Master Thesis

Sustainable Business and Innovation

Faculty of Geosciences

Driving sustainable innovation through collaborative networks in diversified business groups

An action research study

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Abstract

INTRODUCTION Though the role of collaboration in business has been widely studied (Verdecho et al., 2011), significantly less is known about cross-subsidiary collaboration in business groups (Sandford et al., 2022). To find a generalizable approach for addressing sustainability issues among subsidiaries entails complexity (Camarinha-Matos et al., 2008). Hence, the aim of this study was to understand and expand knowledge, in theory and practice, around the creation process of a cross-subsidiary collaborative network (CSCN) in diversified business groups (DBGs) to foster sustainable innovation (SI); using a sample of nine SME subsidiaries of a decentralized DBG in the Netherlands. **THEORY** Literature on open innovation effectiveness and empirical studies on CSCNs were reviewed, and a triple-bottom-line definition of sustainability was adopted. Regarding CSCNs, the influences of four effectiveness factors: holding company support, subsidiary-centric approach, nature of knowledge, and goal congruency, were explored. Concerning SI, it was theoretically expected from a CSCN to make a substantial contribution in subsidiaries' understanding of the stakes and paths towards potential sustainable solutions to sustainability challenges (Camarinha-Matos, Afsarmanesh, et al., 2010). **METHODS** The study used an exploratory action research. This method encompassed theory-informed researcher interventions in the DBG; enabling an in-depth research of the case, in which all relevant stakeholders helped define the methodology as it unfolded. For this, an extensive set of qualitative data was collected for seven months through workshops, surveys, interviews, and participant feedback. The data was coded (mainly) deductively using the four factors as the analytical lens, and examined using thematic analysis. **RESULTS & DISCUSSION** The individual influences of the four factors were proven to be deeply intertwined, and all factors' influence in effectively fostering SI seemed to be moderated by the level of subsidiary (and participants) motivation and curiosity. Aspects found essential when creating a CSCN were the support and engagement of the holding company, remaining sensitive and responsive to subsidiaries' express needs for collaboration, and having collective clarity on the network's goals. Evidence also showed that diversity in employee and firm knowledge fostered collaborative innovation and nurtured innovation capabilities. The CSCN also empowered subsidiaries to discover a share of common sustainability issues, which increased their motivation and sense of urgency. **CONCLUSION** This study made both theoretical and practical contributions for DBGs to apply collaboration for SI. The data offered robust answers substantiated in empirical evidence and stakeholder input, advancing the fields of collaborative networks and of applied action research.

Executive summary

In a BG where sustainability is not a leading topic yet, initiating a CSCN for sustainable innovation has proven to drive the focus towards sustainability and to inspire action. This study shed light in the way a CSCN should be created to maximize the possible gains from it in a decentralized DBG. Performing a similar study can help management teams understand how to support the subsidiaries in a business group, aided by a deeper understanding of their support needs and for the incorporation of bottom-up suggestions.

To create a CSCN, the holding company determination and facilitation is fundamental, if not indispensable. The holding company plays a pivotal role in the process by sensing and translating subsidiary needs into action. In this study, this was enhanced by the constant feedback between the researcher, the Holding, and the subsidiaries.

An key consideration when establishing a CSCN is that the participative nature of such network creation plays a significant role in its success, as subsidiaries are more likely to perceive its benefits and to engage. Therefore, involving the subsidiaries (whether they are large companies or SMEs) while being sensitive and responsive to incorporate their needs and feedback is essential. If these considerations are applied, which can be considered a 'subsidiary-centric' approach, the methodology offered in this study can be applicable to any business group context and business model.

At the same time, evidence found here suggested that even across different industries, subsidiaries face a range of common sustainability challenges that can be exposed as the innovation teams interact. Exploring those cohesions is important as it is known from theory (2.2) and practice (4.3.3) that commonalities tend to increase the level of subsidiaries' motivation and engagement.

Likewise, it is known that corporate sustainability is an increasingly urgent and complex area to address. This is why creating a CSCN specifically around sustainable innovation has a high relevance. The experience in this case study proved to be fruitful as innovations and network objectives were generated and a series of institutionalization aspects begun to emerge thereafter. Another advantage of collaborating around sustainability is that, if well monitored by the Holding, it does not present a significant risk factor in terms of disloyal competition.

Understandably, after having observed the potential of CSC, the recommendation is to seize it, and to capitalize on it. For this, it is important to further develop the most promising innovations resulting from a network. The recommendation is then to initiate the network for SI by mixing subsidiaries, industries, and employee roles (as performed in this research). This enables employees to broadly explore the possibilities for sustainability improvements as they listen to diverse company activities and ideated solutions; fostering innovation and nurturing innovation capabilities.

Once the subsidiaries have identified which innovations they would like to pursue, and the focus is turned towards implementation or more detailed innovation development, the network could start operating with higher cognitive proximity. In other words, in groups of employees that have more similar expertise related to those innovations. These aspects, alongside additional practical details (informed by the literature) are in provided in this document's Appendices. Those sections are also relevant when scaling or replicating this study in other DBGs.

On a societal perspective, the data showed that sustainable business practices among the studied SMEs were not yet widespread. Nonetheless, a visible motivation for the holding company and for subsidiaries to leverage collaboration was upcoming sustainability legislation. This also provided evidence of the positive effects of European sustainability regulation schemes such as the Corporate Sustainability Reporting Directive (to which the top holding needed to abide), and its potential for changing business-as-usual, as it exerts pressure on the private sector.

Specific implications for Indutrade Benelux

Expanding on the aforementioned advice more explicitly for the case company, at Indutrade Benelux the participation in this study allowed subsidiaries to actively discuss and experience collaborative sustainable innovation for the first time. The Holding empirically demonstrated to be the most suitable entity for the administration of such collaborative structure. And the active engagement of the subsidiaries and the researcher throughout the development of the study fueled its success, demonstrating the value of collaboration between the academia and the industry.

Going forward, the SIs and the rich SMART-objectives mix resulting from the workshops are promising outcomes for the sustenance of the initiated network, and provide Indutrade Benelux with a guide to follow up on subsidiary developments. An aspect to keep in mind is that a regular periodicity of centrally organized meetings is considered beneficial for the subsidiaries to stay engaged (also by the subsidiaries themselves). Similarly, the subsidiaries shared common challenges such as: upcoming legislation, new sustainability industry standards, outpacing competitors, supplier management for sustainability, satisfying customer and supplier sustainability demands, have better customer forecasting, optimizing stock management, and avoiding waste. Supporting them in addressing this requires more administrative work from the Holding in the short-term, for which dedicating a person internally to provide such support is recommended.

Likewise, it was noted that no common financial goals were set during the workshops. However, it was clear from the data that conjugating sustainability with profitable growth continues to be a prevalent interest for all stakeholders. This could be acted on more directly by exploring innovation capitalization possibilities in the upcoming Network meetings. For this, the workshop-born idea of creating 'network groups per role' in particular could help narrow down the scope of attention, advance the already proposed innovations more in depth, and discover new avenues for collaboration within the DBG.

In terms of solutions to the challenges identified before the start of the study (1.3), the stakeholders participation in this study increased overall knowledge about sustainability, helped explain Top Holding targets to subsidiaries, and allowed subsidiaries to exchange about their sustainability issues, find commonalities and motivation to pursue and accelerate sustainability work.

In sum, the continuation of the established CSCN will help Indutrade Benelux progress towards a more comprehensive and quicker adoption of sustainability practices. It can enable continuous improvement in the subsidiaries towards the reduction of negative sustainability impacts throughout the value chain, and empower and ease subsidiaries' work towards compliance of top-down sustainability targets. These actions do not only benefit the business in terms of sustainability performance, but can strengthen the entire group's reputation, legitimacy, and market positioning. Most importantly, the network has the potential to increase subsidiaries' competitiveness, as SIs are collaboratively developed and implemented, fostering the group's desired 'sustainable profitable growth'.

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List of Abbreviations

BA	Business area
Network	Benelux's Innovation for Sustainability Network
BUL	Business Unit Leader
BG	Business group
CEO	Chief Executive Officer
CFO	Chief Financial Officer
CSC	Cross-subsidiary collaboration
CSCN	Cross-subsidiary collaborative networks
DBG	Diversified business group
FTE	Full-time-equivalent
Holding	The holding company
Top Holding	The headquarters, the top holding company in the case study
MD	Managing Director
R&D	Research and Development
SMART	Specific, Measurable, Attainable, Realistic, and Time-bound
SME	Small and medium-sized enterprise
SRP	Sustainability responsible person / sustainability representative
SI	Sustainable innovation
TM	Top management
UK	United Kingdom

1 Introduction

The pressing conditions of a changing climate, scarce resources, and a growing social inequality represent risks for businesses and put pressure on them to transform towards more sustainable models and stay profitable. Fortunately, industrial enterprises can create synergies that often translate into beneficial partnerships between individual companies involved in business collaboration relationships (Sonel et al., 2022; Wu, 2021). Business groups (BGs) represent environments with potentially less barriers to form innovation networks, and advance the topic of sustainability (Sandford et al., 2022), as they are composed of independent firms under one common holding company.

This project presents the diversified business group (DBG) model as a space for collaborative sustainable innovation (SI). Here, 'sustainability' is understood from a social, environmental, and economic stance as: business development that meets the needs of the present generation, without compromising the ability of future generations to meet their own needs (Camarinha-Matos, Boucher, et al., 2010; Smith & Sharicz, 2011; White, 2013). The term is then combined with 'innovation', or new ideas; deriving in SI as the desired collaboration outcome.

The following paragraphs familiarize the reader with the underlying problem, the main scientific contributions in the discipline of collaborative networks, and the proposed research question and relevance of the research.

1.1 Research gap

Even though the role of collaboration in business has been widely studied (Verdecho et al., 2011), less is known about the practicalities of cross-subsidiary collaboration (CSC) in BGs (Sandford et al., 2022). Despite this, some authors who studied the topic of collaboration have found that participation in networks has become very important for organizations that aspire to create competitive advantage (Camarinha-Matos, Boucher, et al., 2010; Verdecho et al., 2011), also among small or medium sized (SMEs) (Gonçalves Machado et al., 2019), e.g., collaboration can help rapidly answer market demands in manufacturing companies (Camarinha-Matos et al., 2008).

Regarding cross-subsidiary collaborative networks (CSCN) creation processes, influential factors have been identified in prior literature as critical in subsidiary-tie formation; e.g., the level of support from the holding company, a match in nature of knowledge, and goal congruence (Gnyawali et al., 2009). In terms of CSCN effectiveness, studies offer recommendations for maximization of network benefits such as using a subsidiary-centric approach (Sandford et al., 2022). Nevertheless, CSCN formation requires more empirical research (Sandford et al., 2022) to accomplish more successful future interventions.

1.2 Research aim

To approach sustainability in a way that is applicable to every firm in a BG is challenging due to the uniqueness of their activities and value systems, and of the way in which they set priorities (Camarinha-Matos et al., 2008). Although authors have studied the effectiveness of collaborative networks in DBGs, the number of studies that explore empirically the creation process of such structures is still limited (Sandford et al., 2022). Hence, given the complex nature of the unit of analysis (collaborative networks in a DBG), an exploratory action research (AR) is proposed (this refers to exploratory research, followed by action research).

In contrast with a conventional research approach of 'researching on' and understanding a situation, action research goes beyond. It intends to understand a situation and to improve it, 'researching with' the stakeholders involved (Bradbury-Huang, 2015), who are the ones that potentially experience the benefits of collaboration (outcomes). It is applicable to complex contexts such as CSCN, as it helps to build problem-solving and learning competencies in organizations (Bradbury-Huang, 2015).

Likewise, action research has proven to be useful at initiating and supporting new sustainability management, and innovation practices in organizations (Hind et al., 2013). Stakeholders are engaged in all research steps; from problem definition to the evaluation of outcomes (Bradbury-Huang, 2015; Van Den Berg et al., 2019).

Hence, building on the methodology of (Sandford et al., 2022) for the collaborative network creation process, the study seeks to identify challenges and enablers that arise during a network creation intervention for topic-specific collaboration in BGs. In doing so, the study aims to answer the research question:

How can the creation of a cross-subsidiary collaborative network foster sustainable innovation in diversified business groups?

For this purpose, a business group called Indutrade Benelux serves as the empirical environment. The case of Indutrade Benelux is ideal to explore how a collaborative network between SME-subsidiaries can be established, moderated and supported by the holding company.

Specifically in terms of SI, this exploratory action research of CSCNs aspires to improve future network-enabling processes of among subsidiaries to leverage other companies' initiatives and accelerate DBG's sustainability actions. The exchange of experiences and ideas in the sustainability domain within the DBG is expected to improve resource efficiency, reduce waste, energy consumption, and overproduction (Gonçalves Machado et al., 2019). Also, to increase subsidiary's innovation capabilities (Van Beers & Zand, 2014), and to motivate subsidiaries to rip the benefits of the BGs innovative talent.

1.3 Scientific and societal relevance

This study expands the existing scientific knowledge around the creation of collaborative networks for SI within business groups. The proposed active role of the researcher is a particularity that allows for the collection of intangible data and for the inclusion of the stakeholders throughout the process. Also, it contributes to the collaborative networks discipline by empirically assessing previously identified factors that make CSCNs more effective.

From the coordinating holding company perspective, the creation of a collaborative network can directly or indirectly address challenges such as: a limited employee understanding of sustainability (by planning relevant seminars), a disaggregated or absent subsidiary sustainability strategy (by aligning goals), and the need to accelerate sustainable action (through collaborative innovation in pursue of centralized sustainability targets). For business groups in general, this study helps advance their understanding of how a structure for subsidiary collaboration can be established to effectively drive SI.

This document is organized as follows. Section 2 presents findings from the theory surrounding collaboration in business groups. It closes with a theoretical framework for the investigation that comprises the four theoretical factors being studied: holding company support, subsidiary-centric approach, nature of knowledge, and goal congruency. Section 3 describes in more detail the action research approach, the research design, the case company, and the methodological limitations. Next, Section 4 presents the outcomes of this study, organizing all collected data in subsections that aim to resemble the action research method used. Section 5 presents a summary of the findings, dives into their theoretical and managerial implications, and acknowledges the interpretative limitations of the findings and avenues for future research. Finally, Section 6 provides the main takeaways from the performed research.

2 Theoretical background

This section explores the discipline of collaborative networks creation in business groups (BGs), and how these can be effective at fostering SI. In general, the underlying theoretical positioning of this proposal is the assumption that collaboration among subsidiary companies has a positive impact on their SI capabilities.

The section is organized as follows. subsection 2.1 offers an introduction to collaborative networks in diversified business groups (DBGs). Subsection 2.2 explains the potential challenges that can affect collaboration and describes a selection of relevant effectiveness factors from the literature. Finally, subsection 2.3 delves into what is known about from collaborative networks in the domain of SI and closes with a theoretical framework for the investigation.

2.1. Cross-subsidiary collaborative networks in diversified business groups

DBGs are composed of multiple individual companies that deliver products or services of industries that are unrelated with respect to raw materials, product development, production technology, or marketing channels (Jacoby, 1970; Sandford et al., 2022; Schneider, 2009; Yiu et al., 2007). The companies in a DBG operate independently, with their own management teams and strategies (Yiu et al., 2007), but are yet subject to financial centralized control, usually through significant equity holdings (Schneider, 2009).

DBGs can affect multiple sectors and industries, and other companies in those industries may follow their ways (Poddar & Narula, 2018). By combining different industries, they have the capacity to achieve economies of scale (Jacoby, 1970); and generate higher returns (Yiu et al., 2007). Diversification as a group strategy reduces risk and helps manage volatility (Yiu et al., 2007), leveraging their subsidiaries in order to survive economic downturns. However, having been formed on different grounds, they do not tend to respond the same way to exogenous shocks and market opportunities (Schneider, 2009).

Today, collaboration among enterprises is a common strategy used to increase competitiveness; and the importance of establishing such partnerships has been widely studied in the literature (Verdecho et al., 2011). To better conceptualize DBGs as a context for innovation, the formation of collaborative networks has been explored (Camarinha-Matos, Afsarmanesh, et al., 2010; Camarinha-Matos et al., 2008; Camarinha-Matos & Abreu, 2007; Sandford et al., 2022). In this study, we will focus on cross-subsidiary collaborative networks (CSCNs), which is the when the collaboration occurs across different independent firms that are owned by the same holding company, as is the case in a DBG. Figure 1 illustrates this idea.

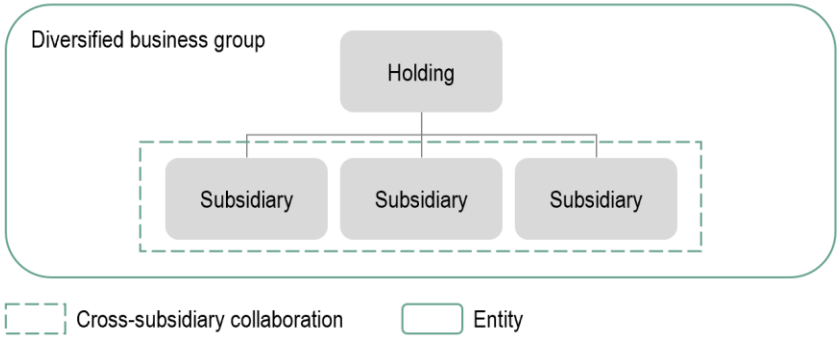


Figure 1. Cross-subsidiary collaboration level, as a multi-partner collaboration mechanism. Source: own, inspired on Sandford et al. (2022).

In fact, CSC is an increasingly popular strategy for innovation (Edmondson & Harvey, 2018) as it provides the space for firms to interact, leveraging the strong intensity of permanent ties between partners in CSC (Sandford et al., 2022) (e.g., the subsidiary companies in a DBG are permanently bound to the same entity). Nonetheless, subsidiary's networking abilities to leverage a network for gaining or sharing knowledge are critical to achieve a competitive advantage (Gnyawali et al., 2009).

Creating CSCNs in DBGs is relevant. Yet, when facilitating such networks, a number of considerations are necessary to optimize their performance. Thus, factors influencing CSC effectiveness are reviewed in the next subsection.

2.2 Effectiveness in cross-subsidiary collaboration

After having explored the nature of DBGs and theory around CSCNs, this section seeks to maximize the gains from a CSCN by recurring to existing literature in the topic. This is done firstly by explaining challenges, or complications, CSC faces. And secondly, by describing a selection of CSCN effectiveness factors found in the literature.

Regarding CSC challenges, the possible high cost of knowledge transfer between collaborators is a first. In some settings, transfer of knowledge is bound to intellectual property protection, requiring additional coordination and transaction costs (Hansen 2002 in Gnyawali et al., 2009; Rihayana et al., 2023). Another widely-mentioned challenge is cross-boundary teaming. This refers to having employees from different organizations work together on a project (Edmondson & Harvey, 2018; Sandford et al., 2022). It becomes a hurdle when the different subsidiaries have their own set of values, goals, and priorities (Camarinha-Matos et al., 2008); which can result in lower network efficiency and in significant need of approach alignment.

Competition between subsidiaries is another challenge, since opportunistic behavior is likely to exist; leading to instability (Gnyawali et al., 2009). Moreover, there are coordination and regulatory challenges. For instance, when basic procedures like accounting and information systems, approval limits, and union agreements of subsidiaries are different, or when regulatory differences create friction and confusion during collaborative work (Gnyawali et al., 2009).

Lastly, there are risks associated to 'innovation' as the purpose of collaboration (as will be deepened in the next section). Namely, the risk of unintentional information disclosure, the increase in complexity of control, and yet again, property rights related issues (Rihayana et al., 2023).

To counter the aforementioned hurdles, extensive research on network effectiveness was performed. It was found from Gnyawali et al. (2009) that the effectiveness of subsidiary ties can be studied from three levels. First, a stand-alone subsidiary level, where the perspective and motivations of a given subsidiary are emphasized; namely, subsidiary motivation and potential partner attributes. Second, a dyadic level. This refers to the effectiveness in the direct collaborative relationships between two subsidiaries. Effectiveness factors at the dyadic level determine the likelihood of subsidiary-tie formation (or the direct collaborative relationships between two subsidiaries).

Third, a BG level. Studying this organizational level is useful to explain the formation of ties and the efficacy of knowledge flow between subsidiaries in the network. The BG level accounts for the influence of other parties in tie formation, such as the holding company. The effectiveness factors on this level will be called contextual factors henceforth, since they observe the subsidiaries interacting in the collective (the BG). Studying the described levels provides a broader view of the complexity surrounding cross-subsidiary networking.

Additionally, literature on open innovation effectiveness, as well as recommendations from empirical studies on collaborative network formation were reviewed. From the review, the selection of 'most relevant' effectiveness-influencing factors resulted in four factors: the level of support from the holding company, the adoption of a subsidiary-centric

approach, the match between the nature of knowledge of collaboration partners, and the congruency of goal and interests. A description of each factor is provided below.

1. **Holding company support** (contextual factor):

As collaborative innovation processes require the stakeholders to institute working relationships with each other, the support of the holding company has been suggested to play a key role in the establishment of a CSCN; in theory (Gnyawali et al., 2009) and in practice (Sandford et al., 2022). In fact, it is determined that this top-down support will establish the ease, speed, and quality of knowledge transfer between subsidiaries (Gnyawali et al., 2009).

Support can be given in a number of ways. Instituting mechanisms for effective communication and exchange, providing greater autonomy, or assigning necessary resources (Gnyawali et al., 2009) are some tactics. For instance, it is known that collaboration may be limited where knowledge transfer costs are high (Audretsch & Belitski, 2022). In a DBG, the holding company's support via resource allocation in favor of a CSCN represents an advantage for the subsidiary companies.

In the same line, just as it is complicated to socialize employees into new cross-boundary, interdisciplinary teams (Edmondson & Harvey, 2018), CSCNs require too facilitation processes. This facilitation can be the organization of meetings of network members, and the facilitation of network's discussions on norms, values, or rituals (Edmondson & Harvey, 2018). These supporting activities are corporate socialization mechanisms that can build interpersonal familiarity and person affinity among the members of the network; which, in turn, fosters openness of communication between them (Gnyawali et al., 2009).

Furthermore, the transversal position of the holding company inside the business group makes it the most suitable entity to manage CSC (Sandford et al., 2022). Its support is believed to encourage collaboration and more effective knowledge creation and transfer (Gnyawali et al., 2009). Lastly, the holding can safeguard subsidiary alignment and power symmetry (Sandford et al., 2022), as will be touched upon in factor 4.

2. **Subsidiary-centric approach** (contextual factor):

The literature suggests that the adoption of a subsidiary-centric approach positively influences the subsidiary motivation to form a CN, or to get involved in collaborative processes (Gnyawali et al., 2009). Such approach is also encouraged as subsidiaries may lack motivation to join a CSCN if they were not involved in its creation due to the not-invented-here syndrome (Stendahl et al., 2022).

A subsidiary-centric approach implies an intervention centered around the subsidiaries and their interests, their goals and the benefits they could rip from a CSC (Sandford et al., 2022). For this, this approach requires to understand the different subsidiary underlying value systems, as the actual meaning of 'benefit' depends on it (Camarinha-Matos et al., 2009; Camarinha-Matos & Abreu, 2007).

At the same time, the approach to collaborative work in a DBG is influenced by the concept of organizational proximity. In general terms, organizational proximity refers to the set of interdependencies within and between subsidiaries (Boschma, 2005) that, in this case, are financially connected to the holding company. These interdependencies define the rate of autonomy and the degree of control that can be exerted in organizational arrangements, such as a network (Boschma, 2005). And, should be taken into account when attempting to center the approach around the subsidiaries as clarified below.

Networks are mechanisms to coordinate transactions, but also vehicles for knowledge transfer that are believed to be beneficial for learning and innovation (Boschma, 2005). However, the implementation of innovation requires organizational flexibility, which is unlikely to be provided in a tight hierarchical governance structure (Boschma, 2005), e.g., when the

collaboration mechanism is fully controlled by the Holding. In fact, to achieve high-performing cross-subsidiary collaboration, holding companies should not dictate the partners nor the mechanisms for collaboration (Sandford et al., 2022), but rather engage the subsidiaries in the network creation process.

Authors indicate that organizational tensions in a DBG are reduced when the holding company provides higher autonomy to the subsidiaries and shares information with them (Akasawa, 2001 in Gnyawali et al., 2009). But to achieve this and still maintain an effective collaboration mechanism using a subsidiary-centric view, a balance should be found with respect to the autonomy of the subsidiaries and the Holding's control over knowledge flows. In other words, too little organizational proximity and interdependencies can mean a lack of control over the CSCN (e.g., due to the absence of a central entity as is the Holding) and danger of opportunism, which is not likely to be the case in a DBG. Conversely, too much organizational proximity (which could be the case in a DBG, exerted by the Holding) can result in a lack of methodological flexibility (Boschma, 2005) for the subsidiaries to operate in a subsidiary-centric manner. Thus, a more decentralized network could enhance capacity to explore new knowledge, but centralized coordination of the network to bring the units together and to exploit new knowledge is required (Boschma, 2005).

3. **The nature of knowledge** (dyadic factor)

This factor's influence on firm innovation capabilities and collaboration effectiveness is twofold depending on the level of proximity in nature of employee knowledge. To explain this, the term of cognitive proximity is used.

Cognitive proximity means that the own cognitive base is close enough to the new knowledge, or partner knowledge, in order to communicate, understand and process that new knowledge successfully (Boschma, 2005). This notion means that people sharing the same knowledge base and expertise may learn from each other (Boschma, 2005). Cognitive proximity is a prerequisite for interactive learning processes to take place (Boschma, 2005), hence, for an effective exchange of ideas during workshops.

In more practical terms, this is here regarded as a match between the nature of subsidiary's employee knowledge (Gnyawali et al., 2009). The nature of employee knowledge refers to the employee's expertise, their role in the company (what they do), and the way they process new knowledge (Edmondson & Harvey, 2018). Thereon, the match in knowledge can happen between a given employee's knowledge and that of the potential partner (another employee) within the CSCN. Gnyawali et al. (2009) propose that such match positively influences the flow, and exchange of knowledge between the subsidiaries.

However, too much cognitive proximity may be detrimental to learning and innovation, and a level of cognitive distance is necessary for preventing lock-in (the state of being trapped and hindering exploration of new directions; e.g., when a company finds it difficult to explore better innovative options because it is fully invested in a specific technology) (Boschma, 2005). This distance is termed here: diversity in nature of employee knowledge; which is understood as the presence of complementary, multidisciplinary knowledge (Van Beers & Zand, 2014). Knowledge building often requires dissimilar, complementary bodies of knowledge, as novelty of sources triggers innovation and creativity (Boschma, 2005).

The diversity of collaboration partners is a strategic factor in building a portfolio for firm innovation (Audretsch & Belitski, 2022), meaning that it can be beneficial if employees in a network have relevant complementary expertise and roles. Simultaneously, a more diverse portfolio of partners facilitates future cooperation (Van Beers & Zand, 2014) and it increases the benefits of collaboration.

Nevertheless, for each new innovation, there exists a minimum level of knowledge needed for firms to bridge that knowledge gap (Boschma 2005). Thus, a too great cognitive distance may be conflicting, as the new information may be too new to be understood by the receiver (Boschma, 2005). Therefore, a balance is necessary for effective collaborative innovation, where some cognitive distance is maintained, but sufficient cognitive overlap is secured (Boschma, 2005).

For this too, the holding company in the DBG can play an important role in the facilitating process of CSCN. Organizations should secure access to heterogeneous sources of information and some openness to the external knowledge (Boschma, 2005). In general, the assessment of tie effectiveness can be done in various ways: volume and quality of knowledge created, speed and volume of knowledge transfer, and quality of knowledge transferred (Gnyawali et al., 2009), among others.

4. **Goal and interests' congruence** (dyadic factor)

This factor, suggests that the likelihood of collaboration between two potential partners increases when there is sound goal congruity and proximity (Gnyawali et al., 2009). If goal congruence is low, SMEs have little incentive to undertake the additional costs of developing ties (Camarinha-Matos & Abreu, 2007; Gnyawali et al., 2009). This are, the additional costs related to coordination, and compromise. It is simpler for the subsidiaries to avoid creating new relationships until the benefits have proven to outweigh the costs (Gnyawali et al., 2009).

Therefore, an interrelated requirement for goal alignment is to understand and to make explicit the benefits of a collaboration (Camarinha-Matos & Abreu, 2007). Questions they might ask first when the topic of collaboration is brought up are "which benefits does this collaborative network bring to my organization?" (Camarinha-Matos & Abreu, 2007). In this sense, the definition of benefit, introduced in factor 2, needs further explanation.

The meaning of benefit depends on the underlying value system used in each company or individual (employee) context; as the behavior of an individual, society or ecosystem is determined by their value system (Camarinha-Matos & Abreu, 2007). Value systems are the ordering and prioritization of the held set of values. In a business context, the dominant value is economic profit, but the value system could include factors such as reciprocity, trust, time invested in collaboration, among others (Camarinha-Matos & Abreu, 2007).

Examples of cooperation variables that can help identify specific collaboration benefits are: costs, risks, dependence (e.g., of third parties), innovation capacity, market position, agility, specialization, regulation, social causes, among others (Camarinha-Matos & Abreu, 2007). Table 10 in Appendix I expands on this idea by providing specific advantages associated to collaboration; for instance, the 'emergence of new sources of value' as a result of collaboration around 'innovation'.

All in all, in a network context, the subsidiaries will establish that a relationship is beneficial if they are able to agree on their objectives and their interests (Gnyawali et al., 2009). In other words, to align their value systems and establish clear benefits of collaboration. In practice, in order for a CSCN to align, the establishment of realistic and concrete network objectives and missions is a key strategy (Sandford et al., 2022; Verdecho et al., 2011).

2.3 Sustainable innovation through collaboration

Previous subsections have underlined how collaborative networks can be a significant source of knowledge creation, and are able to drive change in organizations (Audretsch & Belitski, 2022). The resolve of the subsequent paragraphs is to delineate and describe the scope of the CSCN being proposed: the SI domain. Finally, a theoretical framework to bind the literature review together is presented.

The term SI combines both innovation and sustainability. The first term, innovation, can be understood as *"an idea, practice, or project that is perceived as new by an individual or other unit of adoption" (Rogers, 2003, p.12)*. An innovation may have been invented in the past, but if individuals perceive it as new, it may still be an innovation for them (Sahin, 2006). Beyond the intramural 'innovation' concept, the notion that a single organization cannot successfully innovate in isolation (De Beule & Van Beveren, 2018) derives in the term 'open innovation', which is more closely related to collaborative networks.

The second term, sustainability, has an array of divergent definitions in business (Smith & Sharicz, 2011); the triple-bottom-line being the most common. The triple-bottom-line concerns the ability of an organization to maintain viable its business operations (including financial viability) without impacting negatively any social or ecological systems (Smith & Sharicz, 2011). Hence, SIs comprise not only the environmental dimension, but also economic, social and institutional aspects and represent a subset of all innovations (Stock et al., 2017).

For manufacturing companies, SIs can be processes and systems that use less and more sustainable resources, are safer for internal and external stakeholders, and mitigate negative impacts throughout the lifecycle (Gonçalves Machado et al., 2019). In the realm of sustainable manufacturing, examples are design for disassembly, remanufacturing, recycling, management for resource efficiency. Some associated benefits to these practices are: cost reduction through resource efficiency, regulatory compliance improvement, brand reputation, new market access, less labor turnover due to attractive workplaces, among others (Gonçalves Machado et al., 2019).

Prior research has identified collaborative networks as a means to foster SI (Camarinha-Matos, Afsarmanesh, et al., 2010; Sonel et al., 2022). A conclusion is that these structures can contribute significantly to better understand of the stakes and paths towards potential sustainable solutions (Camarinha-Matos, Afsarmanesh, et al., 2010). They also highlight the sizable potential for beneficial synergies between the field of collaborative networks and sustainability science, acknowledging that it is important for members of a collaborative network to understand benefits linked to collaboration; i.e., to increase innovation capacity (as proven by the collaborative network effectiveness factors in 2.2) and to share social responsibility (social causes) (Camarinha-Matos & Abreu, 2007).

Yet, from the broad spectrum of SI, it not clear where actions should focus first. A study by Sonel et al. (2022) however, provides pertinent insights from an industrial symbiosis lens (an SI-related mutual approach between businesses to reduce raw material consumption and waste production). They identified the following four main criteria to guide initial actions in SI networks, while promoting their time-permanence: environmental, economic, legal, and institutional. From these, the sub-criteria: environmental awareness, reduction in logistics costs, and co-educational opportunities were chosen as the most important ones.

To close Section 2, Figure 2 intends to facilitate visualization of the interplay between the effectiveness factors in the context of a collaborative networks and the expected research outcome. The unit of analysis (left-hand side) shows the four selected effectiveness factors to be assessed in the collaborative environment. All of them work towards an CSCN that is effective at fostering SI (outcome, right-hand side).

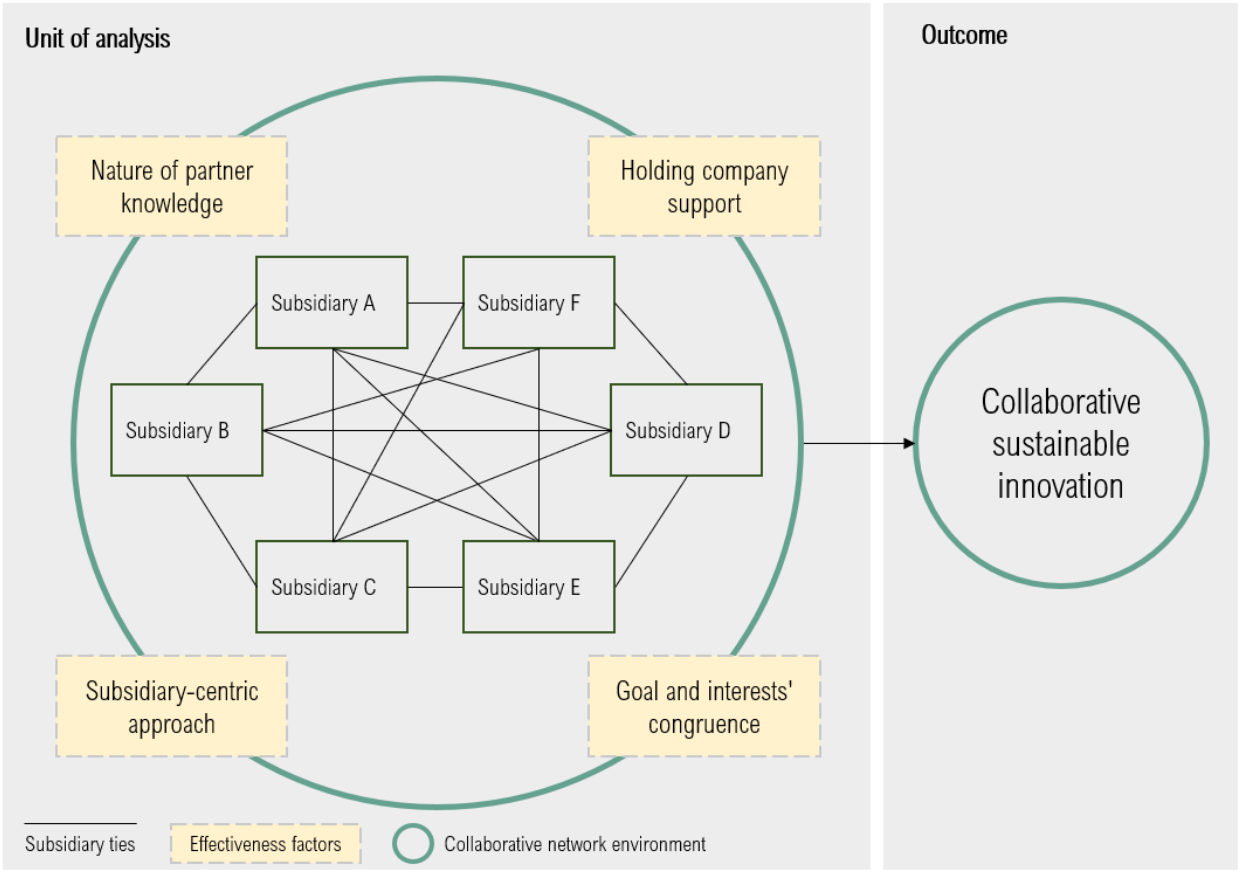


Figure 2. Theoretical framework for the study of collaborative innovation in diversified business groups.

3 Methodology

This study pursues to enhance existing empirical knowledge around the topic of collaborative SI within a DBG by answering the research question *'how can the creation of a cross-subsidiary collaborative network foster sustainable innovation in diversified business groups'*. This section explains how this was achieved.

First, it introduces the proposed research design and the stakeholders involved per research step (Figure 3). Next, it expands on the operationalization of the effectiveness factors introduced in Section 2.2, and the corresponding data collection and analytical methods proposed for this. Following, it presents the business context of analysis, for whom it is important to accelerate the adoption of sustainable practices.

The section finalizes acknowledging a number of methodological limitations (3.4).

3.1 Research design

As posed in the Introduction, action research is an 'engaged scholarship' type of research that aims at building and testing theory in real-world problem-solving contexts (van den Berg et al., 2019). The practices and values of this cyclical mode of inquiry have been largely described by e.g., (Bradbury-Huang, 2015; McNiff, 2013; Reason & Canney, 2015). action research has been a common denominator in the research designs surrounding collaboration in BGs, e.g., Sandford et al. (2022) & Camarinha-Matos, Boucher, et al., (2010) (in different industries); and Van Den Berg (2019) (in the same industry: construction). In the sustainable business realm, a thorough reference is Marshall et al. (2011).

Action research is suitable to find solutions that accelerate the adoption of SI in complex contexts, where 'best' is subject of participants discussion and negotiation; it helps critically examine a situation alongside a very practical concern for useful outcomes (Bradbury-Huang, 2015). This approach is encouraged by researchers because it involves people in the diagnosis of and solutions to problems, instead of imposing solutions or problems (Bryman, 2012). Those complexity and participatory characteristics are embedded in DBGs.

Hence, this project implements an exploratory action research approach with phases: *diagnose, determine desired future, implement action, evaluate action, and institutionalize* (Bryman, 2012). However, the 'institutionalization' step is outside of the research scope due to time limitations. Moreover, DBGs demand an extensive initial exploration of the situation, which is here reflected in a prolonged action research diagnosis phase.

The creation of a collaborative network has been chosen as the unit of analysis due to the long-termism of networks, which is consistent with the permanent business relationship of subsidiaries inside a DBG. This network will be henceforth called Network.

Four CSCN effectiveness factors from the literature were embedded in the research design (Section 2.2), leading to 10 iterative steps. This iterative nature of the process stems from the fact that action research works in cycles of inquiry, the time focus is on the 'here and now' at each step, with reflection on past issues to influence future designs (Bradbury-Huang, 2015). The steps are narratively described below and are later summarized for visualization matters under the action research taxonomy of Bryman (2012) in Figure 3. Also, hints of data collection techniques are provided here for contextualization, but they are presented more elaborately in Section 3.2.

(1) Understanding holding company's interest in collaboration. For this, conversations with the top management were necessary to diagnose major issues in the DBG and identify potential topics of interest for the Network from their perspective. This also included the selection of a sample of companies to participate in the study. Detailed notes were taken and these were later coded.

(2) Gathering knowledge on the current status of collaboration. For this, the TM suggested contacting the business unit leaders (BULs), who are persons in charge of overseeing a group of 2-6 companies. An open-survey was sent to them.

(3) Understanding top holding company's sustainability strategy. This step included desk research on company documentation and the web and informal interviews with the top holding's head of sustainability

(4) Understand the subsidiaries' operations and aims by performing subsidiary informal interviews to the participating subsidiaries prior to the interventions, to tailor them to the companies' needs and gain support for the Network.

(5) Determining top management's desired future in terms of sustainability. Here, the information collected in previous steps was analyzed with the management to move forward accordingly.

(6) Planning the first intervention: Workshop 1. The aim was to offer the subsidiaries, and the TM, the experience of participating in a cross-subsidiary collaboration process, focusing on innovation around sustainability. It involved preparing workshop-related activities such as speakers, materials, group exercises, inviting and confirming attendees, and creating and distributing introductory and preparatory documents for companies prior to Workshop 1 and 2.

(7) Executing Workshop 1: the collaborative processes (and all events) of Workshop 1 were observed with the assistance of 4 additional researchers, who took notes of all working groups and accounted group-innovation generation. Recordings of concluding sessions of the day were also made and later coded. The four theoretical effectiveness factors (Section 2.2) were used as the analytical lens.

In between steps (7) and (8) 1,5 months of time were provided for intra-firm reflection: as part of the action research approach it is necessary that stakeholders also evaluate the interventions to find improvement opportunities. A satisfaction survey was used to collect companies feedback; and a new exercise for preparation to Workshop 2 was provided to the participants.

(8) Planning the second intervention: Workshop 2. While incorporating the feedback from previous steps into this step, the preparation activities for Workshop 2 were similar to Workshop 1. Here, the aim was to study the subsidiaries, and the TM, during group discussions for innovation prioritization and Network objective-setting activities.

(9) Executing Workshop 2: the collaborative processes in the groups were all recorded, transcribed and coded by the researcher. The four theoretical effectiveness factors (Section 2.2) were used as the analytical lens.

(10) Assessing effectiveness of the interventions (analyze data): analyzing the complete data set (the compilation of findings of each research step). For this, all interview transcripts (formal and informal), detailed notes, and audio transcriptions were coded used as the analytical lens to finally draw conclusions to answer the study's research question.

In Figure 3, the black line on the top represents the overarching action research cycle, but each stage is its own cycle. Thus, for instance, step 1 and 2 informed step 4, step 5, and step 8. Similarly, findings from step 9 helped understand step 4 and 5; and the outcome of step 7 (Workshop 1, Appendix V), helped adjust the approach to step 8 (Workshop 2, Appendix VI).

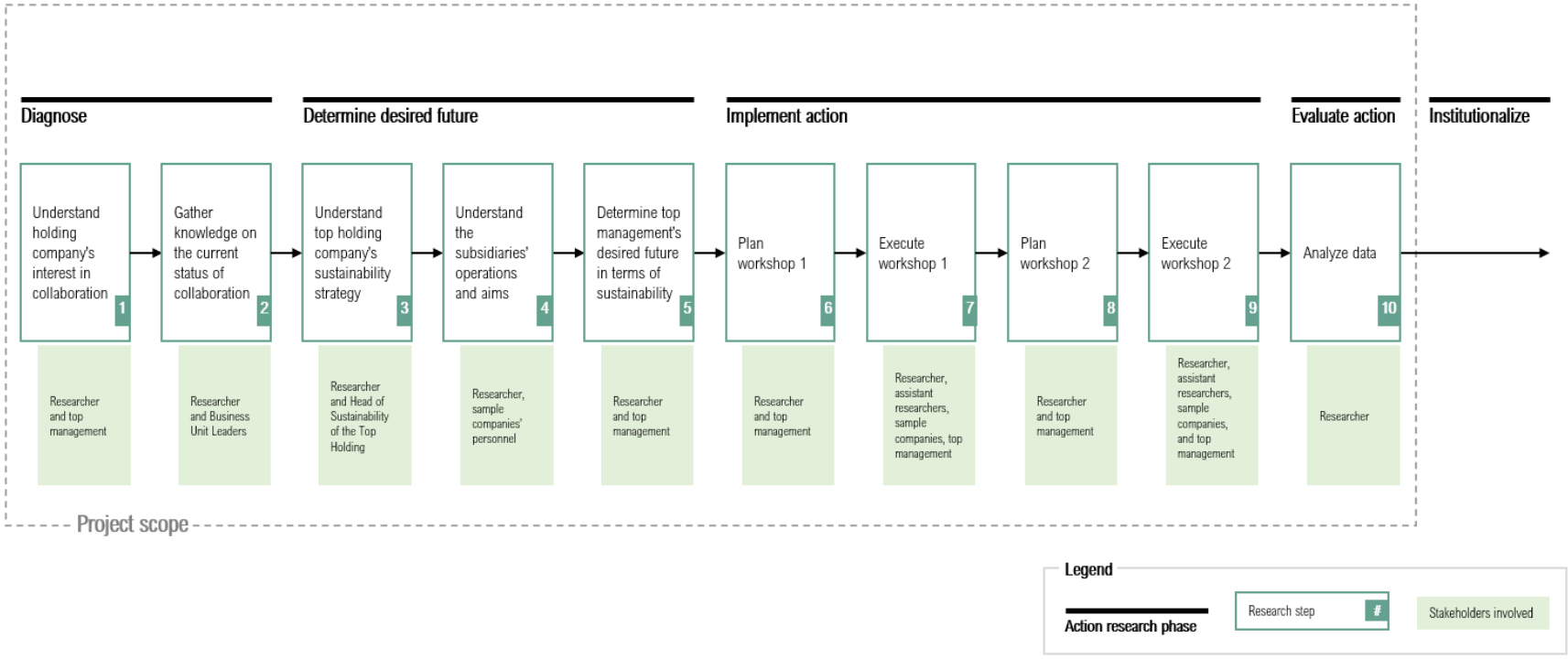


Figure 3. Research design for the facilitation of the creation of cross-subsidiary innovation-for-sustainability network in a diversified business group, under an action research umbrella. Source: own, inspired on Sandford et al. (2022)

3.2 Operationalization

The research design (Figure 3) developed throughout the course of 9 months researcher-company active engagement. As mentioned, the action research phases allowed the researcher to adapt the next phases depending on the findings. This subsection explains the data collection techniques used, based on the effectiveness factors (holding company support, subsidiary-centric approach, nature of knowledge, and goal and interests congruence).

The two main data collection interventions were two workshops; planned in sequential order for participants to learn about sustainability, innovate, and experience the creation of a collaborative network. This study understands 'workshop' as an arrangement whereby a group of people learn, acquire new knowledge, perform creative problem-solving, or innovate in relation to a domain-specific issue (Ørngreen & Levinsen, 2017).

In general, the workshops were used as both 'workshop as a means' (e.g., having the topic of sustainability as the educational domain) and 'workshop as a research methodology' (e.g., where the companies are set up together to study the collaborative innovation process) (Ørngreen & Levinsen, 2017). An important consideration in this setting is that the researcher, or assistant researchers, should be aware of maintaining a balanced role that focuses both on participant needs and on the research (Ørngreen & Levinsen, 2017).

And, even though articulation of how to produce and analyze data from workshops is practically absent (Ørngreen & Levinsen, 2017), this study adopted verified approaches to data collection (and data analysis) previously used in other action research studies. More substantiation on this with reference to previous studies is done in Section 3.4.

The most important data contributions of the two main data collection interventions are included in Table 1. Besides these, each research step had an associated data collection technique, as noted under the research design steps in 3.1, and all data was compiled at the end of the project. The detailed planning of the workshops can be found in Appendix V and VI.

The main type of data of interest was qualitative data, which was collected in the following ways: literature review, company documentation review, observation, detailed note-taking, one open-ended survey, eight informal interviews, two workshops, and a satisfaction survey to evaluate participant perception between Workshop 1 and 2. For note-taking, a method used was the Cornell Method, in which the page is divided in three sections: note-taking area, cue column, and summary area; to promote retention of learned material (Saran et al., 2022). This was later digitalized.

To provide further details on the operationalization, Table 1 summarizes the approach in relation to the effectiveness factors, mentioning the data collection methods. The way the data was analyzed is presented in Section 3.4, after the sample is introduced.

Table 1. Operationalization of the effectiveness standpoints by assessing the theoretical effectiveness factors in a DBG context.

Factors	Data collection method	Factor-Data source interrelation
Holding company support	**Seven (7)** informal interview meetings (note-taking) and **three (3)** recorded and transcribed semi-structured interviews with CEO and CFO	Meetings notes and interview transcriptions helped assess holding company support for the formation of a CSCN and for CSC in general Meetings notes helped identify top management engagement throughout the process Meetings with top management to discuss companies' informal interviews insights helped target BG topics that are relevant for all companies within the network, from the broader holding-company view Meetings helped identify top management's willingness to allocate resources to the formation of a CSCN, which is considered support
	Observation before, during and after Workshop 1 and Workshop 2	Observation will help assess holding company's commitment and contribution to the long-termism of the CSCN
Subsidiary-centric approach	**Seven (7)** open-ended surveys to BULs (in Appendix III) (note-taking)	The response rate and level of detail of the answers helped determine the disposition of BULs to answer the survey The survey answers helped assess the current view of collaboration from a BULs perspective The survey answers helped diagnose the current status of collaboration in the BG (before the interventions and the Network formation)
	Eight (8) semi-structured interviews meetings to subsidiaries (note-taking)	The companies responsiveness informed the disposition and interest of companies to be interviewed and to participate in the research project The interview notes helped diagnose the current status of collaboration in the BG from the subsidiaries' perspective The interview notes and supporting documentation provided by the companies helped understand the subsidiaries' internal structures in terms of organizational governance, business operations, sustainability knowledge, and sustainability issues
	Four (4) feedback meetings about the creation and testing of company-inspired tool in preparation for the workshops (note-taking)	The testing subjects were: - Head of Sustainability Strategy at the Top Holding - Company A - Company I - Holding company support/and supervision This allowed for reassessing, with the help of the companies, the ease-of use of the tool and the subsidiary-contexts adequacy of tool. From the Top Holding's perspective, it helped align the tool with Top Holding Sustainability strategy
	Nine (9) satisfaction surveys about the execution and evaluation of Workshop 1 (written format) *[which shed light on other factors as well]*	The accounting of innovations in Workshop 1 and follow-up in Workshop 2 allowed for assessing the number of perceived-valuable innovations received vs. the total of innovations received by the subsidiary (Camarinha-Matos & Abreu, 2007)

		A satisfaction survey after Workshop 1 (in Appendix V) helped understand the perception of the subsidiaries and gave insights on how to adjust Workshop 2 to their needs and interests The transcriptions of group leaders summaries during Workshop 1 and Workshop 2, allow to understand and assess the internal inter-firm group discussions (alongside the group discussion's notes and innovation accounting results) The open 'motivation and engagement' session during Workshop 2 allowed for voicing and exchanging, now collectively, the struggles each participating company had in terms of networking
Match or diversity in nature of knowledge	Number of employee roles in self-made groups in Workshop 1 (for innovations) Number of employee roles in researcher-made groups in Workshop 2 (for SMART objectives)	The composition (identification of the professional roles each inter-firm group member had) helped assess the match or diversity in knowledge of participants These roles can be assessed in relation to the total number of innovations exchanged and to the number of 'relevant to majority' innovations from each group. Alternatively, the objectives can be assessed in relation to the nature of the objective, the ease of getting there, etc.
	Four (4) (recordings of each innovations groups in Workshop 2) *[which shed light on other factors as well]* **Four (4)** recordings (of each SMART group in Workshop 2) *[which shed light on other factors as well]* Observation and note-taking during sessions (in Workshop 1, Appendix V; and Workshop 2, Appendix VI)	The notes during the sessions regarding the level of participation and overall behavior informed the level of engagement and of knowledge areas of the participants
Goal and interests' congruence	**One (1)** recording of the conclusion session of Workshop 1, and **two (2)** recordings of conclusion sessions in Workshop 2 *[which shed light on other factors as well]* **Four (4)** Assistant researchers' note-taking files of each innovation group in Workshop 1 and throughout the entire day	The discussion in the inter-firm group at Workshop 2 informed the congruence in goals and interests, and therefore: - the likelihood of companies to form longer term ties The 'open session' informed the match in difficulties while forming a network Found similarities in interests on Workshop 1 that could be beneficial to give continuation to by each of the subsidiaries The question regarding collaborative innovation in the survey after Workshop 1 informed the likelihood of companies to be interested in continuing in the network (dyadic dynamics)
	The same four (4) recordings of each SMART group in Workshop 2 mentioned for Nature of knowledge.	The SMART session in 4 different groups helped identify limitations of setting up common goals in the network, that are generic enough to be malleable by subsidiaries in different industries This session also helped observe challenges in the formation of a sustainable network initiative (time investment, interest, etc.) And to observe enablers in the formation of a sustainable network initiative (same legal frame, similar sustainability issues, same industry (more cognitive proximity), etc.)

3.3 Case company and data sample

This research project developed as part of an internship. This section addresses the case company and the composition of the sample (Table 2) in which the action research took place. The main data collection phase in the company lasted approximately 10 weeks of the total project.

In terms of ethics and confidentiality, the data collected was sanitized, leaving personal and company names out of the reports. The agreements used for this can be found in Appendix II. It was clarified to all participants beforehand that the Workshop events and conversations were part of an academic research and that participation was voluntary.

Case company

A DBG called Indutrade Benelux, composed of SMEs, is the corporate group under exploration. Indutrade Benelux, owning more than 30 different SMEs, is a business area (BA) of a Top Holding company, and it is determinedly acquiring companies. The organigram of Benelux, in Figure 4, shows a clear archetypal structure of a DBG (Oxford University Press, 2010).

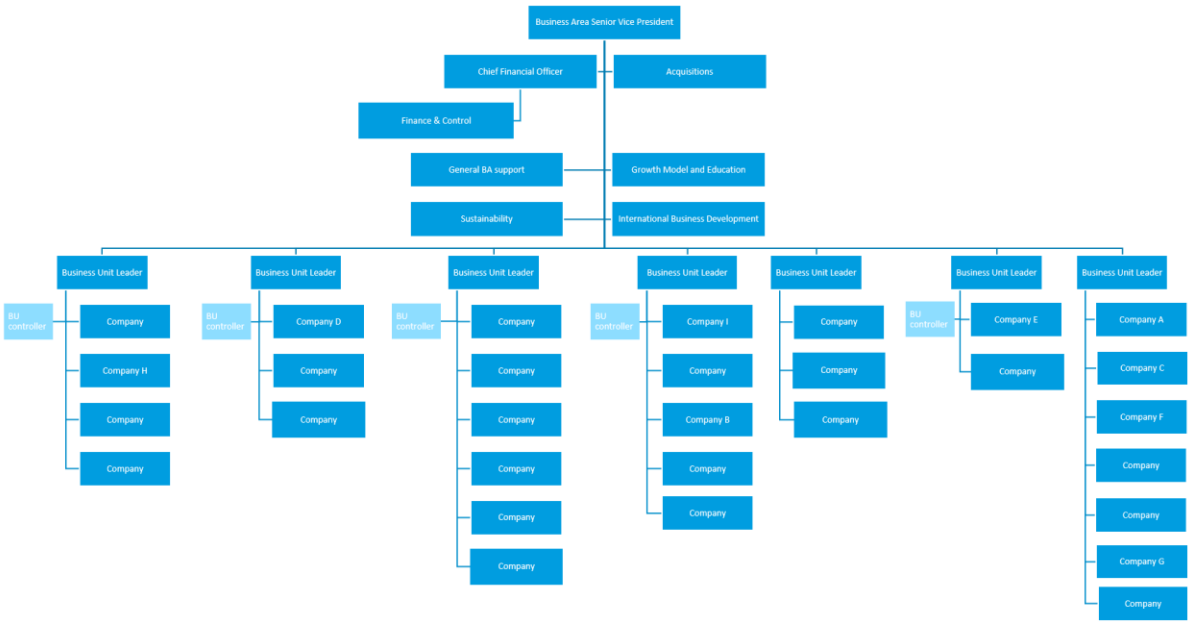


Figure 4. Organigram of Indutrade Benelux. Source: company internal information.

The companies that belong to the Benelux BA are able to maintain their original identity, while gaining access to the collective knowledge and experience of all the Group's employees (Indutrade, 2020). However, top holding has a strong set of sustainability requirements that apply to all BAs. For instance: *"...companies must have a structured process for sustainability work, … with associated goals, KPIs, and follow-up data"*, and a carbon Net Zero goal by 2030 (Indutrade, 2020).

The fast-paced acquisition process, an increase in sustainability compliance requirements and targets from the top holding group, and global geopolitical and stakeholder demands are forcing the Benelux BA to adapt. The desired solution is to rapidly transform or reconfigure current business operations in the direction of SI.

Data sample

Using purposive sampling, a sample of 9 subsidiaries was chosen by the researcher and the management. These companies were classified as 'manufacturing companies', and preliminary information about them was gathered via their website and via personal communication with the managing directors (MDs) and sustainability responsible persons (SRPs) of the sample subsidiaries. Table 2 summarizes their general characteristics.

Table 2. Initial characterization of sample subsidiaries.

Company name	Country	Number of employees (FTE disclaimer: numbers may not be accurate)	Industry and product lines	Key activities and/or value proposition
Company A	The Netherlands	**FTE = 10**	Oil and gas / petrochemical Renewable energy Water treatment Off-shore On-shore	Ensured process safety In-house product design, assembly, manufacturing and sales Field service, maintenance, or consulting
Company B	The Netherlands	**FTE = 16**	Equipment for measurements in and around construction sites Information displays and monitoring equipment for sustainable energy systems Internet linked data acquisition equipment	Engineer, design and production of products to customer specification Measuring projects in the field of sustainable energy Design, production, sales and service of own products
Company C	Germany	**FTE = 108**	Assembly and trading of PTFE hoses, Single-use-systems hoses, in the Pharmaceutical, Medical, Chemical industries	Expertise in hose technology and single-use systems, offering tailor-made solutions
Company D	The Netherlands	**FTE = 35**	Process industry Test, measurement and calibration instruments / solutions Chemical petrochemical, pharma, food industries And customized products	Assembly of customized test benches. Engineer, design, assembly and manufacturing in-house
Company E	The Netherlands	**FTE = 25**	Industrial applications Water management Heating applications	Welding, end forming, tube bending Combination of services, in the business they are in "A 1-stop-shop" Work with the customer to redesign the product to create more value to the customer Lean manufacturing
Company F	The Netherlands	**FTE = 18**	Food and beverages, chemicals, pharmaceuticals and cosmetics, other sectors	Specialist in stirring and mixing technology. Custom production processes. Manufacturing and product refurbishing in-house. A leading name in the field, with a strong market position in the Benelux countries and exports to all continents.

Company G	The Netherlands	**FTE = 22**	Single-use components Pharmaceutical / clean rooms Others	Custom design Flexibility Quality Not only by building components together into a (single-use) assembly, but also by connecting existing (single-use) processes in our customer's manufacturing plants
Company H	The Netherlands	**FTE = 79**	Industrial grabs for a number of purposes from construction demolition to forestry. E.g., combicutter, sorting, stone and tree grabs.	Real power. Grabs in all sizes of assured quality. Customers can order spare parts through our dealers.
Company I	The Netherlands	**FTE = 70**	Single-use components Pharmaceutical Other industries	Custom design, flexibility, and quality Building components together into a (single-use) assembly and connecting existing (single-use) processes in customer's manufacturing plants

3.4 Data analysis

Now that the Case company and Data sample (3.3) have been introduced, this section details this study's approach to data analysis.

The qualitative data collected by all collection means presented in Table 1 was analyzed using the theoretical effectiveness factors as an analytical lens (2.2). As briefed in 3.2, this study adopted approaches to data collection and data analysis that have been previously used (thus, verified) in action research studies by Binet et al. (2019); Falkembach & Torres Carrillo (2015); Lindgren et al. (2004); Ørngreen & Levinsen (2017); and Sandford et al. (2022). The data analysis methods used are: retrospective inferences, thematic analysis, and descriptive statistics as support for qualitative research.

From the data, all non-written data (audios, observations) were properly documented (transcribed) and compiled with all written data (surveys, assistant researchers' and main researcher's notes taken, etc.). Some data files were grouped in 1 data file (like assistant researchers' data) for simplicity. All available documents were collected in the software *NVivo 14.23.1* to reduce the dataset and analyze it, resulting in a total of 20 documents.

To analyze them, codes were created deductively using the *conceptual coding technique* (for all relevant concepts in the theoretical effectiveness factors), and then a *descriptive coding* technique was used (assigning labels to identified themes in the data) (Saldaña, 2015). This was depicted and clearly defined in a *codebook* for code consistency. Later in the coding process, inductive codes were introduced when identified from the text, which resulted in a hybrid coding approach.

The primary data analysis method used thereafter was 'thematic analysis', which is the action of coding and categorization of data, identifying recurring themes, and interpreting the meaning of those themes (Bryman, 2012). Indeed, basic descriptive statistics were also used to assess trends when needed, e.g., to account for innovations in the different working groups during workshops.

3.5 Methodological limitations

The 9-month duration of this study complicated the possibility of doing more workshops, which could have put data collection at risk. As reference, Sandford et al. (2022) performed a similar but more in depth research in 1,5 years. The difference of the present study was its focus on a narrower pre-defined concept of effectiveness and the exclusion of the institutionalization step of the action research approach. Moreover, several steps were taken in advance such as the invitation to the workshop of the relevant persons in the DBG, the questionnaire regarding collaboration status to BULs, and the planning for the period of informal interviews with the sample companies.

Additionally, Workshop 1 was the main data collection point. However, in case of delays, the necessary setup for data collection in Workshop 1 could have been moved to the date of Workshop 2; which ensures a moment for data collection and later time for data analysis. In this same logic, it is known that primary qualitative data cannot be kept and the immediate quality depends on the person who experiences it; which provides a challenge for workshops as research methodology (Ørngreen & Levinsen, 2017).

Moreover, the selected sample was relatively small, 9 out of 34 firms of the studied BA, probably neglecting collaboration potentials. However, the company plan was to extend the invitation to all subsidiaries in the Benelux BA in the future. Besides, the screening individual sessions with the sample companies, may not have been enough to obtain a reflection of each company's real sustainability challenges. To counter this, the workshop had room for companies to discuss internally their real interests based on the topics available.

Another limitation was the adopted research approach, action research, which has been criticized for its lack of academic rigor and limited repeatability (Bryman, 2012). To counter this, the researcher reserved considerable time to ensuring the workshop was theoretically sound and the results were properly documented.

Lastly, the research attempted to prevent the subsidiaries of not being interested in the Network. This, by the early research on effectiveness of collaborative networks and an early introduction of the Network to the top management. Along with the use of hints from innovation diffusion theory to promote its acceptance and its future success. However, in Workshop 2, some discomfort about having the session recorded was shown, also because some new participants were not aware of the dynamics and research nature of the sessions; this was explained to them and they accepted it.

4 Results

Before delving into the outcomes of the present action research, it is worth noting that the steps (Figure 3) of this study are embedded rather than explicit, and that each phase of the action research influenced later phases and helped understand previous ones. Consistently, the main stakeholders involved, namely the top management, the Business Unit Leaders, the Managing Directors, and the subsidiaries' employees, had an active role in shaping the way the research project developed.

As is common in participatory research methods, the role of the researcher was to then process the new information incoming from the stakeholders, to filter it by relevance for answering the research question, and to incorporate it into the next phases of the study. Thus, this should not be read as a linear process, but as the outcome of the total, iterative, action research cycles. This section presents the findings of those iterations.

The Results are organized in 4 subsections that show the research's evolution throughout time. Section 4.1 comprises 'The diagnosis' or the state of the art of collaboration in the DBG. Next, 4.2 explores 'The desired outcome' of this study from the stakeholders' perspectives. Then, 4.3 is a more extensive subsection that dives into 'Experiencing cross-subsidiary networking'. In it, the results from collaborative SI and Network goal-setting are structured around the four theoretical factors described in 2.2. Finally, 4.4 ends the section with 'Stakeholders' captured reflections and evaluations', which is a part of the action research approach's usual research cycle (Figure 3). For clarity, data sources (deriving from the data collection activities in Table 1) were enclosed in square brackets throughout.

4.1 The diagnosis: DBG's current status of collaboration

When introducing a structure for collaboration in a DBG, a number of stakeholders must be taken into consideration. In the case of Indutrade Benelux, these stakeholders are explicitly the Top Holding company, the Top Management of the holding company (TM), the Business Unit Leaders (BULs), the subsidiaries' Managing Directors (MDs), and the subsidiaries' employees' (Figure 4 for reference). An initial screening process on the status of collaboration helped identify the presence, the type and the perception of collaboration mechanisms within the DBG.

It was evidenced that Indutrade Benelux operates under a very strong entrepreneurial and decentralized model, which has allowed for the development, success, and permanence of the subsidiary businesses in the group [TM meetings]. The subsidiaries' core businesses are kept as individual company-internal decisions, which gives a degree of freedom and creativity to each subsidiary's management team that is extensively appreciated by the subsidiaries [Workshops' transcriptions]. While this model has been successful at preventing issues such as disloyal competition between subsidiary companies, it is apparent that it has also been a barrier for stronger and more frequent collaboration initiatives [Satisfaction Survey].

BULs were especially instrumental in diagnosing the status of collaboration, as they have monthly visits to the companies they oversee, work directly with the MDs, have significant knowledge about the companies' core businesses, and are the direct point of contact between the MDs and the TM. They were asked about product-collaboration and about innovation/knowledge-collaboration. Their answers showcased a broad understanding of collaboration in terms of business opportunities and profit-based relationships. Product-collaboration between subsidiaries showed to be prevalent, mainly in the form of trading companies selling to several trading or manufacturing companies within Indutrade Benelux and also within the Top Holding as a whole.

From the BULs' perspectives, the current initiatives of the Holding that fostered collaboration among subsidiaries covered topics around management (yearly MD meetings), business strategy, technology, finance, leadership, and other specific skills development (e.g., sales trainings). The topic 'sustainability' was not an explicit part of any present collaboration scheme, and it was not being actively included in training capsules or business discussions.

Table 3 shows direct quotes about the perception and value of current collaboration initiatives. The assessment showed evidence of an overall support and a significant satisfaction level among the BULs regarding the value of existing collaboration initiatives (i.e., BUL 4, 5, and 7 in Table 3). Given the decentralized model (mentioned by BUL 1), it was understandable to find that the current one-on-one cross-subsidiary collaboration was achieved on a voluntary, and subsidiary-initiated basis (e.g., BUL 7). However, some BULs found current collaboration opportunities fostered by the Holding insufficient, or with an unexplored potential in terms of increasing business profit (e.g., BUL 2, and BUL 3).

Table 3. Diagnosing the status of collaboration within the decentralized DBG.

Participants	Statements about the perception and value of collaboration initiatives in the DBG
BUL 1	"Entrepreneurship and decentralization are the two key words of the BG, we have a very strong culture in which people want to make their own decisions"
BUL 2	"I would push a bit more on synergies, which is a bit outside of the current decentralized business model"
BUL 3	"I believe it would be great if companies had more business with each other, to keep the money inside of the group when possible"
BUL 4	"Everyone is always busy, but I sense that every time there is an event everyone goes home with some new knowledge and new insights"
BUL 5	"I would say all networking meetings being organized by Indutrade are always useful"
BUL 6	"On a voluntary basis, people are always learning and creating their own networks, in which they get collaboration on many issues"

A final takeaway from the diagnostic data was the identification of the influential role and knowledge of the TM and the BULs inside the organization, serving as communication channels that promote connections and business relationships between subsidiaries. Another takeaway was, distinctly, the absence of 'sustainability' in the present collaboration initiatives.

At this point, it was clear that pursuing the creation of a scheme for collaboration around sustainability was potentially beneficial for the DBG, as it was non-existent. The fact that there were already some initiatives in place (e.g. regular cross-subsidiary meetings, trainings, etc.) indicated that the creation of a separate collaboration scheme of sustainability seemed viable. Alternatively, it showed the possibility of leveraging these activities and using them as sustainability knowledge transfer channels. Hence, three potential avenues appeared: to incorporate sustainability to present collaboration initiatives, to establish one activity of its own (CSCN), or to do both. Thus, the TM chose to give more prominence to sustainability and the CSCN creation was pursued.

Thereafter, Subsection 4.2 aimed to turn the collaboration aim towards SI, and explored which outcomes would be perceived as beneficial for the stakeholders when doing this.

4.2 The desired outcomes: stakeholder expectations from a network for sustainable innovation

The need of fostering collaborative sustainable innovation was established via interviews with the TM, and this decision was reinforced after observing the gap inside the broad collaboration spectrum present at Indutrade Benelux. In order to do this, understanding the sustainability-related demands the DBG faced was necessary. This included understanding the increasing sustainability demands from the Top Holding company towards the subsidiaries, and the needs and interest of subsidiaries to move forward with the help of their peers. Simultaneously, the reasoning behind these subsidiaries' needs and interests was relevant (e.g., own subsidiary motivation, additional pressure from stakeholders such as customers, and suppliers).

Concerning this, the TM expressed in several interviews their wishes for the intervention to be of value to the individual companies themselves. For instance, the CFO indicated that: [through fostering collaboration…] *"we should create added value to the companies. To have profitable sustainable organic growth is important"* [CFO, Indutrade Benelux]. This is one of the Top Holding's framework principles, which benefits the individual companies, but also the conglomerate. Likewise, the sustainability requirements from the Top Holding were brought to the researcher's attention: *"There are top-down objectives from Indutrade that need to be reached. How can we give them* [the subsidiaries] *support?"* [CEO, Indutrade Benelux]. Aspects such as the sustainable business case, or how to develop your own product proposition were also brought to the fore as TM's expectations from these collaborations.

The discoveries up to this point led to informal conversations with the Top Holding. It was found that for stock listed companies (like this Top Holding), sustainability regulations are being ever more stringent, demanding for more "top-down objectives" in order to comply as a BG. Thus, it was found that the case of the Top Holding is complex because the independent SMEs that constitute the BG need to comply with requirements applicable to the Top Holding, as if it operated as one big company. More resources (time, knowledge, employees, etc.) are demanded from the SMEs' own operations, and these struggle to comply without proper support. For this, the Top Holding also had created thorough documentation for guidance, and offered sustainability network that broadcasts online sessions periodically on different sustainability topics, open to all subsidiaries. However, from Indutrade Benelux's side, these initiatives remained largely unknown or disregarded; it was clear that 'sustainability' had not been prioritized and that communication from the Top Holding to this BA (and the subsidiaries) was not being effective.

The researcher then approached a sister BA (similar to Indutrade Benelux), which had previously created a sustainability cluster, and the cluster's events organization was centralized by the BA. This BA however, had a 'Business Catalyst' role, whose responsibility was to a great extent dedicated to sustainability. An interview with this person revealed that the faster-paced progress on sustainability initiatives within that BA were thanks to this role and to a graduate program. Within this program, students from several disciplines regularly assigned to specific companies to accelerate progress on certain company owned projects. These students also worked actively on sustainability. After the interview, this BA agreed to send one of their graduates to support the first workshop of the Network, which showed how collaboration around sustainability can also happen horizontally, between BAs. In contrast, Indutrade Benelux did not yet have a person dedicated to sustainability tasks, and this was one of Indutrade Benelux's short-term goals.

Additionally, and taking all previous learnings into consideration, the MDs from the sample companies were interviewed to introduce the CSCN to them and to sense their interest in such initiative. Table 4 comprises some illustrative direct quotes from these interviews, demonstrating an overall positive reaction to the proposed collaboration opportunity. Also, some MDs manifested their concern in complying with the demands of the top holding. The SMEs have limited capacity in terms of the number of personnel, time availability, and sustainability knowledge. Alongside this, the question for investment allowance (e.g, MD 4 in Table 4) arose, as these decisions are bound to the holding company. Contrastingly,

one of the subsidiaries indicated they did not need an introductory meeting of the CSCN and that they would decide who would join based on the topics in the agenda; this company was, therefore, not interviewed. This behavior could be interpreted as the non-prioritization of sustainability by the subsidiary, and/or a trust-based subsidiary-holding relationship and the holding company's support. Namely, it could be interpreted as if the MD would join 'anyhow', but that he is delegating the responsibility of choosing a sustainability topic to the Holding. More critically, it could mean insufficient communication from the researcher on the purpose of a preliminary interview, or a lack of interest.

Table 4. Managing directors' statements about the creation of a cross-subsidiary collaborative network for innovation and sustainability

Participants	Statements about the creation of a the Network
MD 1	"I think that working on sustainability together is much better and stronger than working on it independently in each company"
MD 2	"It would be interesting to see where can we improve, to find improvement opportunities"
MD 3	*[when doing this]* "We should keep the focus on where the SME has control, instead of on the whole sustainability picture"
MD 4	*[it would be good to discuss with the Holding]* "is sustainability allowed to cost money? Will it have impact on the margin we get on the product?"

After having learned that the sample subsidiaries would be willing to participate in the CSCN kick-off events, having compiled their expectations, and the experiences of the sister BA in terms of sustainability knowledge-sharing, the findings were discussed with the TM. Emphasis was given to defining the best way to provide support to the companies, which was another short-term goal of the holding company.

The original researcher's plan was to have a bottom-up needs identification based on the informal interviews conducted with each company, to later address them in the workshops. In consultation with the TM, these bottom-up needs were identified and then they were transformed into overarching topics. The TM realized that several basic sustainability topics had not been addressed before and saw this as an opportunity to expand knowledge rather than only focus on innovation. So, the meetings allowed the researcher to concretize big areas to work on that were applicable to all companies.

That said, the TM was instrumental to find consensus and generality. An example of the change from specific to general is shown in Table 5, which provides a comparison between the potential collaboration areas (derived from the identified needs) from all stakeholders perspectives before and after TM 'filtering'.

Table 5. Example of top management's strategic role in translating specific subsidiary needs to general business group needs.

Subsidiaries (S) and top management (TM) individual interests	Top management's interests post-assessment of subsidiaries' interviews
Improving packaging materials (S)	What is carbon foot printing or carbon accounting
Business intelligence system (S)	How to collect sustainability data
The impact of worldwide shipping (S)	Assessing and addressing my product's impact
Paperless work (S)	
Digitalization (S)	
High energy consumption in manufacturing operations (S)	
Reducing solid waste in assembly processes (S)	
Sustainability data collection (S, TM)	
Assessing the footprint of my products per life cycle phase (TM)	
Monetizing the footprint of my products (TM)	
Sustainability data useful for my company (for B2B and customer relations) (TM)	
Understanding the sustainability needs of my customer (TM)	

In short, different stakeholders expect an array of benefits from the creation of a CSCN for sustainability. The TM aims to fill the sustainability knowledge and action gap present in the DBG, while continuing to promote profitable organic growth. The TM also wishes to find out the kind of sustainability support needed by the subsidiaries, and to comply with top-down objectives. This last wish is shared by the MDs, who are also focused on the SMEs limited resources and operational capacity. For this, they expect that both the sustainability and the collaboration requirements do not disrupt their daily business (in terms of time needed to participate).

In general, sustainability was not prioritized in the DBG. Consequently, the expectation from the researcher, and the TM, was to attract interest toward the topic and bring it to the fore. Fortunately, no evidence of resistance towards collaboration was found. This led to believe that the desired outcomes and expectations would indeed benefit from CSC.

4.3 The collaborative sustainable innovation: experiencing cross-subsidiary networking

This section describes the findings of the collaboration meetings between the subsidiaries, seeking to report the CSC experience from both the researcher's and the stakeholders' perspective. For this, awareness about the duality of this study is needed. Namely, it is necessary to acknowledge that the 'how' in the research question that this project aims to answer (*'how can the creation of a CSCN foster sustainable innovation in DBGs')* can be studied from two potential lenses. One lens is an applied 'how', referring to the practical steps required to establish a collaboration structure in a DBG. A few findings in this 'applied' line are recollected at the beginning of this section (in 4.3.1). Subsection 4.3.1 also aims to provide the reader with the context in which the companies met, the emergent group dynamics, and the resulting collaborative innovations. Nonetheless, this is mainly addressed in the Section 3 and expanded in more detail in the Appendices IV and V.

The second 'how' is more conceptual, concerning the four effectiveness factors (2.2) for collaboration to actually take place in the structure that is being created. Therefore, the remainder of this section is structured around this theoretical lens, touching explicitly on the four factors in (4.3.2; 4.3.3; 4.3.4; and 4.3.5). This being said, the chronological flow of the network creation activities (first lens) has been shuffled and the results have been filtered by the theoretical factors to capture more concise findings for each one of them.

4.3.1 The applied lens: participants, collaboration dynamics, and innovations

The expertise of the attendees at both workshops was distributed in mainly 5 areas: Managing Directors, Financial Officers, Quality Engineers, Research and Development Engineers, Operations Managers, as shown in Figure 5 below; holding company employees were considered as finance (the CFO) and MD (the CEO) (see Figure 5). From the total of 23 participants, 8 were responsible for sustainability affairs within their companies. These participants were 1 MD, 3 Operations Managers, 2 Quality Engineers, and 2 Finance employees. Only 2 companies had not yet appointed a person for the task, and the company that had the MD in charge, had an external consultant working on the topic before appointing someone else internally.

Some attendees of Workshop 1 were replaced or accompanied by new employees in Workshop 2. Workshop 2 had two more attendees than Workshop 1 (speakers excluded). The MDs of the subsidiaries decided who from their company would be best to bring to these activities, which was part of the methodological attempt of answering the different subsidiary demands and perspectives, and respecting their management's decision-making.

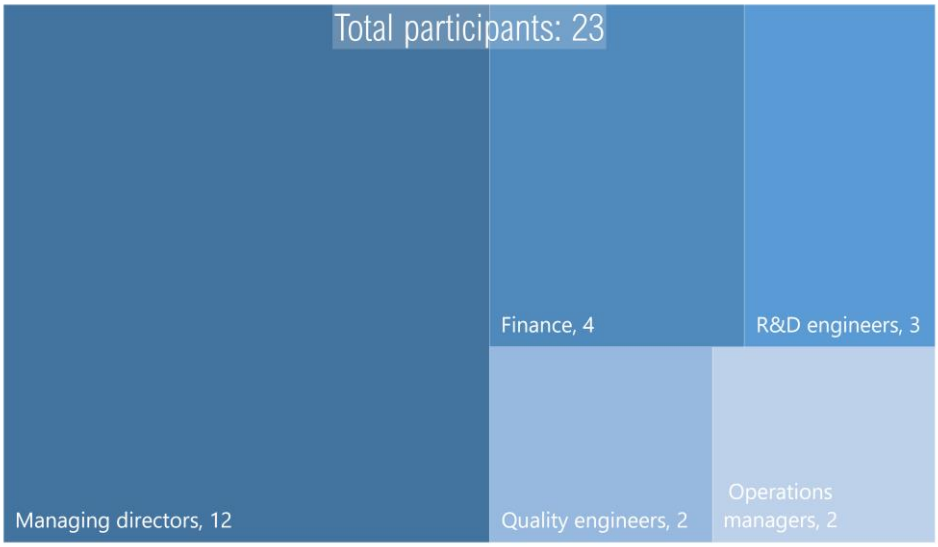


Figure 5. Overview of the roles of workshops' participants.

The seminars, organized around different topics defined in 4.1 and 4.2 and closely related to the areas for collaboration on sustainability mentioned in 2.3, triggered the expected engagement and response from the subsidiaries [Workshop 1]. The fact that this was successful meant that the Holding's translation of subsidiary needs into broad topics (Table 5) was accurate and an appropriate way of setting the stage for the innovation sessions afterwards.

Furthermore, the companies were given the possibility to join inter-subsidiary groups to innovate. The data collected during the innovation sessions revealed that subsidiaries in the groups were motivated, showed initiative, and tried to participate of the workshop activities using different approaches to get to the desired outcome (innovations). In other words, the groups exhibited different personalities and the variety of ways in which collaboration can take place for the same assignment. For instance, two groups elected leaders that helped the conversation move forward. In a third case, leadership throughout the session was taken over by different participants; and in the fourth case, the group decided not to elect a leader and moved forward [Workshop 1].

Despite the diversity in dynamics in the teams, all groups generated innovative ideas and were satisfied with their own result. This demonstrated that, although an initial suggestion for the group collaborative exercises was provided (e.g., to elect a leader / moderator), a certain degree of flexibility in how the innovation sessions unfolded allowed for the observation of the subsidiaries own structuring and diversity (which already touches on subsidiary-centrism further elaborated on in 4.3.4). One participant in fact pointed out that ***"the innovation session was slightly overstructured"*** [MD, Alpha, Satisfaction survey Workshop 1]; and another one said: ***"no structure is also a structure, right?"*** [Gamma leader, Workshop 2]. Thus, this flexibility is necessary and appreciated in a CSCN.

More of this behavioral and approach diversity is described in Table 6 for each of the innovation groups.

Table 6. Collaborative sustainable innovation team dynamics in Workshop 1

Working groups	Alpha	Beta	Gamma	Epsilon
Group dynamics	The raw materials from 1 of the companies were entirely different in nature to the rest, making it difficult to find common ground. They also discussed common challenges such as: ***"how are you able to influence [powerful] parties? That are very far in the supply chain?"*** *[MD, Alpha leader].* A participant seemed disconnected from the activity, negatively influencing the group engagement level and the discussion dynamics. The position from this participant is one of renunciation, e.g.: ***"I cannot change how the market behaves"*** *[MD, Alpha].* This participant did not rate the innovations. The atmosphere was participative and comfortable, with slightly challenging attitudes.	Concerning the alignment: ***"we merged three questions into [..a general] one which is 'how to measure and reduce the footprint of transport'"*** *[R&D, Beta leader]* Respectful and informative discussions were generated between the holding company representative in the group and the other participants, as budget approval was necessary for one of the most valuable innovations (to purchase bigger batches from suppliers). Such measure requires more storage, more investment, and slower turnover; which was not directly appealing to the Holding. The atmosphere was light, easy, participative, and fast-paced.	The members of Gamma formulated a new question that fitted everyone's interests and worked on that one. They overcame the evident divergence between trading companies and manufacturing companies in the group: ***"we finally found out that we are actually all in the dark when it comes down to where the most energy is used"*** *[R&D, Gamma leader].* Significant congruence in terms of sustainability issues was found specially between Company H and Company F. The atmosphere was participative, inclusive, and enjoyable.	This group decided to select questions per company and help that company 'improve'. They worked on two questions. There was a language barrier, as non-Dutch members were excluded from the conversation at times. There was a significant level of divergence in firm activities and knowledge. The participants refused to rate the innovations as they considered it only applicable to the corresponding company and not to the themselves, but they rated them anyway. The outcome of the rating was perceived as: ***"from the context of the companies you also see some different answers. [Member] with his 35 years lifetime of products thinks red for certain ideas, but for [member] it is very interesting. So nice to see those differences"*** *[MD, Epsilon leader].* The atmosphere was comfortable and supportive, most members (not all) contributed actively to the conversation.

As is evident in Table 6, the data collected already sheds light on the presence of the theoretical factors (2.2) at play in the sessions. E.g., one Alpha member had very low knowledge proximity and low interest congruency when it came to the use of raw materials, as his company's were different from the rest; which isolated him from some of the conversations (also on purpose, as it seemed he felt he 'did not belong' to that group and showed renunciation) [Workshop 1]. Likewise, Beta and Gamma exhibited members being able to overcome firm-activities diversity and interest divergence, by merging questions or creating new ones, applicable to all. Hence, having observed evidence of these factors at this early stage of collaboration already confirmed the need for exploring more deeply the role they play in a CSCN, as will be done later in following subsections.

In Workshop 1, to assist participants in submerging in the innovation processes, the impact estimation tool (mentioned in Section 3) was sent to all with detailed instructions. 71% of the subsidiaries indicated that the tool had been useful to come up with more accurate questions for the innovation sessions [Satisfaction Survey]. It was documented by the researchers that unprepared companies were slower and needed more explanations to be able to participate fruitfully; a behavior that was confirmed by researcher observation in Workshop 2. Thus, prior knowledge about the topics to be discussed proved to be a driver of effective SI in network meetings.

Table 7 contains the list of the main innovations resulting from the groups, which were organized per value chain stage as part of the structuring of topics for discussion. In terms of SI, concepts described in the theory (2.3) such as design for disassembly, remanufacturing, recycling, and cost reduction through resource efficiency emerged in the discussions during Workshop 1, as was expected for manufacturing companies (Table 7). Other more general innovations such as 'placing smart meters for electricity monitoring' emerged in the teams that managed to align more.

Also, the collaborative generation of SIs triggered discussions that helped further get to know each other's activities and drive for sustainability. An example is around organizational change, in which all participants in Gamma agreed that they did not like be a police agent (as they had had to be) within their companies [Workshop 2]. They agreed that the implementation of some innovations came with a necessary role of chasing personnel (specially the least academically educated), but that the change should come from personal motivation. Visibly, this type of conversation also displayed congruency and common issues, as will be better explored in 4.3.3.

Table 7. Subsidiary-generated sustainable innovations per working group from Workshop 1.

Working groups	Alpha	Beta	Gamma	Epsilon
Value chain focus	Raw materials and raw materials outsourced processing	Transportation supplier to company	In-house operations	Use-phase and end-of-life
Key innovations	Team up with industry branches Use certifications to identify the origin of the materials Consolidate conglomerate's manufacturer zones	Buy bigger batches Buy locally Establish delivery slots and combine orders Redesign your products modular, less components Reduce empty packaging volume (move less air) Prevent emergency shipments (usually by air freight) Make transport part of supplier selection criteria	Place smart meters to monitor electricity or gas use Switch to more energy efficient machines Place insulation material to hold the temperature constant in the warehouses with less energy (e.g., green roofs).	Reduce the mass of necessary raw materials needed in the products Use the sustainable alternatives of raw materials (biodegradable, recyclable) Look into the past: reconsider techniques in the industry before single-use materials Extend the lifetime of the products Design for maintenance and serviceability: modify the design of the product to replace only parts Design for less power (e.g., require less batteries in devices)

4.3.2 Nature of knowledge

As mentioned earlier, this factor was visible throughout the action research (Table 6's short factor reflection in 4.3.1). Its influence was proven to be both a challenge for collaboration when there is too much cognitive and operational distance (such as the Alpha participant who showed renunciation towards sustainable practices in his subsidiary and shielded in the distant firm knowledge, he isolated himself and did not rate the innovations), and an enabler for collaboration. An example of the latter was found in internal group dynamics that allowed them to complement each other when discussing innovations and priority. Members were able to overcome firm-activities diversity and interest divergence, which is a remarkable collaborative effort and success.

Alongside the aforementioned (Table 6), some quantitative data was documented. Namely, the number of innovations derived from each group, the value it represented to each of the subsidiaries *(green: very valuable; yellow: valuable; red: not valuable / not applicable to my company),* and the groups' composition. Figure 6 illustrates such quantitative results. The dark-filled bars in Figure 6 represent the total number of innovations of each group, the striped bars represent the percentage of the innovations that were valuable to the majority of the group (rated 'green' by all members, or with at least two 'green' and one 'yellow' rating).

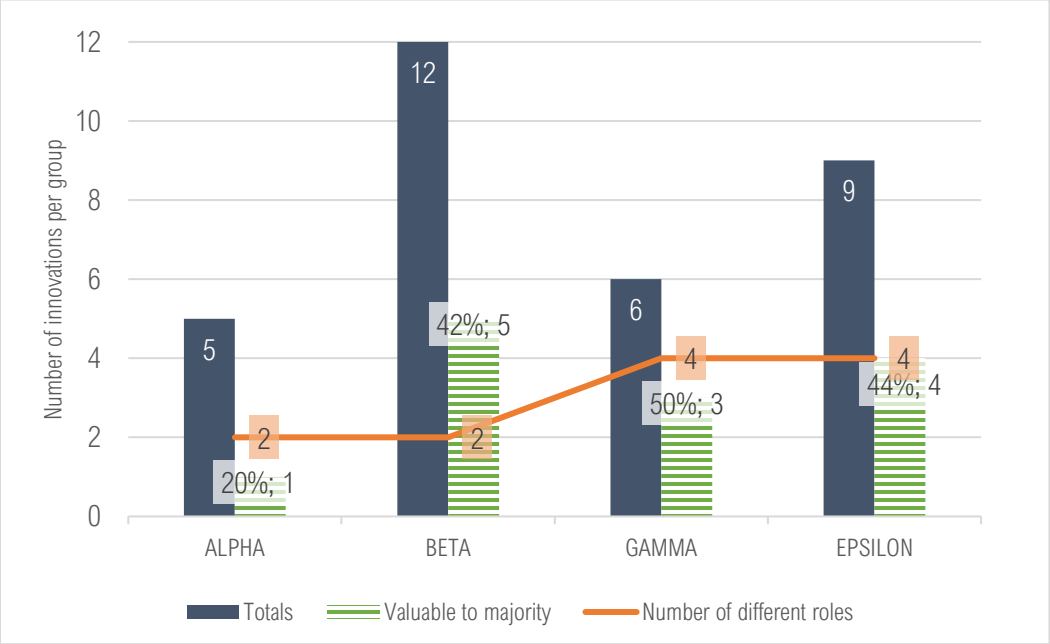


Figure 6. Innovation session group metrics.

The qualitative data collected (as summarized in Table 6) suggests that Alpha was the team with more behavioral barriers for collaboration stemming from its members, which could explain the lower total number of innovations. Interestingly, in this group all members knew each other beforehand as they were all MDs, meaning there were relatively less social barriers in comparison to other groups where members did not know each other beforehand and had to first introduce themselves. In this case, researcher observations suggested that Alpha's social proximity, and the challenging attitudes present, hampered their openness and motivation and therefore, their innovation capabilities.

As introduced earlier in this section, researcher notes and observations in the workshops suggested that the group dynamics and the leadership of teams like Gamma and Epsilon facilitated discussions between the parties, to overcome the clear differences present (mainly between trading and manufacturing companies). Team-work helped them find common sustainability issues and applied innovative solutions for these (Table 6). This is supported by Figure 6 as these

groups, which were also coincidentally more knowledge-diverse, had the highest percentage of innovations valuable to the majority.

Contrastingly, the discussion in Beta was not as deep. The participants took a very practical and productive approach, slightly (not entirely) disregarding the search for common ground. This team, with the highest number of innovations (Figure 6), had a lower variety in roles than Gamma and Epsilon and was composed of two persons in R&D roles, and two MDs. Their result makes sense as well because one participant mentioned they wanted to be 'fast' with coming up with ideas, so there was a sense of competition that a team like Alpha, did not have.

The exercise during Workshop 2 of reassessing the innovations they (and other teams) had produced in Workshop 1 trigged new reasonings and presence of complementary knowledge in several areas. An example of this was around supplier management for sustainability, which served as a driver for advice-giving about finding sustainable suppliers and discussing the value of contacting them. E.g., group Alpha was discussing the challenge of gathering supplier sustainability data (some suppliers did not respond, and they, as SMEs were 'too small to put pressure', etc.). Then Company A explained to some of his peers the supplier research he had done about his main supplier, and the way he was now using the data to his own benefit [Workshop 2]. Topics such as warehouse insulation methods in place [Epsilon, Workshop 2], or energy use [Gamma, Workshop 2] were also discussed.

Teams also showed to be ambitious in terms of improved logistics, alignment with company goals, and investment requirements vs. profitability thanks to the presence of quality engineering, finance, and MDs. The more knowledge-diverse groups were particularly critical when assessing the feasibility of innovations, e. g., validating time-feasibility for redesigning a product with help of the R&D employees presence [SMART 4]. It is worth reminding that for these sessions employee roles and companies were mixed on purpose, allowing for these observations.

Also, complementary knowledge was identified in the form of cross-fertilization of sustainability knowledge between members, or in voicing different perspectives to understand or to apply the same innovation. A transcript extract to illustrate this is posed below.

Example of knowledge sharing in a conversation extract from Team Alpha during Workshop 2:

MD Company G: "…Company C suggested *'use less raw materials'* [then he jokes about the high difficulty of this]"

Quality manager Company D: "No, no, no, that is not the point I think. Look, we have metal boxes for sensors.. and the plates are like this thick. We could use less material to make it a little bit less. [For us] it's engineering!"

MD Company A: "We have enclosure cabinets which were [brand], always this deep. I never knew why, so I asked the guys, why? They said that's what I bought. So I found a new company and they make them this [shows] deep. And this is less material!!"

MD Company G: "Same for us, when they the employees assemble [products], they pack them in plastic bags. We've got several bag sizes. But often somebody just picks a bag and then cuts off more or less here [shows]. So the rest is plastic which we have to throw away […]. Because everything is custom made, we never know how big it [the product] is when we start, so that's one of the actions we will start [working on], to determine what the bag should be like [in advance]"

In short, the conversations showed significant knowledge exchange between participants, where each gives examples of how a certain innovation would be (or not) applicable to their business. This consistent dynamic allowed for two companies to find out they shared a specific supplier, purchasing different products. It is certain that they learned about other businesses operations in terms of sustainability and supported one another.

Regarding subsidiary-Holding knowledge transfer, the extent of operational sustainability issues from a subsidiary were communicated to a representative of the Holding who was not previously aware: Holding: ***"I think also the impact [of preventing emergency shipments] is not that high. I think 90% or 99% is not emergency […].*** To what Company D replied:

"Actually, I think that we have a lot of movements of couriers, on a weekly basis". This information altered the priority level that the Holding gave to addressing emergency shipments as an environmental impact (higher than expected), showcasing the potential impact of Holding-subsidiary knowledge transfer. Also, team motivation was captured, e.g., Company E and Company D were trying to convince Company A of believing that buying locally was possible, also for them; and that inquiries about quality and price of supplied goods were a matter of research. This illustrates the type of positive cross-subsidiary interactions that showed potential for fostering individual subsidiaries' sustainability action.

Thus, subsidiary openness and curiosity toward others empirically proved to be an enabler of knowledge exchange between participants. This particular finding is intrinsically linked to the success of some groups in finding better company alignment despite of the differences. Which will be discussed in the next section (4.3.3).

Henceforth, the nature of knowledge proved to be a challenge and an enabler of collaboration, and its influence on CSC seemed to be moderated by the level of subsidiary motivation and curiosity in the groups. In terms of innovation capabilities, the sense of competition increased team productivity (number of innovations) but allowed for relatively less discussions with potential to trigger collaboration. However, in Beta being the example for this productivity, participants seemed to have a high cognitive proximity and expertise, which facilitated the innovative process as it did not require deep elaboration when proposing innovations. Conversely, an inductive finding was that social proximity seemed to hamper innovation capabilities. The CSCN also provided evidence of knowledge transfer between the subsidiaries and the Holding, which proved that the inclusion of TM members in the Network activities is a good strategy to focus business' sustainability strategy in the right direction.

4.3.3 Goal and interests' congruency

In CSC, it is no doubt that the search for common ground is continuous among participants, making this factor intriguingly relevant and deeply intertwined with other factors. It was clear that this relevance was also captured by the majority of the participants, as all groups attempted (to a certain extent) to align with others, or to find cohesions.

To elaborate on this, an example is the congruence found when assessing the possibility of installing energy use monitoring systems in Gamma (Workshop 1 and 2). Although these companies had different operations, after deep conversations they found out that they did not know where their largest energy use came from (see also Gamma's quotes in Table 6). They also agreed that to be able to act on sustainability, they needed to have this data. Thus, and acknowledging that the team dynamics in Gamma where very participative and enjoyable (Table 6), this showed that even if firm or employee knowledge is very diverse among participants (as discussed in 4.3.2), it is possible to find similarities if you dig deep enough. The data also inferred that motivation of the subsidiaries to collaborate plays a significant role in how deep the teams choose to dig, as the theory (Section 2) has been suggested. As this motivation could have been lower in Alpha in Workshop 1, mainly by the influence of one or a few participant, or in Gamma itself during Workshop 2, for instance.

Similarly, companies could also agree or disagree on the level of support they would require from the holding company to achieve them (as will be explored further in Section 4.3.5), especially when it came to setting up the CSCN objectives. And example of how companies could agree on the level of difficulty a few innovations entailed is that they found an innovation to be ***"a lot of work, but once you set something up, then it's easy"*** [Company E, Epsilon].

It was observed that groups also submerged into topics that represented common challenges during the inter-subsidiary sessions. One of these challenges was the dilemma of the high cost of adopting SI versus the business-as-usual; they together decided that they would prioritize the innovations based on sustainability impact, but that a financial assessment should be done to the selected SIs if a strategy were to be drawn. This finding also confirms that subsidiaries were considering an integral definition of sustainable innovation, that should be both profitable and socially and environmentally optimized. They also realized from their interactions and feedback that, although low-hanging-fruit was being identified on a graph, these items' perception and feasibility could change over time.

However, the presence of too much divergence led to team resolutions such as: ***"Ok, we have to place [the innovation] somewhere in the middle, somewhere in conclusion"*** [MD Company G, Alpha, Workshop 2]**.** This was consistent throughout the groups, as Beta also struggled to align interests when prioritizing innovations: e.g., - *(1) says* ***"it's difficult"*** *[R&D, Company D, Workshop 2];* (2) says - ***"No, it's not! Ok, we need to have a common agreement. So should we place it in the middle?***" [MD Company E, Workshop 2]. Then (3) replies: - ***"For us it is along this line***" [R&D, Company A, Workshop 2]**.** Therefore, these resolutions were less conclusive than they would have been had the companies been more similar (core business).

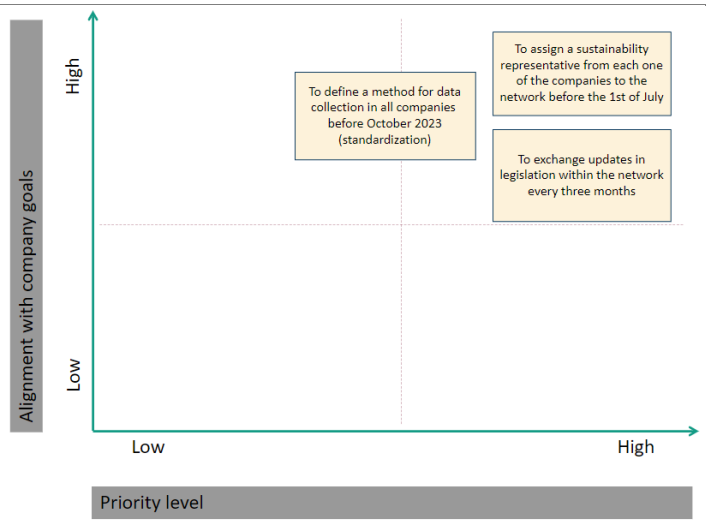
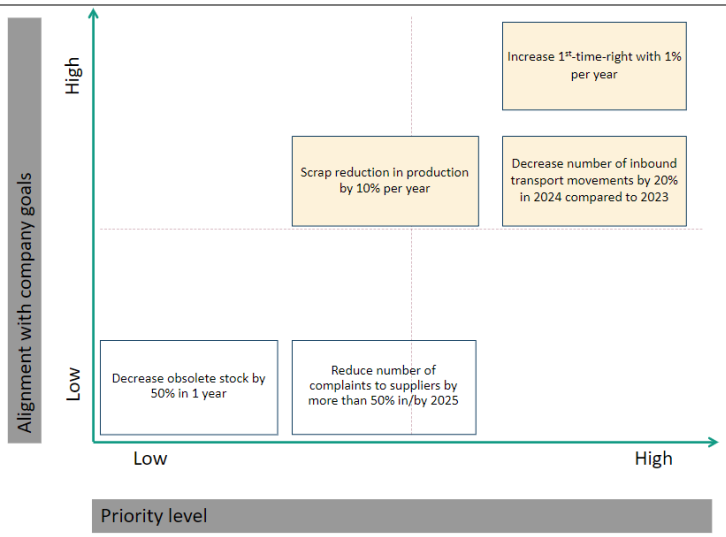
Furthermore, at this point it is worth reminding the reader that the activity that helped concretize the network's goals was the final session in Workshop 2 where network SMART objectives were subjected to a vote (as per Appendix VI). Here, and to add more in relation to interest and goal divergence, it was also noted that some companies had an approach to goal-setting that was very company-specific (or subsidiary-centric), which undoubtedly made it harder to reach congruency at repeated occasions (the subsidiary-centric concept will be further elaborated on in 4.3.4).

Nevertheless, in general, a few team members pushed for this congruency to be reached; probably stemming from the researcher's instruction to create common goals and from their own understanding of the aim of a CSCN. Yet, when discussing partner search among the groups to implement the innovations [Workshop 2] the outcome can be summarized in the quote: ***"for this we don't need help right? Everybody can do this by themselves I think"*** *[MD, Beta]*; or ***"[it is] just doing it"*** *[MD, Epsilon]***.** This finding suggests that even though SIs were found collaboratively, the subsidiaries believe

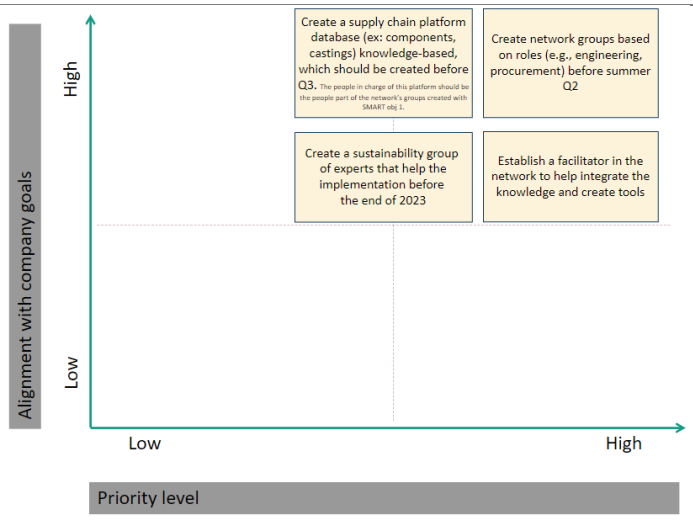
that the actual implementation of the innovations has less potential to be collaborative in this decentralized DBG, which is an encountered challenge for further exploration (as will be done in when discussing the Factors interplay in 5.2).

Table 8 summarizes the work of the SMART teams and the final outcome of the CSCN's objectives (last row), for which they actually believe collaboration can be beneficial.

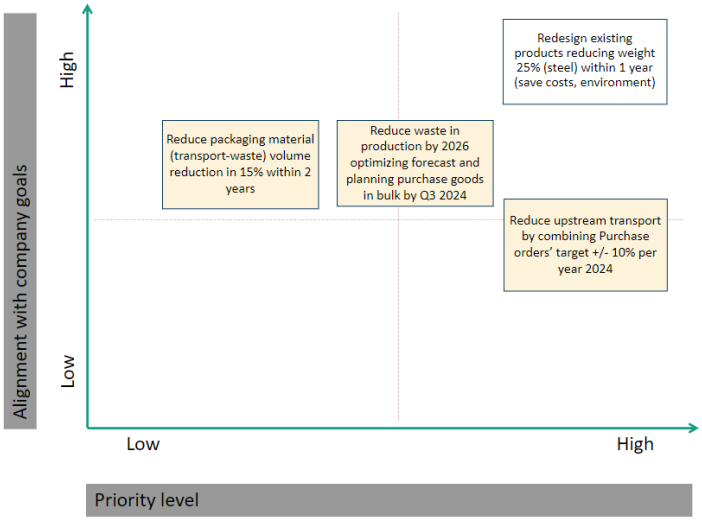
Table 8. Network SMART objectives generated consensually by the Network teams.

SMART team	Proposed SMART objectives subject to a total group's vote *(yellow background = accepted by total group; white = outvoted by total group)*
SMART 1	
SMART 2	

SMART 3



SMART 4



Total compilation of Network-accepted objectives **

1	Reduce packaging material (transport-waste) volume reduction in 15% within 2 years
2	Create a supply chain platform database (ex: components, castings) knowledge-based, which should be created before Q3.
3	To define a method for data collection in all companies before October 2023 (standardization)
4	Reduce waste in production by 2026 optimizing forecast and planning purchase goods in bulk by Q3 2024
5	To assign a sustainability representative from each one of the companies to the network before the 1st of July
6	Create network groups based on roles (e.g., engineering, procurement) before summer Q2
7	Increase 1st-time-right with 1% per year
8	Scrap reduction in production by 10% per year
9	Decrease number of inbound transport movements by 20% in 2024 compared to 2023
10	Reduce upstream transport by combining Purchase orders' target +/- 10% per year 2024
11	Establish a facilitator in the network to help integrate the knowledge and create tools
12	To exchange updates in legislation within the network every three months
13	Create a sustainability group of experts that help the implementation before the end of 2023

***BISN = Network*

Fortunately, this continuous search for common ground also enabled exchanges between companies about the external pressures they were perceiving. Items of interest that demonstrated to be prevalent were: pressure from upcoming legislation, new industry standards, competitors, suppliers, customer demands, better customer forecasting, optimizing stock management, and avoiding waste. A few additional congruency insights the conversations revealed are provided next.

Common sources of external pressure and drivers for collaboration

In respect to customers' perspectives, Company I mentioned: ***"I think that the customers are now more aware.. I think [being sustainable] is more important than a couple of years ago. I'm not saying that they are at the point that they're willing to pay more […]".*** To which Company F replied: ***"But if you look at the process industry they don't take the risk. They like to keep it how it is".*** Exposing a known challenge that SI adoption poses for businesses; if they increase prices because of sourcing sustainable raw materials that are more expensive, they will have a disadvantage against their competitors if the customer is not willing to pay the difference.

Moreover, the dilemma of extending product lifespan was generally perceived as to be bad for sales. One company signaled: ***"we already have complaints that they [the products] last too long" [Company D, R&D, Beta].*** Which exposes another complication for companies that apply SI, in which their financial sustainability can be tampered by the social and environmental sustainability.

Lastly, in connection with the Nature of knowledge factor (4.3.2), the data showed that there was also company-specific knowledge spillover, even when the focus was more on congruent collaboration within the Network as a whole. Internal group conversations show that some objectives were not relevant, or considered unrealistic by members of some groups. But expressing this was what helped expose further sustainability challenges from the participants and find challenges (or opportunities) congruency.

In general, goal or interests congruency was identified from the data even across industries and between trading-manufacturing when the team's atmosphere was motivated, open to learning about others, and supportive. This congruency was identified in areas such as the level of difficulty a SI entailed, the level of support needed from the Holding (explored in 4.3.5), common challenges, and common interests and goals. Divergence also caused some of the low-hanging-fruit identification outcomes not to be directly conclusive for implementation (some innovations were placed in the middle, as teams could not find common ground) which is a challenge. However, the SMART objectives voting proved to show implementational feasibility, both for the network and for the individual companies. Only then, the commitment of the majority was really identified.

To close, in Workshop 2 (Appendix VI) a mission for the Network was proposed by the researcher (agreed on previously in consultation with the Holding) and it was accepted by all subsidiaries, demonstrating a homogeneous understanding among the group regarding the long-term aim of the Network:

Network's mission: to be an enabling environment for the exchange of experiences, best practices, and difficulties the subsidiaries may have, to accelerate sustainable innovation.

4.3.4 Network's subsidiary-centric approach

As stated earlier, the companies were asked to create SMART objectives for the network (Table 8). In doing so, participants' attention switched towards the collective benefit and the network's sustenance. However, as introduced in 4.3.3, some participants took a very subsidiary-centric stance, trying to answer their isolated interests and demands. It was harder for these participants to understand that the goal of a CSCN is common benefit, even if that benefit is not immediately beneficial to all.

Examples of this is individualism are some members of Epsilon in Workshop 1, not wanting to rate the innovations because they created them with their company-individual benefit in mind (Table 6). Another example is someone in Gamma in Workshop 2, who expressed discontent with the collaborative approach to rating innovations, as they felt that the companies were too different to be able to identify low-hanging-fruit as a group: ***"if it is so different between the companies [..] if it is this high for you, but so low for you, then you should know it yourself, right? To be able to identify it later. But what is then the value if you put in in the middle?".*** Two other Gamma members replied to this that the *discussion* was the most important part of the exercise, really understanding the aim of creating a CSCN at this initial stage.

An interesting finding of the subsidiary-centric approach applied to the full network is that the majority of the company-specific objectives proposed were voted out by the collective, as the participants detected, and openly discussed, the strong specificity and non-generalizability these carried. In other words, even though a number of individuals may have pushed for more individualistic goals and benefits (consciously or not), the will of the collective gained representation when the objectives were subjected to a vote. However, an emerging critical perspective is the need for close assessment of the resulting collective goals and the conversations that unfold during the voting sessions. This, to ensure that the Network goals serve all subsidiaries well, and that individualistic needs are also being fulfilled.

On a different angle, and to link the subsidiary-centric approach to the importance of team diversity in a CSCN (4.3.1), it is possible to observe in Table 8 that the groups that created more company-activities-specific objectives were SMART 2 and SMART 4. Whereas SMART 1 AND SMART 3 created more 'general-oriented' objectives, fostering also the future organization and sustenance of the network structure. Hence, the total CSCN's objectives became a rich mix between practical company-applicable goals, and collective collaborative benefit's perspective. All, subsidiary-ideated and therefore, subsidiary-centric.

At the same time, a discussion within SMART 3 (Table 8 for reference) is a key example of a subsidiary-centric perspective born inside the network. SMART 3 agrees to propose the objective of 'creating additional network groups per role' (filtered by employee knowledge: procurement, sales, R&D, etc.). However, when crystalizing the idea, conflicting opinions between decentralization and control were initially observed; in terms of the potential creation of a 'project management organization' in the holding company (to support the implementation of the innovations that come out of the innovation groups per role).

A decentralization party argued that this project management would be telling the companies what to do, which may be counterproductive: ***"it can have a huge negative impact if you've got people coming into your company telling you what you need to do when it's your company. Indutrade is such a group of individual thinking organizations and you… don't want to piss many people off"*** *[MD Company A, SMART 3, Workshop 2].* The centralization counterpart asked for implementation support: ***"If somebody offers me help, I'd be happy, I'd say please come"*** *[Finance Company H, SMART 3, Workshop 2].*

Already in nature, this conversation embeds the holding company (4.3.5) as a key stakeholder. For now, it is relevant to point out more generally that some participants wanted help to achieve their goals, and others did not. These type of differences in subsidiary views were usually solved in participants' conversations (the cases where these were solved by the Holding will be addressed in 4.3.5).

4.3.5 Holding company support

Evidence of this collaboration effectiveness factor is present in all aspects of this study. An important angle underlined in the workshops is the relationship between the presence (or the offer) of support, and the acceptance and the ask for this support by the subsidiaries themselves. Therefore, findings here are presented around the evidence of holding's influence and support, the subsidiaries' level of acceptance or openness to it, and the subsidiaries' demand for it.

Evidence of support was observed as the Holding was actively involved with the researcher in the planning of the educational sessions of Workshop 1. The TM's suggestions for topics (4.2) proved to be essential as the activities were overall perceived to be valuable by the subsidiaries [assistant researchers' and researcher observations]. This positive perception was also confirmed by a Satisfaction Survey, where a 75% of the companies replied they were satisfied with the content of the educational sessions, a 25% indicated they learned 'many new things'. Similarly, the idea of preparing a tool for subsidiaries to familiarize with the workshop topics (mentioned in 4.3.1) was another successful suggestion from the TM [Satisfaction Survey, Workshop 1].

A second piece of evidence arose during the network goal-setting session, where the holding-company presence in the group helped establish actionable next steps, or reach certain agreements between the subsidiaries. E.g., as a team was discussing the organization of network meetings a participant expressed: ***"the only question is then who again? Who wants to take these [organizational] tasks?"*** [MD Company F, Workshop 2]. It was debated that not only MDs should be in charge, and that if this task was given to group leaders from within the organizations, their role should be to delegate and distribute work. The Holding intervened saying: ***"that's a good point we can address during the MD meeting in early June"*** *[CEO Indutrade Benelux, Workshop 2].*

Referring to subsidiary openness and acceptance of support, in 4.3.4 a conversation within SMART 3 where difference between subsidiary support demands and acceptance was introduced. In it, after the divergence around the level of support they accept from the Holding for establishing network groups per role, they found common ground with the help of a holding company's idea: getting support and guidance from a centralized specialist, that does not give implementation directions (as was one participant's concern). The group was then satisfied with the outcome and discussed the need of one specialist per network topic (a potential demand for more support from the Holding).

Another 'acceptance' finding is that the holding-company-proposed horizontal collaboration (subsidiary-subsidiary or business group-business group) was welcomed in the workshop events, and useful to the attendees. Namely, the extracts from the presentation of the sister BA that introduced company cases in other countries caught significant attention and generated questions. Similarly, after a presentation from Company E, practical inquiries in terms of return on investment and customer response to a new (more sustainable) product offer arose. This also triggered conversations during the break between the presenter, the CEO, and a company with a similar product development opportunity; clearly showcasing how that this holding's-initiated subsidiary-subsidiary collaboration around sustainability was appreciated.

Lastly, the TM also arranged for a presentation of a guest company (centralized, non-diversified conglomerate), which reassured the value of horizontal collaboration. It impressed and inspired the subsidiaries, who mainly questioned the number of people necessary to advance sustainability inside the company. They repeatedly voiced comparisons between their business and the guest speaker's, even long after the Workshops had taken place.

In terms of demand for support, it could be expected that in a decentralized business model companies would always like to operate in independently. However, throughout the study, the data showed that the subsidiaries requested help on sustainability topics (see also BUL opinions 4.1). In the Workshops, it was confirmed that the subsidiaries needed, and demanded this support in the form of guidance and tool facilitation, to be able to comply with sustainability requirements (related to the subsidiary-centric approach discussed in 4.3.4).

Additionally, it was clear from the discussions that some innovations, for instance 'buying bigger batches', had a high (negative) impact on the businesses cashflow. This allowed to capture an interesting 'demand' perspective: ***"it would be good for the holding company to realize that being sustainable is going to cost money […]. Not only for purchasing bigger batches but also for manufacturing; manufacturing bigger batches can be more cost efficient"*** [MD Company I, Epsilon, Workshop 2]. As a reminder, the holding company's most fundamental role in the DBG is its financial control. Hence, this quote (which was not the only reference to this from the subsidiaries) clearly illustrates the bottom-up demands of more financial flexibility, to be able to implement sustainable innovations (for which investment is required). On a higher level, investment is also required to be able to transition to more sustainable businesses.

In sum, the presence of Holding's support was largely evidenced in this study. An acceptance level for this support was observed from the subsidiaries as the support proved to be beneficial for them, and particularly useful when finding common ground or establishing actionable steps. And, although it was expected for subsidiaries in a decentralized business model to prefer working independently, a demand for support on sustainability was specifically witnessed; noticeably, around the need for investment allowance from the Holding for SI implementation.

4.4 The final reflection on the collaborative experience: collective lessons learned

As is embedded throughout the Results section, the action research cycle includes an 'evaluation' stage after each 'action implementation' that helps the researcher determine how to move forward (Figure 3). This subsection represents a final general reflection of the CSC experience, from all stakeholders' involved in the collaboration.

In terms of collaborative innovation methods and effectiveness, three subsidiaries were approached after both workshops in informal conversations to understand their opinion. Overall, they felt that their needs and interests were being considered in the planning and development of the workshops and that there was room for interaction and connections with other companies [informal conversations with Company E, Company I, and Company A]. These conversations unfolded the need for regular meetings, and for constantly finding beneficial outcomes for the subsidiaries to keep them engaged. E.g., ***"it quickly fades away if you don't meet too often"*** *[Company E]*; or ***"for the companies it is important to feel they are getting something out of it as well. Questions are how to make it more tangible, rewards, how to stay motivated?"*** *[Company A].*

Additionally, the feedback received in the satisfaction survey, and quotes from informal conversations illustrate the subsidiaries' opinion about the collaborative experience in Table 9. At the same time, this feedback sheds light on what a potential institutionalization of the network should look like to be effective (see also 4.4.1).

Table 9. Compilation of subsidiaries' feedback to improve collaborative sustainable innovation.

Operations manager, Company E	***"The activity was good to hear from bigger companies. I think that for some Indutrade companies this was the first interaction with everything"***
R&D, Company A	***"The connections I've made were nice for personal/hobby use, but not for company purposes. For personal use, they work with automation too, but my company does not do that. The products are very different, and the processes too. We'll see."***
R&D, Company F	[feedback] ***"try to group companies with similar core businesses. For example trading and production companies"***
MD, Company B	***"Cases are more useful than general information. It is always good to share experiences"*** [referring to the seminars in Workshop 1]
MD, Company G	[feedback] ***"Cluster the teams around the similarities"***

An interesting finding here is the similarity of perceptions in Table 9, where the engagement of the subsidiaries is evident, and a suggestion that is most prevalent is to cluster teams around similarities. This coincides with the find in 4.3.4, in the conversations of SMART 3; making this one of the most frequent suggestion from the subsidiaries.

Regarding the holding company's learnings during, and after the Network experiences, it was found that listening to the educational seminars helped educate the TM as well, and motivate them in terms of the need to move forward with sustainability and to support the subsidiaries more actively in the short term. The Holding realized that they were relatively late pushing sustainability top-down (acknowledging that this was linked to the decentralized business model, that delegates all responsibilities to the operating subsidiaries). The CEO made this clear to the group in his final intervention at Workshop 2: ***"[…] we really have to start doing things if we have not started yet"; "the*** *[sustainability]* ***awareness in the Benelux group is not so big yet"*** *[CEO, Indutrade Benelux].*

The CEO also expressed in his closing words at Workshop 2: ***"there are quite some good ideas created in this room. How to go forward. And in the company, I would say, my advice is […] make it part of your day-in, day-out life. Tell us what we can bring to you or what we can do to support, because we fully understand it's a necessity, it's something you need to do in addition*** (to daily business)***"*** *[CEO, Indutrade Benelux]*. This showed a clear commitment to support the subsidiaries going forward.

Also, before the collaborative experience, the TM thought that: ***"as long as we don't interfere with the strategy or the core business of a company, they're happy with the help"*** *[CEO, Indutrade Benelux]*. They learned that this belief was right from the collected data. Subsidiaries were demanding support in terms of sustainability but did not appreciate being given operational directions.

It was perceived that the topic of 'innovation' was found to be appealing to the Holding and to the subsidiaries when applied to sustainability, because that wording helped them connect a more familiar term (innovation in business) to the more unknown and newer term (sustainability). Thus, the wording used by the researcher in practice was "innovation for sustainability", instead of "sustainable innovation". For the companies, and rightly, innovation could be used for transitioning towards a more sustainable business model, but could also boost product development, business intelligence systems, process optimization, etc. This was entirely in line with the expectations of the TM of fostering sustainable profitable organic growth (as described in 4.2).

The collaborative 'actions' also created awareness and a sense of urgency in the attendees [researcher notes Workshop 1], as much as they created peer pressure. E.g., a BUL felt upset as Company B expressed they would not join Workshop 2, but then he acknowledged that ***"****[they should anyway come.. but]* ***if they don't catch up complying with sustainability requirements this year I would understand. Certain things in the company require urgent action"*** [informal conversation]. Similarly, companies motivated each other to think differently as was mentioned at the end of 4.3.2 with some peers insisting that a company could buy locally; or as was observed during open discussion sessions where participants would challenge each other to think sustainably.

At the same time, the problems that had already been found in 4.2 were confirmed in the collaborative experience. For instance, the expected level of disconnection between the Top Holding's sustainability strategy and the subsidiaries (4.1) was observed during the Top Holding's intervention [Workshop 1]. In it, the listeners' response showed that the employees present were not fully aware of the sustainability collaboration efforts carried out by the headquarters (such as the availability of online sustainability meetings and of documented guidance). The MDs were slightly more informed. Thus, evidence suggests that the inclusion of the Top Holding in the initial stages of the network helped transmit top-down key sustainability collaboration messages first hand. It is also believed that it helped provide context for the subsidiaries to continue working on the top-down sustainability requirements.

Lastly, as a final researcher's note, the collaboration helped stakeholders exchange knowledge and practices in all areas of sustainability, which also exposed the fact that some individuals in the DBG were very critical thinkers and were more informed than originally expected [researcher observations].

4.4.1 Institutionalization insights

Although the 'institutionalization' phase of a normal action research cycle is out of the scope of this study, a few findings demonstrated the effect of the network's initiatives in the participating subsidiaries and holding company's actions. To name a few, Company E appointed an additional person to support sustainability topics, next to the persons who regularly performed these tasks. Company A performed supplier sustainability research not done before the network, to find out that (fortunately) his largest supplier was 'cleaner' than expected. Company D started working on the creation of an intra-company team to fulfill sustainability requirements and make it part of the daily business. And, the Holding Company had several strategy meetings with the researcher after the network interventions to assess which were effective ways to give support to the subsidiaries going forward. Two network-born initiatives that are developing particularly fast at the Holding are the creation of network groups per role *(a proposal for this is provided in Figure VI-13, Appendix VI)*, and the centralization of sustainability support available to all subsidiaries.

5 Discussion

The aim of the present study was to understand and to optimize the creation process of a collaborative network to foster sustainable innovation in a DBG, both in theory and in practice. For this, the purpose of the investigation was to answer the research question *how can the creation of a cross-subsidiary collaborative network foster sustainable innovation in diversified business groups?;* which was found to have a dual interpretation: a conceptual 'how', and a practical 'how' (see also 4.3).

In order to analyze the obtained results, this section is divided in five subsections. First, a summary of the findings, where reader is reminded of the analytical framework and a reflection on the usability of the methodology is made. Second, theoretical implications are discussed. Third, the implications for intra-conglomerate networking are provided as management advice. Next, avenues for future research are presented and the identified limitations of this study are acknowledged.

5.1 Summary of findings

Fostering cross-subsidiary collaborative sustainable innovation in a conglomerate (the DBG) is significantly valuable as it allows the group to explore and to seize the innovation potential of its members. The theory suggests that cross-boundary teaming and diverse company values can represent challenges for achieving effective CSC. This was particularly visible in this case study, in which Indutrade Benelux's level of decentralization posed an interesting additional challenge.

To delineate the theoretical scope of the project, focus was placed on the influence of four theoretical factors applicable to the unit of analysis; these were: nature of partner knowledge, goal congruency within the network, the influence of holding company support, and the adoption of a subsidiary-centric approach to the collaborative network. This was done inside the empirical context of Indutrade Benelux.

A match in nature of partner knowledge proved to enhance innovation capabilities, while greater diversity in nature of knowledge proved to be fruitful when critically assessing the applicability of SIs or the feasibility of Network objectives. Goal congruency, on the other hand, showed to be desired, looked-for, and found by the subsidiaries. Often as a result of deeper conversations and alignment efforts when subsidiary activities and company goals were too divergent. In terms of partner search for SI implementation, companies did not seem to recognize the need for collaboration. In this same regard, value was gained for the Network and for the individual subsidiaries by the establishment of SMART objectives a workshops' outcome.

The adoption of a subsidiary-centric approach showed to be successful as the subsidiaries were engaged and participated actively in both workshops. It is believed that because of the participative nature of the research, no visible resistance was encountered. This factor was found to have two possible interpretations: being sensitive and responsive to subsidiary demands in the CSCN creation and development, and, the individualistic (subsidiary-centric) behaviors that emerged throughout the study. In relation to this, the Holding's support was evidenced throughout the research. In the studied decentralized business model, and acceptance of this support 'to a certain extent' was evidenced (as long as the support does not interfere with the subsidiaries core business). This was also found applicable for Holding-company initiated collaboration initiatives and for sustainability support. All factors' influence seemed to be moderated by the level of subsidiary motivation and curiosity (*as theoretically expected*).

The action research approach was selected as a research method (Figure 3), excluding the institutionalization phase due to time limitations. The use of action research demonstrated that this research method can be a more efficient research approach in such socially-complex context, in comparison to conventional research (drawing on Bradbury-Huang (2015)). In conventional research, the researcher usually drafts the methodology and applies it to the research subject. Here instead,

stakeholders participated actively in shaping the methodology, while incorporating their interests; which made the interventions even more insightful as they knew their context better than the researcher (external). Likewise, the achieved engagement of the Holding, and the accurate identification of subsidiary knowledge gaps was possible also thanks to the use of this research method.

At the same time, the internal stakeholders have executional power (internal change makers). The sustainability progress this research enabled in the company where it was developed is proof of how fruitful the application of the action research method can be to advance sustainability in contexts with significant social complexity, such as this decentralized DBG. In other words, the conducted study is a valuable example of how theory can be implemented in business practices, and be advanced simultaneously.

5.2 Theoretical implications for cross-subsidiary collaboration

More generally, in a DBG it is only natural that the holding company will have a major role. As noted earlier, the decentralization of Indutrade Benelux posed an additional challenge for CSC. Nevertheless, it was proven that the organizational proximity inside a business group provides the subsidiaries with the opportunity for closer collaboration with lower coordination complexity and transaction costs. This, as the holding company is a shared resource that also aligns companies around certain values and goals, finding previous literature statements in this regard also applicable to decentralized BGs.

Consistently with the decentralized model, the subsidiaries operate independently, and it was confirmed that their motivation towards finding partners is necessary for collaboration initiatives to take place. The role of the Holding regarding collaboration was found to be advice-giving, but not directive, forcing its influence to be more subtle. Yet, and due to the regulations the Holding (or top holding) abides by, it is possible for the holding company to demand compliance from the subsidiaries, create a sense of urgency herewith, and push for CSC forward. Which implies an additional lever for Holdings of decentralized DBGs to foster CSC.

Likewise, it is possible for the holding company as a central entity to emphasize the benefits collaboration can have to the subsidiaries, as this study demonstrated. In this aspect, the presence of BULs in the organizational structure also proved to be a very valuable asset, both as a communication channel between the subsidiaries and the Holding, and in terms of their outstanding potential (or existing) role in identifying collaboration opportunities within the group. Thus, more generally in DBGs organizational models, it was confirmed that middle managers play a key role in BGs' collaborative processes.

As Sandford et al. (2022) anticipated, this study confirmed that the holding company is the most suitable entity to govern a CSCN. From a strategic perspective, the holding company proved to have an overview of the subsidiaries needs and capabilities and to help the subsidiaries establish actionable steps (proven in 4.3.5). From a bottom-up perspective, the holding company taking organizational control tasks over the CSCN (mentioned in 4.3.5) is what the subsidiaries manifested to be most desirable. Yet, this remark has some limitations for decentralized business models, as suggestions for collaboration and sustainable innovation are welcome, but the final collaboration decisions and SI implementation should remain a responsibility of the MD and the subsidiaries own management teams (as 4.3.4).

Certainly, fostering business progress and improvement is also part of the Holdings' responsibility and commitment; and this is also related to the outlined fact that some of the most challenging requirements (such as the incoming sustainability legislation or the Holdings overarching sustainability targets) fall on the subsidiaries because they are part of a bigger group. In this sense, Indutrade Benelux's active participation in this study showed an important effort to institute a mechanism for communication and exchange (Gnyawali et al., 2019). The outcomes of the Holding efforts documented here (the successful creation of a CSCN with long-term potential) can serve as guidance for other Holdings in the future.

To further explore the influence of using a 'subsidiary-centric approach', the data revealed that two interpretation angles of such factor were possible. A first angle concerns the methodology adopted in this study; with the inclusion of, and attempt to, answer subsidiaries' interests and demands throughout the network creation process. For example, the interviews, the feedback recollection, and the subsidiary-generated SMART objectives, which will be discussed in relation to goal congruency later. That creation process confirmed pre-existing theory establishing that the process should be sensitive and responsive to subsidiary demands.

The inherent methodological flexibility that adopting a subsidiary-centric approach required proved to be an enabler for CSC in a network context. The groups took different approaches to create sustainable innovations and to generate SMART objectives for the network, which resulted in a rich mix that fulfilled the theoretical purpose of this research (to assess the influence of the factors across groups) and the practical purpose (to create a collaborative structure that would respond to subsidiaries' demands and have sound time permanence potential). However, it was essential that this methodological and structural flexibility was not limitless. A set of structured tools and collaboration setups proved to be necessary to guide companies in their innovation or goal-setting processes. Hence, to incorporate the subsidiary-centric effectiveness factor in CSCN creation processes, maintaining a balance between methodological flexibility and structure was essential; and, this was enabled by the use of action research as a research method.

A second angle concerns the manifestation of individual interests, reflected in participants' individualistic behaviors instead of a search for shared benefits (examples given in 4.3.4) during the collaborative processes. A study by Stendahl et al. (2022) adopts a 'subsidiary-centric' concept that is more in line with this second angle. These behaviors were observed during the SI sessions, and during the network setting activities (Table 6 and 8). To prevent them from negatively impacting the performance of the network and the collective benefit, it is important for the researcher, and for the stakeholders involved to be reminded of the objective of networking, and that the benefits for the collective are not always directly beneficial to the individual. However, doing this implies a sharp monitoring of the collaborative processes to ensure that individual goals are not being entirely disregarded but rather included in the collective targets.

Furthermore, and to link the subsidiary-centric factor to the holding company support factor, the need and request for support expressed from the subsidiaries in this study may be limited to SMEs, or more critically put, to this case study. SME subsidiaries' appreciation of support can be greater than that of larger companies with more resources.

Unsurprisingly, the subsidiary-centric factor played a big role also in terms of goal congruency, as the subsidiaries had to navigate their marked differences to find common interests, common challenges, and then, common goals. All groups attempted (to a certain extent) to align with others, or to find cohesions (4.3.3), which was a positive and unexpected outcome. Logically, the provision of a holding-company-enabled collaborative structure facilitated these exchanges, but it is believed that in action research, it could not have been predicted how the collaboration interactions were going to unfold.

Moreover, the relevance of finding congruency was also intuitively captured by the participants. It was interesting, yet expected, to find a significant set of congruency in terms of sustainability interests and concerns between subsidiaries in similar industries, or between those who purchased the same type of raw materials (e.g., Company H and Company F). Most remarkably, not an insignificant number of common sustainability issues emerged between companies that were entirely different in terms of nature of knowledge (as presented at the end of 4.3.3), demonstrating that achieving congruency among the diversity is feasible.

The study revealed that although resistance to collaboration and incredulity was observed in some participants, it was the team atmosphere, and collaboration spirit driven by (at least) a fraction of the participants' motivation, what enabled the groups to dive into deeper conversations that either revealed further sustainability challenges, and/or helped them align. Cooperation variables such as innovation capacity and understanding of regulatory requirements were certainly fostered (Camarinha-Matos & Abreu, 2007). The creation and search for new sources of value was also evidenced, which is

considered a positive achievement in this study, especially as it took place in early stages of a CSCN. This demonstrates a good potential for this CSCN to explore additional sources of value as the ones posed in Appendix I.

No merely-financial network objectives were proposed, even though several conversations in the groups recalled the importance of economic analyses to the sustainable innovations being proposed (4.3.3). This is in line with the associated statements in 2.2, since the general concept of 'benefit' was proven to be directly associated with profit, as has been the usual DBG's *modus operandi*. Furthermore, the theoretical expectation of 'goal congruency' to increase the likelihood of two participants to collaborate was confirmed, companies seemed highly enthusiastic when proposing and (out)voting SMART objectives; more conversations were observed between companies who shared interests.

In short, and drawing on Gnyawali et al. (2009) and Sandford et al. (2022), the idea behind fostering goal congruency in the network was to help subsidiaries identify their sustainability needs and establish which relationships would be beneficial for them. The approach used was considered successful in doing so, as collective interests were captured in network objectives with a good potential for network continuity. This, if followed up on by the holding company.

In terms of the influence of 'nature of knowledge' (4.3.2) at the early CSCN's phase under analysis, it was observed that firm knowledge proximity played a greater role than employees' cognitive proximity (4.3.2). The companies with more likelihood of tie formation in the sample connected because of similarities in their business activities and industries; while the employees had significantly different roles (e.g. Finance and R&D). However, it is possible to infer from this research that at later, more operational phases of sustainable innovations' development, employees' cognitive proximity will become more influential in the effectiveness of collaboration. A match in nature of knowledge can help advance more specific issues in depth.

Despite this inference, the experiment of mixing roles in this research proved to be beneficial for company-specific knowledge spillover, mostly regarding the exchange of different approaches to tackle the innovations discussed. The knowledge diversity of participants also enabled peer-motivation and counseling behaviors. It is believed that in terms of network initiation and goal-setting, employee and firm knowledge diversity is the preferred approach; as employees with different expertise make distinct contributions around feasibility and strategic goals of the network.

An interplay between the factors

On a final note, the interplay between the studied effectiveness factors was identified theoretically (Section 2.2) and demonstrated in the Results (4.3). The following lines summarize that interplay.

The creation of a CSCN in this study appears to be strongly holding-company dependent. The holding has the ability to facilitate and translate subsidiary needs into actionable steps, and to prevent disloyal competition. However, for this to be accepted by at least a number of subsidiaries, it is possible to deduce from the findings that a subsidiary-centric approach should be used; considering the concept of 'centric' as incorporating their interests and suggestions, not so much their individualistic behaviors. These two factors seemed to be contextual (as noted in 2.2) and have influence throughout the total action research method, which is a novel relationship found between this method and the theory around collaborative networks.

The nature of knowledge remains the most complex factor as diversity can influence positively by fostering innovation, or negatively by obstructing effective communication (low cognitive proximity), as conceptually discussed using Boschma (2005), and van Beers & Zand (2014). Nonetheless, knowledge diversity has demonstrated here a strong positive influence on the goal-setting mechanisms (goal congruency) of a CSCN. In turn, goal congruency and goal clarity have shown to foster subsidiary motivation, while increasing the likelihood of the CSCN to persist in time. Therefore, these factors seemed to have a significant influence in the interventional (the action) phases of the action research method; and in the initial phases of the creation of a CSCN. This method-theory relationship is another innovative finding of this study.

Finally, regardless of the positive reaction from the participants, maintaining the motivation for collaboration, which is closely related to the subsidiaries finding it beneficial (Camarinha-Matos & Abreu, 2007), is a challenge found. More specifically, subsidiaries lost interest in collaboration after having found common goals and established next steps (based on the innovations). They believed that for the implementation of the innovations they did not need help (4.3.3). It is possible to infer, from the way this study unfolded, that this subsidiary perception changes over time, as the deployment of the innovations turns more complex and subsidiaries regain an interest in collaboration.

5.3 Implications for intra-conglomerate networking

Creating a CSCN using an action research approach enables the Holding to gain a deeper understanding of subsidiaries' needs and to incorporate bottom-up suggestions in the process of addressing those needs. The findings discussed showed clear potential for management teams in BGs to support subsidiaries advance sustainability in an effective manner. As the study is participative in nature, the methodology offered here can be applicable to any business group context and business model.

Key aspects to consider when establishing a CSCN are the indispensable support and active push from the holding company and the need for remaining sensitive and responsive to subsidiaries express needs for collaboration. Additionally, when grouping subsidiaries in collaborative sessions (for which workshops were used here), the diversity of subsidiary industries and employee knowledge fosters innovation and their respective feasibility assessments; which is why fostering diversity is recommended at initial stages of a CSCN. However, a better match in nature of knowledge (same subsidiary or employee expertise) can be used as a lever for enabling deeper conversations and complex problem-solving, recommended as the network matures.

At last, the recommendation is to find ways to seize it, and to capitalize on it. For this, it is important to further develop the most promising resulting innovations. To facilitate this, it is important that the goals of the network are clearly established, understood, and agreed on by all stakeholders. This safeguards the CSCN's success.

A more thorough management advice for BGs in general, and a specific one for the case of Indutrade Benelux, have been provided in the Executive Summary section on page 3.

5.4 Limitations and avenues for future research

While this study has strived to thoroughly address the creation of CSCNs for sustainable innovation, it is appropriate to acknowledge certain limitations to the generalizability of the findings. Four limitations are provided below.

1. The methodology used here to create a CSCN, although initially subsidiary defined in the workshops, resulted in working groups where diversity in knowledge was the norm. This did not allow for as many findings from groups with match in knowledge, where clear evidence of lock-in, or hampered innovation capabilities could have been found. Thus, an avenue for future research is the creation of an action-research-enabled CSCN that explores, alternatively, the performance of groups with match of knowledge instead. From this, comparisons could be drawn from this, and the understanding about the 'nature of knowledge', the innovation capabilities, and group dynamics would be enhanced.

2. Another limitation is the exclusion of the CSCN's institutionalization, as the development of the Network and its pursue towards the established goals is outside of the research scope. The study of CSCN in full, employing action research, requires researcher-company engagement through a long(er) period (also mentioned in 3.5), which is the reasoning behind the institutionalization phase and the innovation adoption being left out. Consequently, even though it is affirmed in 5.2 that goal congruency seems to increase the likelihood of

subsidiary tie formation given the enthusiasm of the participants when creating common objectives, and also when finding similarities, present evidence remains largely unclear in the long-term and should only be interpreted in the context of the initial stages of the a CSCN. Hence, this represents an valuable opportunity for researchers to advance. Namely, to study the institutionalization phase of this initiative, how to stay engaged, how to foster network sustenance and continuous improvement. Similarly, it would be interesting to study the implementation (or generation) of sustainable innovations inside the subsidiaries themselves post network creation and post collaborative SI.

3. A third limitation concerns the studies pertinency and generalizability, as the outcomes hold for BGs consisting of SMEs. The wishes expressed by the subsidiaries in terms of demand for Holding company support, or preferences and eagerness for collaboration may be limited to SMEs. This research does not provide information about larger companies, to which statements may not be applicable. Therewith, a recommendation for future research is to study other BGs composed of larger organizations using a similar approach to the one used here.

4. Finally, the proposed CSCN is a collaboration mechanism that heavily relies on interpersonal exchanges. As an alternative, a critical perspective is explored by Stendahl et al. (2022) who studied ways of lateral collaboration in less space-time sensitive ways. Even though the geographical proximity of the participants in Indutrade Benelux decreases complexity in this sense, future research could focus on the creation and development of such CSC mechanisms on internet platforms or virtual spaces (as Camarinha-Matos, Boucher, et al. (2010) have studied already). At the same time, further research could be done on how such technology-based network should be managed (also centrally by the Holding, by an employees' steering committee, by an external company, etc.).

In spite of these limitations, this research substantially contributes to the comprehension of CSCNs in decentralized DBGs using action research, and it adds to the existing groundwork in these two not-so-frequently-explored fields, enhancing the prospects for future research.

6 Conclusion

This research developed in Indutrade Benelux, a decentralized DBG based in The Netherlands that served as the empirical context. The study aimed to answer the inquiry: *how can the creation of a cross-subsidiary collaborative network foster sustainable innovation in diversified business groups?,* which was found to have a dual interpretation: a conceptual 'how', and a methodological 'how'.

To provide an answer to the methodological 'how', this research built on Sandford et al. (2022), adapting and optimizing their action research approach for the case of a decentralized DBG. The use of action research as a method is a particularity of this study that proved to be especially useful for studying collaboration in DBGs, as a socially-complex unit of analysis where the outcome depends on several stakeholders. The usability of action research was found to be related to the participative and cyclic nature of the method, in which the findings could directly circle back to the practical setting. More specifically, this approach was successful at achieving the participation and engagement of subsidiaries in the collaborative processes, the exchange of subsidiary-perceived valuable knowledge and sustainable innovations, and the establishment of objectives for the creation and sustenance of a CSC network with long-term potential.

For the conceptual 'how', four effectiveness factors were analyzed: the holding company support, the subsidiary-centric approach, the nature of knowledge, and goal congruency. The individual influences of these factors were proven to be deeply intertwined when are applied to the creation of CSSN for sustainable innovation. All factors' influence seemed to be moderated by the level of subsidiary motivation and curiosity (as theoretically expected).

To expand on this conceptual 'how', this study encompasses an evidence-based and theory-informed approach to CSCNs for SI among SMEs. In it, clarity in the purpose of the network creation was essential, as cross-subsidiary networks may not be perceived valuable by all subsidiaries, but rather face the risk of being rejected due to limited personnel time availability, amongst other complications identified. For this reason, the CSCN creation process should be sensitive and responsive to subsidiary demands, which here is regarded here as subsidiary-centric.

However, a set of structured tools and collaboration setups proved to be necessary to guide companies in their innovation or goal-setting processes. For this, central support from the holding company was accepted and even demanded from the subsidiaries. In the case of decentralized BG, the only clear bottom-up requirement manifested was the non-interference with the subsidiaries core business when providing this centralized support.

Evidence showed that diversity in employee and firm knowledge fostered collaborative innovation and nurtured innovation capabilities, which makes it the preferable approach (in comparison to too much cognitive proximity) when grouping subsidiaries at initial stages of a CSCN. Likewise, diversity showed to be fruitful for collectively assessing the feasibility of Network goals being set; in which regard, demonstrated that achieving congruency among the diversity can be enabled by participant's alignment efforts.

Furthermore, it is believed that, though nature of knowledge remains the most complex factor at play, the importance of cognitive proximity and match in knowledge increases as the network matures. Once the subsidiaries identify which innovations to pursue individually, and the focus is turned towards implementation or more detailed innovation development, the network could start operating with higher cognitive proximity. In other words, in groups of employees that have more similar expertise related to those innovations.

This thesis holds true previous literature affirmations about goal congruency increasing the likelihood of subsidiary ties, at least for the initial stages of the CSCN experienced here. The objectives established in the Network succeeded to represent the will of the collective by being subjected to a vote; and, in developing these general goals, it is believed that the collective considered subsidiaries' individual aims.

Yet, it was found that subsidiaries lost interest in collaboration when discussing innovation implementation stages. In this light, this thesis poses that subsidiary perception may change over time; as the complexity of the innovations deployment increases. Then, the collective problem-solving capabilities will be beneficial for the subsidiaries. Accordingly, the factor 'holding company support' resulted the most fundamental factor assessed, as it helps to enhance all other factors. In this case particularly, the holding company has the ability to help subsidiaries recognize the benefits associated with CSC and monitor the CSCN's development.

In terms of the critically relevant topic of sustainability, the CSCN has proven to help subsidiaries identify their own room for improvement and ideate possible solutions or strategies to address that. In doing so, the CSCN empowered subsidiaries to discover a share of common sustainability issues in which they can support each other. Consequently, it increased their motivation and sense of urgency. Similarly, sustainability as a topic does not directly embed risk factors such as disloyal competition if the collaboration structure is managed appropriately (with holding company support).

Moreover, collaboration mechanisms such as the proposed here require certain periodicity of centrally organized meetings to maintain participants engaged, making this method heavily reliant on interpersonal exchanges. A key recommendation in this sense is to initiate networking processes face-to-face (if contextually possible in the BG), and create a complementary virtual (internet-built) site where collaboration can continue to take place in the future.

In sum, this master thesis has explored the creation of CSCNs and the factors that make these structures effective for sustainable innovation in decentralized DBGs. In doing so, it made both theoretical contributions, but also the very practical learnings for conglomerates or DBGs that want to explore collaboration to advance sustainability. The study offered robust answers substantiated in empirical evidence and stakeholder input, which filled previously identified research gaps in the field of collaborative networks and applied action research, posing new avenues for future scientific exploration.

7 Acknowledgements

I would like to express my deepest gratitude to the following individuals and institutions who have played a pivotal role in the completion of this Master Thesis:

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Appendix I. Collaboration benefits

Table 10 below expands on the possibilities of benefits resulting from a collaborative network in practice. The 'target goal' column is linked to, among others, the cooperation variables mentioned in Section 2.2.

Table 10. Examples of associated advantages resulting of collaboration relationships between subsidiary companies. Source: Camarinha-Matos & Abreu (2007).

Target goal	Example of some advantages associated to collaboration
Share costs	• Have access to new markets and/or businesses without the need to make high investments. • Share R&D costs. • Ability for SMEs to compete with large competitors.
Share risks	• Companies operate in changing environments and with limited, therefore imperfect, knowledge. Consequently in some cases the level of uncertainty may have a negative impact on the decision-making processes. Sharing knowledge among several partners allows a reduction of this uncertainty level. • When several partners are involved in a collaborative project there is a partition of the responsibilities among them (co-responsibility). • In some cases solidarity mechanisms can be established among partners. • Also enabling the competition of SMEs with large companies.
Decrease the dependence level in relation to third party	• All companies depend on others to some extent for products, services, raw materials, tangible and intangible resources and competencies. Through co-operation companies can reduce this dependence by creating privileged links to other firms in an attempt to reduce transaction costs that arise when uncertainty increases. • Also enabling the competition of SMEs with large companies.
Increase the innovation capacity	• Increase the capacity of generating new ideas through the combination of the existent resources and diversity of cultures and experiences (critical mass). • Emergence of new sources of value. • Reduction of the life cycle of the products and technologies. • Possibility of developing more robust products fitting the customers' expectations and therefore contributing to an increase of the quality.
Defend a position in the market	• Achievement of economies of scale by sharing resources. • Establishment of defensive coalitions with the purpose of building entry barriers in order to defend themselves against a dominant firm or a new player. • Establishment of offensive coalitions with the purpose of developing competitive advantages and strengthening their position by diminishing the other competitors' competitiveness. • Increase the negotiation power in relation to suppliers and/or customers that are outside of the collaborative network. • Also enabling the competition of SMEs with large companies.
Increase flexibility	• Share of resources and combination of skills among partners. • Use the core competences from other partners. • Increase the adaptation capacity towards several business environments simultaneously. • Offer a broader range of products/services. • Grow for new segments in a stable way reaching a larger stability.
Increase agility	• React in a short period of time to a business opportunity through the establishment of more agile procedures. • Increase the interoperability between several processes and products (establishment of norms)
Increase specialisation	• Let companies concentrate their resources on the critical activities.
Establish proper regulations	• Definition of rules to avoid opportunistic behaviour and to avoid conflicts. • Increase common culture of trust.
Share social responsibilities	• Obtain recognition from others (intangible value). • Develop social responsibility. • Altruism. • Reinforce values that are common.

Appendix II. Ethical considerations and confidentiality

Confidentiality

Indutrade's internship contract contains a specific article referring to confidentiality shown in Figure I-7. This will be carefully followed. An oral 'pre-agreement' was made with top management of the business group in order to convene which information could be disclosed and what should be kept confidential.

ARTIKEL 10 - Geheimhouding
De stagiair verplicht zich zowel tijdens als na de stageperiode tot strikte geheimhouding van alle bedrijfsaangelegenheden, waarvan het vertrouwelijke karakter geacht kan worden hem/haar bekend te zijn. Voor publicaties in welke vorm dan ook. Waaronder mede inbegrepen het stageverslag, is voorafgaande goedkeuring van de stageverlener vereist. Deze wordt gegeven door een ondertekende verklaring in het stageverslag.

Aan het einde van de stageperiode dienen bedrijfseigendommen, alsmede alle correspondentie, aantekeningen, enzovoort betrekking hebbende op bedrijfsaangelegenheden, direct door de stagiair bij de stageverlener te worden ingeleverd.

Figure I-7. Indutrade Benelux's confidentiality contract excerpt

Ethical considerations

Regarding the 1:1 data collection: the questionnaire, the interviews, and the online satisfaction survey, participants will be asked for consent and informed at least one week in advance. All participant's personal data will be kept confidential.

For Workshops 1 and 2, as group data collection techniques will be applied, the following informed consent form will be provided in advance and requested as a requirement for participation during the Workshops.

Dear attendee,

Workshop 1 and 2 are part of a master thesis research study at Utrecht University, The Netherlands. Hereby the researcher requests your consent for participation. Feel free to ask questions if this form is unclear regarding the collection and use of your data.

The purpose of each workshop is to expand academic and empirical knowledge around the formation of collaborative networks for innovation and sustainability in business groups, including the challenges and opportunities encountered in the process. Support staff with relevant knowledge in the topic of sustainability will be actively collecting non-personal nor company-linked data throughout today's activities in the form of:

- *Observation*
- *Detailed note-taking*
- *Pictures of the activity setup or resulting documents*
- *If audio or video are required, permission will be asked before-hand.*

Company confidentiality will be achieved by allocating an alphabetical letter to each company (Company A, Company B, etc.) during the data analysis stage; at the workshop setting, official company names will be used.

However, the research will include a general description of the company's industry, the company size (FTE), and the company's location (city level, no address). Only the researcher, the university supervisor, and the second reader will have access to company names or sensitive information.

No personal information will be used in the final documents, and only for communication purposes during the workshop settings. The researcher expects you will not experience any confidentiality risks by participating in this study.

If any sensitive information is shared during the innovation sessions of the workshop, kindly notify the staff in charge of data collection to mark it as non-disclosure data. The type of data collected is for example:

- *Characteristics such as the nature of the ideas shared, the number of ideas shared per company, the role/position of the participant in the companies (finance, operations, etc.).*
- *The ideas shared (i.e., place solar panels, hire a recycling facility, replace the diesel fleet with a hydrogen fleet)*
- *Client names or third party names will also be kept confidential and will be coded, if needed.*

The decision to participate in this study is yours and no actions will be taken against you if you choose not to participate. Participation is voluntary and you may decide to stop participating in the study at any point in time. You can also refrain from answering uncomfortable questions.

If you have further questions, you can contact BSc. Eng. Ana Victoria Cubero Mata: a.v.cuberomata@students.uu.nl / acuberomata@indutradebenelux.com.

By signing below, you are agreeing to participate in this study under the aforementioned conditions.

I understand how my data for Workshop 1 and Workshop 2 will be treated and agree to participate in this research study,

_____

Attendee signature

Date

Appendix III. Questionnaire for business unit leaders

The following three questions were asked by email to business unit leaders (BUL) as part of the diagnosing phase of the action research approach.

1. **Which collaboration relationships are there between your BU companies and other companies within Indutrade?**
    a. Please include the following details: company names, type of collaboration (e.g., sales, innovation/ideas, other), type of product traded (if applicable), type of idea shared (if applicable), applicability of product/idea in the recipient company). See the following examples.
        i. Example of product collaboration: Company 1 sells "stainless steel process interlock keys" to Company 2, where it is used for/ as "a component of a bigger product (details accepted, not required)".
        ii. Example of innovation/ideas collaboration: Company 1 shared their "approach on water management inside the manufacturing plant" with Company 2 for "improving energy efficiency".
2. **Are you aware of regular meetings or activities happening within the companies in your BU or outside or your BU, which help transfer knowledge, create trading opportunities, etc.?**
    a. All insights are welcome, even if they're not related to sustainability.
3. **Which activities organized by Indutrade do you consider useful for the exchange of knowledge and the identification of collaboration opportunities?**

Appendix IV. Informal interviews to sample companies

The following three questions are being asked personally, or via an online meeting, to the management of each of the subsidiary companies in the sample; as part of the diagnosing phase of the action research approach.

1. Basics of the company, including FTE number and industry they belong to. The following **question is also asked**: can you explain to me what your company does? What is its value proposition, what makes you different from others in the industry?

2. The second open topic concerns your company's main negative environmental and social impacts. We will do a follow-up on an Indutrade Benelux materiality assessment that COMPANY NAME performed last year. For this part of the meeting (1 h approximately), it would be ideal if other persons you consider relevant join us. I would particularly suggest that SUSTAINABILITY RESPONSIBLE PERSON (SRP) joins, as the SRP, but more persons (maybe leadership/procurement) are welcome to join as that makes the discussion richer.
   Questions such as: you can see COMPANY NAME results on the screen, do you think this visual representation of the company's impacts is accurate? What would you change?

3. The next topic concerns my research project, where COMPANY NAME is a part of the sample of companies that we will be starting with (a total of 9 companies from the Benelux BA). I'd like to explain to you what the project is about and ask you a couple of questions about the business, such as the organizational structure and hopefully to see / make a flow chart of operations. This will help me understand more about your company.
   Questions such as: What do you think about this initiative? Would you like to participate? What recommendations do you have for this initiative to be effective? are asked.

4. **Final questions** around interest: Do you have a SRP? What sustainability topics are you interested in developing in the short term? Which are your company's main impacts in your opinion?

Appendix V. Workshop 1

Workshop 1 took place in March 2023, MDs and attendees were invited 2,5 months in advance to ensure their agendas were reserved for this matter. The researcher assigned 4 weeks for planning, participant contacting and coordination, and logistic activities concerning Workshop 1 to ensure its academic rigor.

The topic of the workshop was **"Assessing and addressing the main negative impacts in my value chain".** This topic was believed by the top management to be valuable to all companies, leaving no one behind. It was also considered a long-term strategic topic. This being said, the program and detail of the collaboration activities for Workshop 1 was documented in this Appendix.

Participant practical details

Participants were given tags with their names and company names; roles within the company nor last names were excluded to ensure that there is no bias while contributing ideas during the workshop, which could be related to power interplay.

Table 11 shows the logic behind the formation of the groups, which are also maintained for Workshop 2.

Table 11. Inter-firm group formation.

Aspect	Number / detail / responsible
Average employees per company	50
Total expected attendees from companies [real number]	22 [23]
Expected attendees per company	1 out of every 20 FTEs, with a maximum of 5 persons
Number of groups	5; 3 groups with 4 people 2 groups with 5 people
Areas in the company	As diverse as possible
Decision of who joins which group	Researcher and managing directors mainly based on value chain stage of negative impacts being assessed/addressed

Furthermore, a few key participants were included as support for this event. The persons with a more leading or data collecting role will be gathered the day before the event and trained to be prepared for the workshop day. The following key participants relate directly to the structure in Figure V-8:

1) The CEO of Indutrade Benelux was present
2) The CFO of Indutrade Benelux was present
3) The Head of Sustainability from the Top Holding was present
4) A member from the UK BA in charge of sustainability workshops took part as a speaker on "carbon footprinting"
5) An inspirational talk is was provided by the MD of one of the most advanced subsidiaries in terms of sustainability
6) An external speaker from a larger centralized conglomerate took part as a speaker on "sustainability journey"
7) Fellow master's students worked as assistant researchers during the event for active data collection.

Structure and program

As preparation for Workshop 1, the companies were asked to perform an assessment. For this, a tool was be developed and provided in advance to help the identification of their most negatively impactful value chain stage, from an environmental perspective. The results of the tool were meant to be shared among participants on the day of the workshop to find commonalities and initiate innovation.

Also, participants should have studied the program of the workshop and decided who and to which team to send their employees. Figure V-8 shows the structure of Workshop 1.

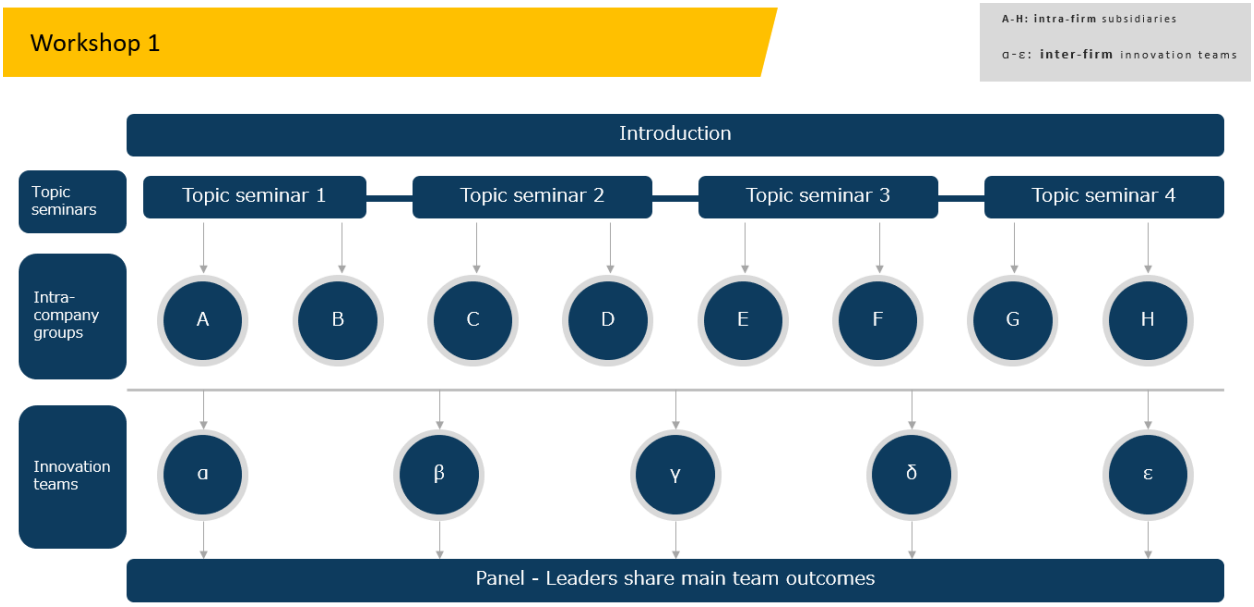

Figure V-8. Structure of Workshop 1

In more detail, Figure V-8, the groups A-H were composed of the persons of the individual subsidiaries. They were asked to create a question (or more) around their most impactful value chain stage (resulting from the provided tool). Then companies were asked to select a team per subsidiary employee (alpha-epsilon; α-ε) depending on the value chain stage of interest.

Consistently, the inter-firm groups α-ε were created based on a pre-defined value chain stage as:

ALPHA (α) – Raw materials and raw materials outsourced processing

BETA (β) – Transportation supplier to company

GAMMA (γ) – In-house manufacturing / operations

DELTA (δ) – Sales, marketing, services, R&D

EPSILON (ε) – Use-phase and end-of-life

Each inter-firm group should have selected a leader or a person to represent them in the plenary for the wrap up of the workshop, where they should present the main topic, main findings and remarks of the experience inter-firm experience.

Data of interest in Workshop 1

In this session companies were asked to perform 2 data-generating tasks. Data was collected by a team of 5 researchers via observation, note taking, photographic interpretation and audio recording of the main sessions. The purposes of the activities in relation to the research question are detailed below.

Purpose of A-H intra-firm discussions

1. To familiarize subsidiaries with the Network project and assess their motivation by identifying whether or not companies had performed the impact assessment prior to the workshop.
2. To implement a subsidiary-centric approach by incorporating own companies' interests in the dynamics, and allowing them to dive into individual issues. The request to them was to make at least 1 company-relevant question per employee in relation to their problematic value chain stage, to raise in the inter-firm session.

Purpose of α-ε inter-firm discussions

1. Assessing congruence and group dynamics while having the group prioritize questions (based on collective value, repetitiveness, or any other criteria the group chose).
2. To identify challenges and enablers for collaboration by analyzing the discussions the participants had while prioritizing questions and generating ideas.
3. To identify the main sustainability issues in each company (and in the collective) by making a complete list of impact-addressing innovations.
4. To continue implementing a subsidiary-centric view, once the innovations list was ready, the participants were asked to rate the ideas using company-specific colored sticky notes provided in the A-H groups. On those stickers, they used the traffic-light color coding (green = valuable; yellow = moderately or potentially valuable; red = nonvaluable or non-applicable) to rate each innovation. This facilitated the data filtering process after the event; in other words, the researcher could identify which company rated which idea as valuable.
5. At the same time, the value rating allowed for congruency check between companies. This means, to observe which ideas were valuable to the majority of companies in each innovation team (alpha-epsilon), and potentially, why some companies had more similar interests than others.

Participant's satisfaction survey questions

After Workshop 1, participants were asked the following questions:

- I am answering this survey on behalf of my company: _____
- Was Workshop Day 1 your first time to attend an event around the topic of sustainability? (Likert scale used)
- Do you think the Workshop Day 1 was well organized? (Likert scale used)
- Did your company fill out the Impact Estimation Instrument that was assigned as preparation for the Workshop Day 1? Yes/No
- How difficult was to assess the impact of the product you chose using this Tool and the provided instructions? (Likert scale used)
- Do you consider that using this Tool helped you identify the negative environmental impacts of your supply chain? (Likert scale used)
- Do you consider that filling out the Tool in advance helped you come up quicker with more accurate questions for the innovation sessions? (Likert scale used)

- Why did you not fill it out in advance? Please provide an argument: _____
- How satisfied are you with the content of the educational sustainability sessions? (i.e., session 1, session 2, session 3, session 4) (Likert scale used)
- In general, how satisfied are you with the Workshop Day 1 event as a space for collaborative innovation? (Likert scale used)
- Do you have any suggestions for us to improve the Network? (E.g., specific content, collaborative work dynamics, ...) _____
- What are the main hurdles (difficulties) your company has to participate in the Network? _____

Appendix VI. Reflection time and Workshop 2

Reflection time

Between workshop 1 and Workshop 2 there were be at least 4 weeks' time.

The researcher provided each company with their top rated ideas and a file to assess them once more with colleagues in their company. The file contained a list of the 'valuable' innovations per company/ per group. With this, participants had an opportunity to reflect on the innovations they'd like to implement in-house based on value to their own firms, and to reflect on the idea of forming a network.

Companies were asked to use the following classification method for each perceived 'valuable' idea (rated green in Workshop 1):

- **Unchanged (U)**: solves the same issue in the same way
- **Modified (M):** (or replaced) solves the same issue in a different way
- **Eliminated (E):** phased out

Table 12 (*draft version*) was given to the attendees of Workshop 2, per subsidiary. It was asked from them to bring it to Workshop 2, for inter-subsidiary discussions.

Table 12. Workshop 2 innovation classification after firm assessment.

Idea generated in the previous workshop	Status after reflection (unchanged, modified, eliminated)	Intra-firm reasoning for the status	New idea
Green idea company X	U	NA	NA
Green idea company X	E	(Intra-firm reasoning for the status)	NA
Green idea company X	M	(Intra-firm reasoning for the status)	Modified green idea company A

Interpretation: the researcher collected these files and accounted all 'unchanged + modified (or replaced)' ideas as successful innovations born from the exchange in the network. Retrospective inferences were used to make conclusions.

[Disclaimer: originally, the intention was to apply descriptive statistics, e.g., comparing the initial number of ideas to the final number after internal reflection and consequent elimination; this was not possible as not all subsidiaries filled out Table 12. However, discussions during the inter-group sessions regarding the status of the innovations allowed for the status qualitative interpretations and discussion purposes].

Workshop 2

Workshop 2 took place in May 2023 and it lasted 6 hours. Reserving the time from the companies for the purposes of Workshop 2 served as a buffer in case of delays/issues encountered in Workshop 1. However, everything went as preliminarily planned, and all data collection activities took place.

Figure VI-9 shows the structure of Workshop 2.

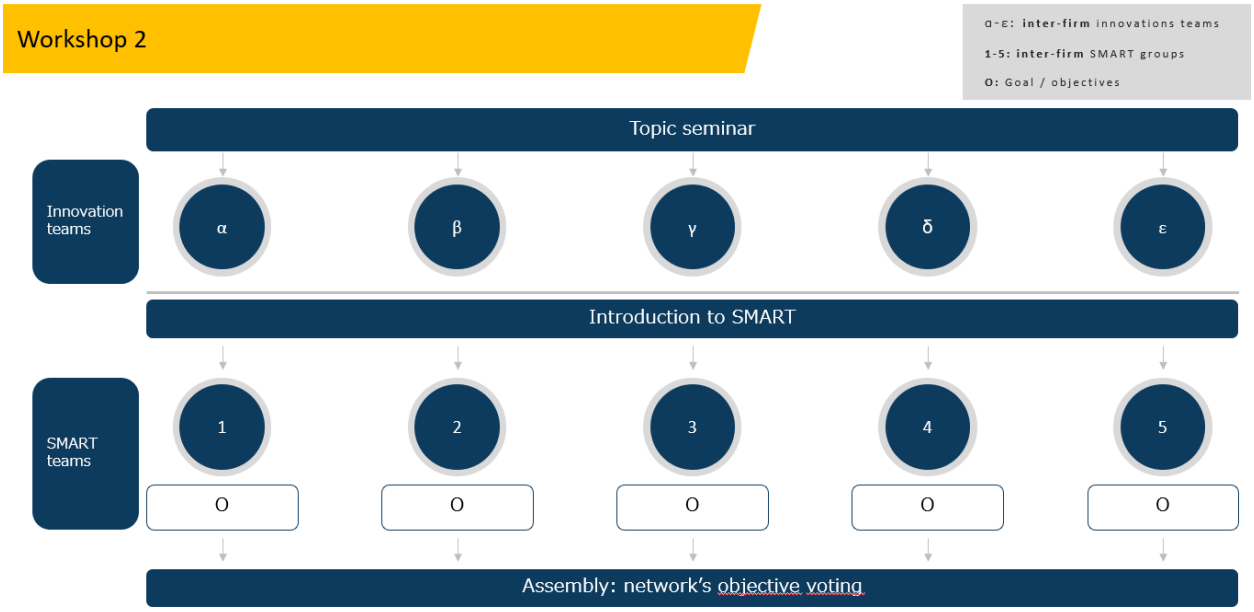

Figure VI-9. Structure of Workshop 2

In the same teams as in Workshop 1 (alpha-epsilon; α-ε), each company was asked to present their internal assessment / development of the innovations in-house during the reflection weeks. Companies were then asked to identify low-hanging-fruit from the innovations collectively, which triggered very rich conversations of the priorities within each subsidiary. For this, a matrix was provided as shown in Figure VI-10.

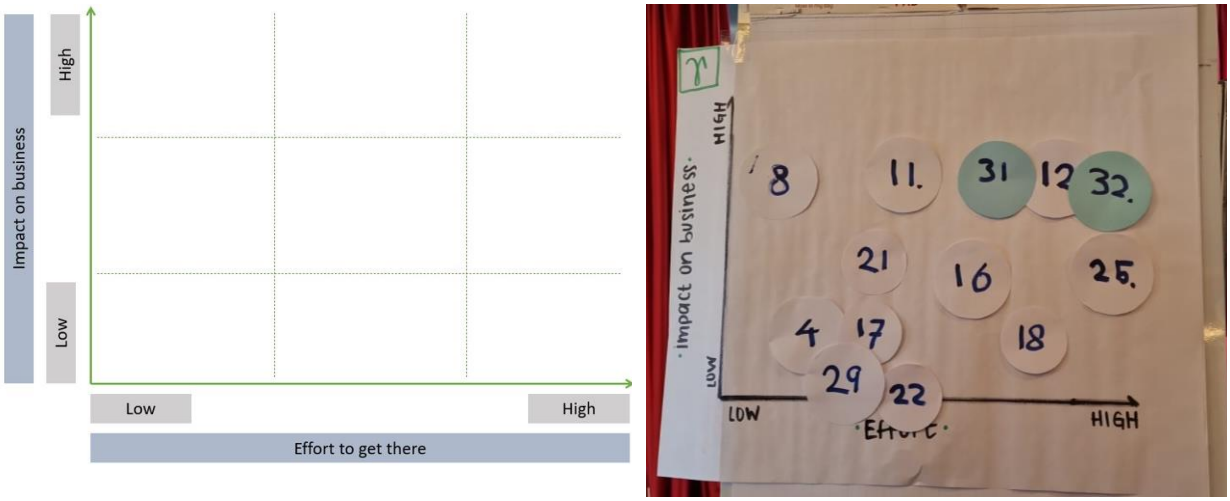

Figure VI-10. Low-hanging-fruit identification matrix used in Workshop 2 (left-hand-side). And Team Gamma's results as an example (right-hand-side)

Next, new teams were formed during a SMART objective setting session (see Figure VI-9). Employees were mixed both in terms of different subsidiaries, and different roles in the company, resulting in:

SMART 1	–	MD, R&D, Finance, Operations manager
SMART 2	–	MD, R&D, Operations manager, MD, Holding representative
SMART 3	–	MD, Finance, MD, Holding representative, Quality manager
SMART 4	–	Operations manager, MD, Quality manager, R&D

A new matrix was used for the purpose of company alignment as shown in Figure VI-11. All digitalized results for this session can be found in Table 8, Section 4.3.3.

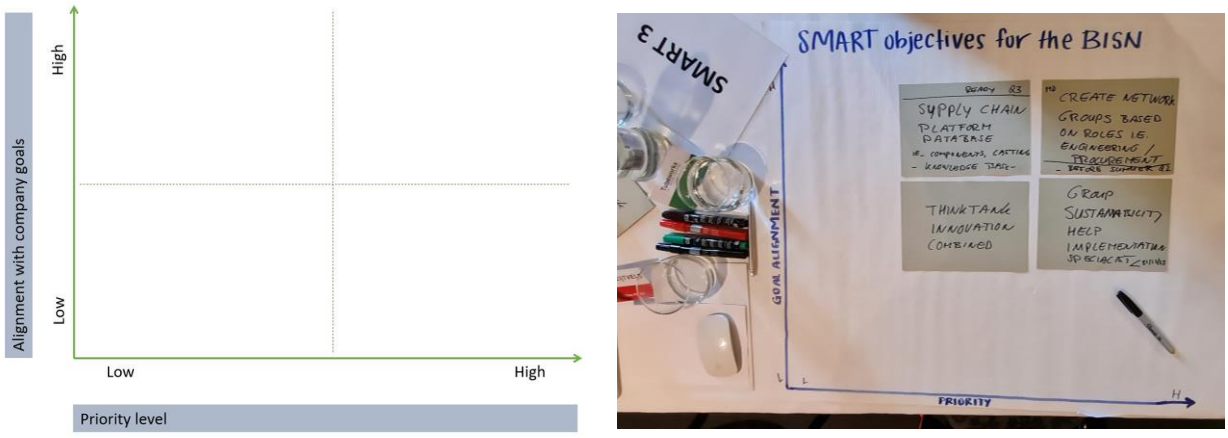

Figure VI-11. SMART objective setting matrix used in Workshop 2 (left-hand-side). And Team SMART 3 results as an example (right-hand-side)

For clarification, the objective-setting activity refers to the group's proposed network goal/objective, which should be aligned to sustainability goals. For this, the SMART technique was used (see Figure VI-12).

Figure VI-12. Description of the SMART technique

Lastly, a voting session took place. The objectives were compiled by the researcher after the SMART session and the subsidiaries voted out a certain number of objectives (see also Section 4.3.3). The creation of a steering committee to be

in charge of planning the future meetings of the network and of moderating the interactions was proposed after this session, as per Sandford et al. (2022). For this Network, the proposal for such committee can be visualized in Figure VI-13.

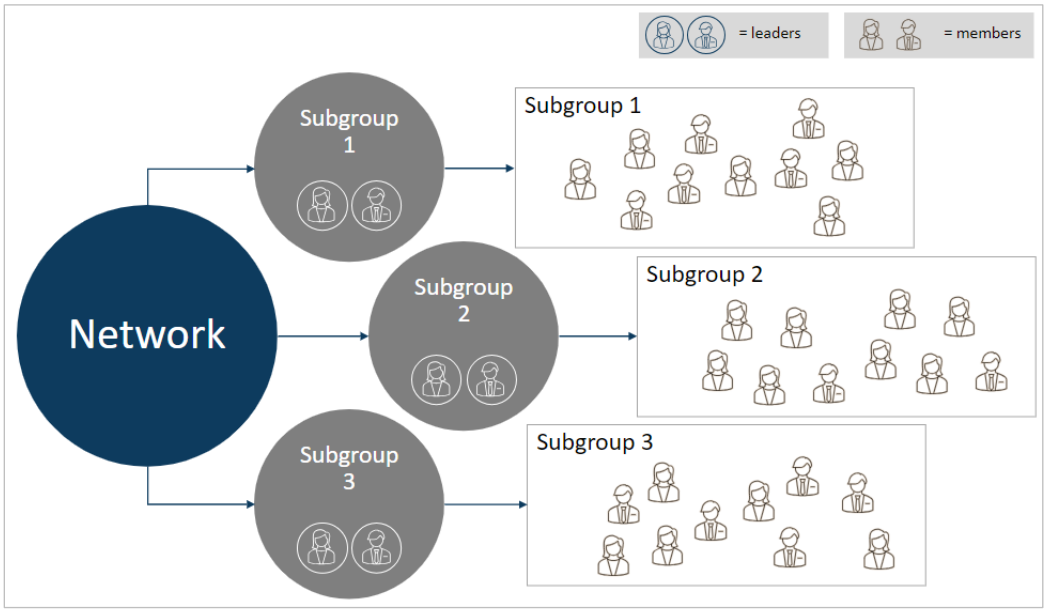

Figure VI-13. Proposal for the creation of network groups per role inside the Network

In the end of this session, a mission for the Network was proposed and accepted by all present participants.

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