driver (D4)* has received the second priority among the main drivers. Because the company did not experience any pressure from the customer or the competitor towards SP implementation, *Pressure (D7)* has obtained a low priority. Regarding knowledge and training around the SP concept, due to the current lack of mandatory regulation and consumer pressure, and as the company is in its infancy stage in learning about the concept, the *Knowledge & Training (D1)* driver has attained an equally low priority. Although government rules and regulations are important in driving organizations towards the implementation of SP practices (Ruparathna and Hewage, 2015), due to the current lack of mandatory rules and regulations from the government side for implementing SP in private organizations, particularly for an SME-based remanufacturing company like Company Alpha, the *Regulation (D5)* driver hasn't been the top priority.

As shown in Table 19 and Table 20, among the sub-drivers, *Personal Values (D32)* has attained the top ranking. Despite the factors like SME-based company, no regulation or customer pressure for sustainable products, and due to the presence of positive personal values of the employees and the top management towards the sustainability concept, *Personal Values (*D32) has been identified as the major driver for their proactiveness towards SP implementation. As the company can't be proactive towards any sustainable change without active top management support, *Active Top Management (D41)* has received the second priority. Even though the company is proactive towards SP efforts, there are currently no mandatory government regulations for the company to implement SP. Full integration of SP can only be achieved by means of strong government rules and regulations, so, in this study, the sub-driver *Government regulation and legislation (D51)* has obtained the third priority. But it is important to mention that the full integration of SP cannot be achieved without the strong commitment of suppliers and sub-suppliers in addition to the pressure that comes from the government. The company has the experience of maintaining long-term relationships with most of

their suppliers, and they are also open minded and positive towards any new innovations that add value to the buyer and supplier's competitive advantage. Hence, motivating suppliers can help the case company make progress towards SP initiatives. Thus, *Trust building in suppliers (D33)* is highly essential and considered the fourth most important sub-driver. Along with the experience of maintaining long-term relationships with suppliers, the proactive nature of the case company encourages any positive innovative ideas that may arise from their stakeholders, which helps the case company achieve high-quality standards in their products. Thus, the sub-driver *Collaboration capability (D62)* has received the fifth priority towards SP implementation. Currently, due to the absence of customer demand for sustainable products and sustainability-related training programs, the sub-drivers *Customer pressure/demand (D71)* and *Sustainability-related training programs (D11)* have attained a low priority towards SP implementation in their organisations.

Company Beta

The prioritization of the sub-drivers obtained for Company Beta is shown in Table 20 and their discussions follow. Being a small company, the company's strong commitment to the environment and to innovation has helped Company Beta to sustain their market. Thus, *Environmental commitment (D34)* and *Innovation capability (D61)* have obtained the top two priorities, respectively. Due to the small size of the organisation, gaining business benefits through any new sustainable practices helps Company Beta sustain their market for the long term; therefore, *Gaining business benefits (D21)* has been considered the third top sub-driver for SP implementation. *Pro-environmental and positive attitude towards sustainable/green products (D31)* has obtained the fourth priority due to the strong focus of the company on the environmental dimension and open positive attitude towards sustainable practices whenever required by their customer. As the company shows strong commitment to the environment and acknowledges the fact that the social aspect is well established in Denmark, the sub-driver *The firm's preference towards SP/sustainable development goals (D42)* achieves fifth priority. As the company receives no demand from their customers or the government to deliver sustainable products by integrating SP into their business function in the current situation, *Customer demand (D71)* and *Government regulation and legislation (D51)* are considered not relevant to Company Beta. Based on the discussions with the decision-makers of Company Beta, it was explicit that while the current lack of customer demand and government regulations has hindered private organisations from implementing SP, they acknowledged that pressure from customers and the government has a strong influence on SP implementation. Also, the sub-driver *Middle management support (D45)* is not considered relevant due to the small size of the company.

Company Gamma

The prioritization of the sub-drivers obtained for Company Gamma is shown in Table 20 and the discussions follow. *Top management support (D41)* has been identified as the top driver because relevant rules and procedures need to be approved and guided by the active participation of the top management for the implementation of any new practices. As the companies will not be motivated to implement any new complex practices without any requirements from the government, *Government regulation and legislation (D51)* is considered the second most important sub-driver towards SP implementation. As Company Gamma also maintains long-term relationships with their suppliers because of the trust created in their suppliers, *Trust building in suppliers (D33)* has resulted in the third priority. Being a wholesaler, as the company is not selling different products when compared to their competitors, *Compliance with contracts, organisational requirements* (D46) is highly essential and has obtained the fourth priority towards SP implementation. As price and trust are the two key aspects Company Gamma has embedded in its company's DNA to attract customers, any practice that leads to the business benefit of attracting customers and in turn generating profit for the company can positively drive the company towards implementation. Thus, *Gaining business benefits (D21)* has achieved the fifth priority. As the company belongs to the wholesale sector, where there is no real production or manufacturing of the products and no R&D or design, there is a lack of a proper measuring system to measure sustainable impact, so sub-drivers such as *Innovation capability (D61)* and *Ecological motivations (D36)*, *Product supplier availability (D47)* are considered not relevant to decisions on SP implementation. As the company currently has no competitor pressure for SP implementation, *Competitor pressure (D72)* is considered not relevant for Company Gamma.

Company Delta

Customer demand for buying sustainable products plays a vital role for the focal organisation regarding investing and implementing SP practices. To capture the priority of Company Delta towards the preference of procuring sustainable products from their suppliers (including Company Alpha), this study considers the prioritization of SP drivers from the customer perspective as well. It is important to note that, aligned with the upstream members (Company Alpha, Company Beta, Company Gamma), there currently exists no mandatory regulations/pressure from any of the stakeholders for Company Delta to focus on the implementation of SP. Due to the proactiveness of Company Alpha towards the implementation of SP and, as mentioned earlier, to capture the inputs from the customer of Company Alpha, Company Delta is asked to provide their preferences. The decision-maker of Company Delta chose their priorities by considering their current business strategy/goals and by making some assumptions about the changes that may happen in future. The prioritization of the sub-drivers obtained for Company Delta is shown in Table 20 and the discussions

follow. Consistent with the literature such as Giunipero et al. (2012) and Ruparathna and Hewage (2015), *Government regulation and legislation (D51)* has been considered the top driver for SP implementation in Company Delta. While the company currently has no mandatory government regulations regarding the implementation of SP, the decision-maker prioritized it with a high rank to show their top priority regardless of the changes that happen in the future. Since the company wants to be a quick mover in their market, the sub-drivers *Competitor pressure (D72)* and *Innovation capability (D63)* have been considered essential and prioritized as the second and third ranks respectively. As the company is more particular and focused on following government regulations and reacting faster to changing customer demands compared to their competitors, *Monitoring suppliers and maintaining quality suppliers* are considered essential regardless of the changes that happen in stakeholders' request. Owing to its large size and high reputation, it is possible for the company to monitor their large supply base with quality suppliers. Thus, the sub-drivers *Monitoring capability* (D61) and *Quality suppliers* (D48) have obtained the fourth and fifth ranks respectively. As the customer pressure/demand (D71) for the purchase of sustainable products is currently lacking, the sub-driver *Customer pressure/demand (D71)* has been prioritized as not relevant to the company about SP implementation. But, during the discussion with the decision-maker, it was revealed that the company is very quick to respond to their customers regarding any new innovative demands that are also complex for their competitors to work on.

6.2. Comparative analysis based on extended multi-tier theory

Once the prioritization of the SP drivers has been made across the extended multi-tier, the comparative analysis based on the rankings obtained for the sub-drivers according to the perspectives of the supply chain entities are as follows. Whereas *Personal values (D32)* is the top driver for Company Alpha, personal values towards sustainable products is not relevant to the customer (Company Delta). Since price is the most dominant criteria in the automobile sector in which Company Delta performs its wholesale business, personal values towards any sustainable practices or services are not in their interest unless Company Delta receives pressure from the government/customer. For Company Beta and Company Gamma, preference for personal values towards SP implementation is of same importance (ranking as the sixth priority). *Active top management (D41)* has been considered most important for both Company Alpha and Company Gamma and resulting in 2nd and 1st priority respectively for SP implementation. But for Company Beta and Company Delta, *top management support* for any new complex practices like SP will only be possible if pressure is enacted from the government/customer. Regarding *Government regulation and legislation* (D51), although the preferences differ among the supply chain entities (3rd, not relevant, 2nd, and 1st for Company Alpha, Company Beta, Company Gamma, and Company Delta

respectively), a vital fact was revealed from the discussions with the companies. All four companies acknowledged that no mandatory regulations or any kind of incentive from the government to implement SP currently exist in their business, no matter the size of the companies. If there is any future change with regard to government regulations on SP implementation, all the companies agreed that they will act according to stakeholder requirements. *Trust building in suppliers (D33)* has been considered important for both Company Alpha (4th priority) and Company Gamma (3rd priority) as showing their long-term commitment to their suppliers. Regarding *Collaboration capability (D62)*, due to the open-minded and positive attitude of Company Alpha, D62 is among the top five when compared to their supply chain entities. Regarding *Innovation capability (D63)*, as Company Beta has a strong commitment and innovation is one of the core business values of Company Delta, the sub-driver receives top priority when compared to Company Alpha and Company Gamma. *Business Benefits (D21)* is considered important to both Company Beta and Company Gamma as a driver towards SP. Regarding *Customer pressure/demand (D71)* towards SP implementation, it is obvious from the ranking obtained by Company Alpha, Company Beta, Company Gamma, and Company Delta that there is a lack of customer demand for sustainable products. Overall, it is important to observe the fact that lack of mandatory government regulation and lack of customer demand towards SP implementation hinders companies in terms of motivating them towards SP implementation.

6.3. Interrelationship analysis

Following the prioritization and comparative analysis of the SP drivers, to help Company Alpha learn about the interrelationships that exist between the drivers of SP implementation, DEMATEL has been employed in this study to find the cause and effect groups and correlation analysis within the top 20 key sub-drivers ranked based on Company Alpha's perspective. The results obtained through the application of DEMATEL are as follows. The sub-drivers with ri-ci > 0 are considered the cause drivers whereas the sub-drivers with ri-ci < 0 are considered the effect drivers and are categorised in Table 24.

From Table 24, it is obvious that the sub-drivers *Competitive advantage (D22), Personal Values (D32), Trust building in suppliers (D33), Environmental commitment (D34), Suppliers sustainable initiative (D35), Active top management support (D41), Upstream supply chain risk management (D43), Compliance with contract, Organisational requirement & international standards (D46), Quality suppliers (D48), Government regulation and legislation (D51),* and *Collaboration capability (D62)* fall under the cause group. The cause group drivers are sorted as follows. *D41 > D32 > (D34 = D51) >D33 > D46 >D22 > D35 > D43 > D62 > D48*. Among these cause group drivers, the drivers D41, D32, D34, D51, and D33 are considered the primary causal drivers that have the greatest

potential to influence the other drivers. When the results were communicated to the decision-makers of Company Alpha, it was confirmed that *Active top management support (D41)* and *Personal values (D32)* are the two top primary factors that currently motivate the company towards SP implementation despite the lack of customer demand and government regulation. As Company Alpha shows strong commitment to environmental practices such as remanufacturing automobile parts (the base of the business), recycling water used during the production process, sending packaging materials back to recycling, and having a long-term relationship with most of their suppliers who are also knowledgeable and open-minded towards any new innovation practices, the sub-drivers *Environmental commitment (D34)* and *Trust building in suppliers (D33)* are considered among the causal group. The company is currently proactive towards SP implementation due to its small size and despite its limited resources. They feel that the integration of sustainability into procurement practices will be made more effective and efficient only if the company receives any mandatory government regulations along with incentives such as tax rebates and subsidies. Thus, the sub-driver *Government regulation and legislation (D51)* has been considered among the causal group. Among the cause group drivers, the sub-drivers *Collaboration capability (D62) and Quality suppliers (D48)* has less influence on the effect group drivers.

On the other hand, the sub-drivers *Awareness creation and knowledge accumulation (D12), Business benefits (D21), Pro-environmental and positive attitude towards sustainable products (D31), Ecological motivations (D36), Sustainable organisational culture (D44), Middle management support (D45), Product supplier availability (D47), Monitoring capability (D61),* and *Competitor pressure (D72)* are considered the effect group drivers. The effect group drivers are sorted as follows. D72 > D61 > D36 > D31> D45 > D12 > D21 > D47 > D44. Among the effect group drivers, the sub-driver C*ompetitor pressure (D72)* is close to the cause group and is less influenced by the cause drivers. Based on the discussions with Company Alpha, it was inferred that their independent aftersales market is more concerned about price and quality compared to the other sustainable values like the environmental and social value generated by their products. Once customer perceptions towards the products change to a sustainable focus, there will be a vast change in the market. In turn, change may be created in competitors' preference for integrating sustainability into their business practices. Thus, unless a change takes place in government policy or customer demand, competitor pressure cannot be made to influence Company Alpha towards SP implementation. The sub-drivers *D61, D36, D31, D45, D12, D21, and D47* create less influence on the SP implementation of Company Alpha when compared to the other causal drivers. From the results, it is obvious that the sub-driver *Sustainable Organisational Culture (D44)* has the least potential to drive the company towards SP initiatives because of many dominant factors such as the nature of the automobile sector (more price-

sensitive), lack of resources due to the SME-based company, lack of pressure from the government regarding sustainability integration and reporting for the SME and/or the independent aftersales market, and lack of customer demand for sustainable products.

Once the results of the total influence matrix were communicated to Company Alpha, it was inferred that there was too much complexity for the company to deal with the influential relationships among so many drivers. To help the company focus on the most important influential interrelationships by eliminating the least important interrelationships among the sub-drivers, this study uses the threshold limit, which is denoted by α. The value for the threshold limit is calculated by considering the mean and standard deviation of the total influence matrix (Govindan and Chaudhuri, 2016). The interrelationship values that exceed the threshold limit of 0.077175 have been shown in Table 24 and Figure 4. From Table 25, it is obvious that the sub-driver *Sustainable Organisational culture (D44)* is mostly influenced by other sub-drivers. Specifically, the sub-driver *active top management (D41)* has the greatest impact/effect on *Sustainable Organisational culture (D44)* with the highest value of value 0.119. This result indicates that by improving the support exerted from the top management, the driver *Sustainable organisational culture* can be improved and thereby help Company Alpha towards SP implementation. In addition to the proactive attitude of the company, requirements that may arise from the customer and/or the government help the company make justifiable investments in SP initiatives, which helps improve the sub-driver *active top management support (D41)* towards SP implementation.

6.4. Managerial implications

The results of this research study help the case company with the following managerial implications. The research framework proposed for the study helps the case company look for potential ways to identify and analyse the key driving factors that positively influence their SP implementation under the theoretical lenses of TBL, dynamic capability, and institutional theory. The key drivers identified in the study inform the case company about the degree of positive motivation that can influence their decision about SP implementation happening either currently or imminently. By making the comparative analysis based on the extended multi-tier theory through a consideration of the supply chain entities' (supplier, sub-supplier, and customer) perspectives on the SP drivers, the focal company (Company Alpha) gets input on the degree of motivation that exists with their supply chain members when the company proactively moves towards SP implementation. With the identification of the cause and effect groups among the key drivers, the study provides awareness about the primary causal and effect drivers that can strongly influence the focal company in their efforts in moving

towards SP implementation. Overall, this research study helps the decision-makers and industrial managers of the focal case company find the level of positive motivation that exists within their organisation and learn the behaviour/attitude of their supply chain members towards Company Alpha's implementation of SP.

7. Conclusion

This study contributes significantly to the growing field of literatures in the context of multi-tier SSCM (Mena et al., 2013; Sauer and Seuring, 2018; Wilhelm et al., 2016a) and specifically to sustainable procurement. As the study deals with the abductive multiple case study approach, firstly the study starts with an expansion of the traditional multi-tier theory to an extended multi-tier SSC theory. This theory expansion has been accomplished in a qualitative manner by discussions with a team of academic and industrial experts from the focal company, whose managers want to make decisions with regard to SP implementation.
Secondly, this study contributes to the empirical based SP literature using novel an extended multi-tier SSC theory under the Danish SC context. The work is validated using multiple case studies, including the focal company (Company Alpha), supplier (Company Beta), sub-supplier (Company Gamma), and Customer (Company Delta). Thirdly, this study contributes to the usage of multiple theorical lenses (extended multi-tier, triple bottom line (TBL), dynamic capability, institutional theory, and decision theory) which helps to deepen the knowledge for the complex and well-established topic that is sustainable procurement (SP).

Fourthly, to capture the attitudes of both the upstream and downstream supply chain members towards SP implementation in a focal organisation, the analysis of SP drivers within the extended multi-tier context (sub-supplier, supplier, focal firm, customer) has been made using the three-stage deductive research framework proposed in this study. The deductive research phase mainly focuses on the combination of BWM and DEMATEL to investigate the drivers of SP implementation in a Danish context. BWM helps to prioritize the SP drivers relevant to the perspectives of the four supply chain entities: the focal case company (Company Alpha), supplier (Company Beta), sub-supplier (Company Gamma), and Customer (Company Delta). As a result, *Personal values (D32)* and *Active top management (D41)* have obtained the top two rankings demonstrated in the focal case company's context. Performing comparative analysis among the four supply chain entities helps the case company to know the view of the supply chain entities towards its proactiveness towards SP implementation. Through the comparative analysis, this study tries to communicate that despite the current lack of government regulation and legislation and the lack of customer demand for sustainable

products, the future implementation of SP in Company Alpha and its supply chain entities will be greatly influenced by two main drivers: government regulation and legislation and customer pressure/demand. Thus, it is concluded that for an effective and efficient SP implementation, this study sends a signal to policy makers to enact changes to the current government regulations. If minimum mandatory requirements are set, all organisations will be motivated to implement SP practices. On the other hand, creating awareness among customers about the long-term benefits attained from purchasing sustainable products will lead to changes in local and global markets. Armed with that knowledge, customers will demand protecting the environment, society, and the survival of our future generations. This advance, in turn, helps organisations and their supply chains work towards SP implementation and creates a huge impact on the attainment of sustainability goals (for example, SDG 12) both locally and globally. To help the focal company know the interrelationships that exist between the key SP drivers, the DEMATEL method has been employed to identify the cause and effect drivers that largely influence the SP implementation of the focal case company.

7.1. Limitations and future scope

Despite the above-mentioned contributions, some limitations exist. Although the novel extended multi-tier theory confines to any number of upstream SC entities, theory testing has been done by considering only the 1st and 2nd tier supplier with regard to the focal company. Future research can consider including more than 2nd tier supplier in their upstream context. By doing so, as the complexity increases, future researchers can consider employing the complexity theory in their research. As the SP implementation in an organisation is greatly influenced by the active engagement of their upstream SC members to deliver sustainable products/services, effective collaboration is highly essential towards the upstream entities and to the direct customer. Hence, to analyse the interactions that exist around the different SC actors to work towards an innovative solution, future research can consider including the collaboration theory in their study. In addition, the behavioral theory could be used to analyse the behavioural consequences of interorganizational aspects under extended multi-tier context. In this study, dynamic capability theory has been employed in general during the categorisation of the relevant SP drivers list. Future work can be extended specifically to the three components of the dynamic capability theory (see Wang and Ahmed, 2007), namely adaptive capability, absorptive capability, and innovation capability. Although the present study performs the empirical validation under the Danish context for the extended multi-tier design, future studies might be pursued on a global context by focusing either purely on the emerging economies context or with the combination of both the developed and developing nations context. Moreover, this work can be extended by performing a longitudinal research study to find out what differences there may be in the prioritisation and interrelationship analysis that influence the results of the SP

drivers towards Company Alpha's decision towards SP implementation. As the present study has performed the interrelationship analysis of the SP drivers only for the focal company, future work can consider performing the interrelationship analysis for all the SC entities on the factors considered for the study, an approach that may strengthen the degree of implementing sustainability practices across the SC entities. Finally, this work can be extended by integrating Industry 4.0 technologies (Choi and Luo, 2019) to implement SP practices.

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