MANAGING PARTNER RELATIONSHIPS WITHIN GLOBAL SUPPLY CHAINS OF CARGO AIRLINES TO REACH SUSTAINABILITY GOALS

A Decision Support System applied to the operations of KLM Cargo

MSc thesis Complex Systems Engineering and Management

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by

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Preface

By handing in this thesis, my time as a student comes to an end. Delft, both as a city and home to its University of Technology, has brought me so much over the past six years. My journey in this city also extended beyond its borders, providing me the incredible opportunity to go abroad to Indonesia for my electives. During this experience, I began searching for a thesis subject. Aviation has always intrigued me with its challenges and the contrasting subject of sustainability. This pursuit from abroad brought me to an interesting situation: I had an online meeting with Debby from KLM Cargo while sitting in a coffee bar in Bali. It made me feel like one of the many digital nomads over there, a role I was not particularly proud of. Yet, in the end, it worked out perfectly, leading me to start at KLM Cargo in March 2024.

I owe a great deal of gratitude to my two supervisors from the TU Delft, Jafar and Linda, and my two supervisors from KLM Cargo, Debby and Dennis, for their support and guidance throughout this process.

First of all, I want to thank Jafar. I enjoyed our very easy-going meetings every two weeks. You allowed me to conduct my research in the way I wanted, which I highly appreciate. When I doubted if something was correct, most of the time, your simple question, "*Why?*" was enough to clarify my thoughts. Through our conversations, I often realised that my approach was indeed in the right direction, and you could give me this confirmation. Your explanations, by using very concrete examples, made complex concepts very clear to me, which helped me a lot.

Linda, although we did not see each other much, your incredibly fast response time was extraordinary (and by incredibly fast, I really do mean incredibly fast...). Your fast but detailed feedback, often within an hour, allowed me to quickly incorporate your insights and keep my work moving forward. Your perspective as an 'outsider' was valuable, making me realise that some things are not as given. This opened new doors or highlighted the need for more argumentation on these topics.

To Debby, your ambitions truly motivated me. You find yourself in an environment where you must continually push to get the idea of sustainability on the agenda, and you succeed. Our smooth collaborations and discussions helped me translate my scientific ideas into practical business concepts. This experience was really educational and will undoubtedly benefit my future career when these translations need to be made more often.

I want to thank Dennis for taking over the supervision so seamlessly. We had frequent sparring sessions from the beginning, which gave me many new insights. In addition, you always made time for me and provided the right connections within the organisation, which was helpful.

Besides that, I want to thank my family, friends, my roommates from the *Markt 17B* in Delft and my new roommates from *'t Nest* in Rotterdam, *28*, the *inner inner circle*, and my *Ringvaart ploeg* (such a lovely idea to row the Ringvaart during graduation, wasn't it?).

Now, it is time to introduce my research to you. *Managing partner relationships within global supply chains of cargo airlines to reach sustainability goals* demonstrates that, even in a challenging industry like aviation, collaborative efforts with partners can lead to significant sustainability achievements. I hope this work inspires you to pursue sustainable practices, regardless of the industry and its size. Every small step counts and it is crucial for everyone and every sector to contribute to a sustainable future now.

T.P. (Tim) Verwer
Delft, August 2024

Executive summary

Situation

In the context of global environmental challenges, the aviation industry, including cargo airlines, faces significant pressure to enhance sustainability. While most attention has been placed on the sustainability of airlines themselves, the ground operations, managed by various partners worldwide, also play a crucial role. The necessity to integrate sustainability into these operations is critical for the industry's overall environmental impact reduction. Cargo airlines must address the environmental impact of their entire supply chain to achieve sustainability.

Complication

The Main Research Question (MRQ) guiding this study is: *How can a Decision Support System (DSS) be developed to guide Partner Relationship Management (PRM) for the operations of existing partners of cargo airlines to achieve sustainability goals?* This question addresses the challenge of creating a structured approach to managing and enhancing the sustainability practices of partners within the global supply chain of cargo airlines. Achieving these sustainability goals is complicated by the diverse nature of global partners and the varying levels of commitment and capability regarding sustainable practices.

Approach

The research follows a systematic design approach divided into six phases: problem identification, designing solution objectives, design and development, demonstration, evaluation, and communication. The different Research Questions (RQs) are based on the phases of the design approach.

1. **Problem identification:** Key aspects from the literature on sustainability, PRM, and DSS were identified to frame the problem, highlighting the need for a decision-focused system that integrates models and analytical techniques with user-initiated and controlled processes.
2. **Designing solution objectives:** The objectives for the DSS were established, emphasising a decision-focused system, user initiation and control, and the integration of models and analytical techniques. The DSS aims to develop sustainable strategies for different segments of partners based on specific criteria.
3. **Design and development:** A conceptual model for the DSS was created, incorporating sustainability goals, partner data, and a Multi-Criteria Decision Making (MCDM) method using the Best-Worst Method (BWM). This phase ensured the DSS was systematically structured to address the sustainability objectives through partner evaluation and segmentation.
4. **Demonstration:** The DSS was applied to KLM Cargo's operations, focusing on achieving zero emissions and zero waste by evaluating and segmenting partners based on capabilities and willingness. This practical application illustrated the DSS's functionality and its potential impact on guiding PRM towards sustainability goals.
5. **Evaluation:** The effectiveness of the DSS was assessed through result validation and alignment with the system's objectives. This phase included exploring the generalisability of the DSS for broader application across cargo airlines, confirming the system's robustness, and identifying areas for further refinement.
6. **Communication:** Answering the MRQ and the whole thesis serves as the communication to other researchers and practitioners.

Results

The DSS effectively segmented partners into four segments based on their sustainability capabilities and willingness. Analysing the results based on the Ground Handling Agent (GHA) of the outstations

and the areas they operate in proved highly effective. It revealed that GHAs operating multiple outstations tend to score better overall, with Europe scoring the highest based on the capabilities and willingness scores. This categorisation enabled the creation of a step-by-step strategy in addition to the DSS, which identified which partners to focus on first. Specified components of strategies were developed for each segment, providing actionable guidance for sustainability efforts. Additionally, it became clear that a checklist is necessary to assign a sustainability score to each outstation, offering insights into how sustainable these outstations already are beyond just their capabilities and willingness scores.

The validation process confirmed the robustness of the scoring, criteria, and segmentation methods used in the DSS. However, it also identified specific areas for improvement, such as the need for reassessment and enhanced communication strategies. The DSS's practical applicability in guiding PRM towards sustainability goals was demonstrated, indicating that the system could significantly enhance the sustainability performance of cargo airlines by providing structured and systematic guidance on managing partner relationships.

Contribution

This research contributes to the field by developing a comprehensive DSS tailored to the unique needs of cargo airlines, focusing on sustainability. It provides a validated framework for segmenting partners based on their capabilities and willingness to adopt sustainable practices. The research presents a full list of sustainability criteria based on capabilities and willingness. It also demonstrates that market segmentation, as done before, can also be used for partner segmentation based on existing relationships to achieve sustainability goals. By integrating MCDM with BWM, the DSS offers a robust method for evaluating and prioritising partners, facilitating the development of targeted sustainability strategies. The approaches can be applied more widely and help to achieve sustainability goals. The research also highlights the importance of collaboration among cargo airlines to collectively pressure Ground Handling Agents (GHAs) into adopting sustainable practices. Furthermore, the study offers valuable insights into the practical application of DSS in a real-world context, demonstrating its potential for broader application in the industry.

Next steps

Future research should focus on testing best practices to ensure consistent scoring, exploring the correlations of capabilities and willingness criteria in sustainability contexts, and validating and applying the step-by-step strategy in broader contexts. Additionally, it is essential to assess the DSS's applicability to other cargo airlines and industries to determine its adaptability and effectiveness across different operational environments. Developing clear guidelines for using different segmentation techniques will also be crucial, as current literature lacks detailed recommendations on this aspect. Investigating alternative segmentation methods, such as segmenting partners based on their dependence or impact within the supply chain, can provide further insights and enhance strategy development.

Cargo airlines are recommended to adopt the DSS, starting with small sustainability goals to validate the system and gradually progressing to more extensive objectives. Collaboration among airlines to pressure GHAs collectively can accelerate the adoption of sustainable practices, creating a unified effort towards sustainability in the aviation industry. By continuously refining the DSS and incorporating feedback from its application, cargo airlines can ensure that their PRM strategies remain effective and aligned with evolving sustainability goals.

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Nomenclature

Abbreviations

AHP Analytic Hierarchy Process

ANP Analytic Network Process

AOD Area Operational Director

BWM Best-Worst Method

CoSEM Complex Systems Engineering and Management

DEMATEL Decision-Making Trial and Evaluation Laboratory

DSS Decision Support System

FPP Fuzzy Preferences Programming

GHA Ground Handling Agent

KLM *Koninklijke Luchtvaart Maatschappij* (Royal Dutch Airlines)

MCDM Multi-Criteria Decision Making

MRQ Main Research Question

NGO non-governmental organisation

RFD Research Flow Diagram

SAW Simple Additive Weighting

SMART Simple Multi-Attribute Rating Technique

PRM Partner Relationship Management

RQ Research Question

SCM Supply Chain Management

SDG Sustainable Development Goal

SSCM Sustainable Supply Chain Management

TBL Triple Bottom Line

WFS Worldwide Flight Services

1 Introduction

Supply chains are essential to our daily lives, from the groceries we buy to the mobile phones we use. The networks which allow us to buy these kinds of items are the backbone of international trade and commerce. The sizes of the supply chain networks vary from local to global scales. When looking at global supply chains, the complexity presents significant challenges. Especially when looking at the Paris Agreement, which mandates a reduction in emissions and a shift towards more sustainable practices (United Nations, 2015). Sustainable Development Goal (SDG) number 13 is also arguing to "*take urgent action to combat climate change and its impacts*" (United Nations, 2023). Achieving sustainability is a complex task for global supply chains, partly due to the increased number of involved partners (Sharma, Kumar, Borah, & Adhikary, 2022).

1.1. Current situation

Not only are the companies making use of the transported goods via the supply chain involved, but also the carriers operating via sea, air, rail, and road. Of these different modes, air freight is the most emitting one (International Chamber of Shipping, 2022). The air transport sector's environmental impact primarily stems from its contribution to global warming (through greenhouse gas emissions), with CO_2 being the most significant among them (Alonso, Benito, Lonza, & Kousoulidou, 2014). The global contribution of aviation to CO_2 emissions stands at approximately 2% (International Energy Agency, 2023). This seemingly modest figure takes on greater importance when considering the challenges associated with decarbonising the aviation industry (Ovdiienko, Hryhorak, Marchuk, & Bugayko, 2021). In the context of a world committed to achieving net-zero emissions by 2050 (United Nations, 2015), the urgency of addressing this aviation-related emission in global supply chains becomes clear. With no foreseeable decline in aviation's role in modern society, sustainable practices are essential to meet climate goals and to ensure a sustainable future (Gössling & Humpe, 2020).

When examining the landscape of aviation sustainability, it is crucial to recognise that airlines are not solely responsible for sustainable contributions. A large number of operations are linked to aviation, which should all be taken into account when looking at the sustainability of aviation within global supply chains (ICAO, n.d.). With current innovations, it is easier to achieve sustainability goals with this kind of ground operations in comparison to decarbonising the aircraft. To give an example, the ground operations at Schiphol Airport have been recognised as CO_2-neutral since 2012, and their goal is to be an emission-free airport in 2030 (Schiphol, n.d.).

1.2. Partner Relationship Management

The ground operations which take place at Schiphol Airport, which are required for cargo airlines to carry out their operations, are playing a significant role in achieving sustainability goals. When cargo airlines want to achieve sustainability goals within their global supply chains, they heavily rely on their partners spread around the world to achieve these. This includes partners in developing countries, who may have little or no incentive to adopt sustainability practices. Without incentive, the trade-off

between the business model of a company and sustainability practices will most likely be in favour of the business model. This represents the broader approach needed to address aviation's environmental impact within global supply chains.

Partner Relationship Management (PRM) focuses on "*how to build collaborative relationships with partners through effective and reliable processes*" (Suh, Kim, Hong, & Kim, 2005, p. 50). These effective and reliable processes probably have to be adjusted to realise sustainability goals without neglecting the partner relationship. Despite its importance, it seems that a system that guides PRM towards achieving sustainability goals within global supply chains has not yet been developed.

Managing the relationships with these partners, on which cargo airlines depend, seems to be of great importance when looking at achieving sustainability goals. An example of PRM in combination with advancing towards a sustainable future is a company like *Interface*, a carpet manufacturer. They have set remarkable examples within their supply chain, with the goal of achieving zero environmental footprints as early as 2020. This initiative not only required instructing suppliers but persuading them of the intrinsic value of Sustainable Supply Chain Management (SSCM). (University of Cambridge, 2023)

Whoever the partners are, when multiple partners need to be managed, a uniform approach is impractical because partners differ from each other. Therefore, getting an overview of how partners perform is important. To achieve this, categorising these partners can be helpful. Partners can be classified based on characteristics, criteria, or conditions to determine their status and categorise them accordingly. Managing relationships can be done individually when the number of partners is limited. However, when the number of partners is large, this becomes inefficient, and categorisation can streamline and support the efficiency of the process. Although the literature does not specify a threshold at which categorisation becomes more efficient than tailored strategies, it has been widely used. (Panizzolo, 1998)

Additionally, by segmenting partners based on specific characteristics, criteria, or conditions, strategies can be developed for each segment rather than creating individual strategies for each partner. This segmentation enables the creation of uniform strategies that address the shared characteristics of partners within each category. This approach could enhance the efficiency and effectiveness of PRM.

1.3. Research objective

The research objective is to develop a system designed to enhance the relationship management of existing global partners for cargo airlines. The system should support cargo airlines in achieving their sustainability goals by recognising the differences between the partners. The aim is to create strategies that address the specific needs and differences of the partners to facilitate more effective collaboration and reach certain sustainability goals. Additionally, the system should be able to address the specific needs and differences of the partners by creating a way to categorise them. This categorisation should be based on an evaluation method of the existing partners, allowing for the development of strategies tailored to groups of partners with similar characteristics.

To support the PRM, a Decision Support System (DSS) is proposed. A DSS is a "*computer-based systems that bring together information from a variety of sources, assist in the organisation and analysis of information and facilitate the evaluation of assumptions underlying the use of specific models.* (Baizyldayeva, Vlasov, Kuandykov, & Akhmetov, 2013, p. 1725). The DSS to be developed should have the ability to systematically evaluate the characteristics of partners, enabling the creation of tailored strategies to achieve certain sustainability goals that address the specific needs and differences identified through this evaluation process.

1.4. CoSEM relevance

The relevance of this research topic to the Master's program in Complex Systems Engineering and Management (CoSEM) is underscored by the complex socio-technical system already present within global cargo airline supply chains. These systems involve numerous global partners, each with distinct characteristics, opinions, and interests. Managing these diverse partners effectively is important for achieving sustainability goals. The design of a system that systematically assists in managing these partner relationships aligns with the objectives of the CoSEM program. It addresses the technical chal-

lenge of integrating complex operations and diverse stakeholder management within cargo airlines with the goal of achieving a social goal, highlighting the Master's program's focus on engineering solutions in multifaceted settings.

1.5. Application

An example of a cargo airline striving for sustainability is *Koninklijke Luchtvaart Maatschappij* (Royal Dutch Airlines) (KLM) Cargo. With ambitious sustainability goals, KLM Cargo is committed to achieving 'zero emissions' and 'zero waste' within the ground operations, which are executed by a Ground Handling Agent (GHA) at outstations. This commitment is an important component of their overarching objective to become net-zero by 2050, reinforcing their status as a sustainability frontrunner in the aviation industry. In the *Climate Action Plan* of KLM Cargo, they emphasise their dedication to sustainability with the statement: "*Rather then developing a business strategy and a separate sustainability strategy, we put sustainability at the core of strategy*". (Air France-KLM Group, 2023, p. 5)

Within the broader KLM organisation, KLM Cargo is responsible for the air freight transport operations of its global supply chain. To achieve sustainability goals, specifically zero emissions and zero waste, KLM Cargo heavily relies on its GHAs at the outstations spread around the world. At those outstations, GHAs are responsible for processing the freight transported by KLM Cargo, making them crucial in realising the sustainability goals. The proposed system, as outlined in the research objective, will be applied within KLM Cargo's operations to guide PRM.

1.6. Knowledge gap and Main Research Question

The current literature on PRM has largely overlooked the development of a DSS that specifically guides PRM towards achieving sustainability goals within the global supply chain of cargo airlines. While existing research provides insights into partner selection strategies, it appears insufficient in addressing the management of ongoing relationships, particularly concerning sustainability objectives. The creation of a system designed to guide these relationships, with a focus on meeting sustainability objectives such as zero emissions and zero waste, fills this gap.

Translating this knowledge gap into a research question will lead to the Main Research Question (MRQ). This question will be the foundation for the research, which will create new insights and make a scientific contribution. Also, because of the demarcation of the subject, it will make the study more manageable and clear. Therefore, based on the knowledge gap, the following MRQ can be drawn up:

Main Research Question (MRQ)

How can a Decision Support System (DSS) be developed to guide Partner Relationship Management (PRM) for the operations of existing partners of cargo airlines to achieve sustainability goals?

1.7. Structure

The structure of this thesis is designed to guide the reader through the development, application and evaluation of the DSS, with each chapter addressing specific Research Questions (RQs). Chapter 2 provides an introduction to key concepts of sustainability, PRM with sustainability criteria, and the DSS. It sets the foundation for the research by reviewing literature and theoretical frameworks. Chapter 3 outlines the research approach, including the RQs. It also introduces the research methods, detailing their relevance and application within the study. Chapter 4 answers RQ I, RQ II, and RQ III by developing the DSS based on its identified aspects and objectives. It explains the design and structure of the DSS, ensuring it meets the requirements. Chapter 5 answers RQ IV by applying the DSS to KLM Cargo as a use case. It presents the results of this application, showcasing the practical implementation and outcomes of the DSS in a real-world context. Chapter 6 answers RQ V by checking the effectiveness of the DSS. It validates the results obtained in Chapter 5 and assesses the DSS against the set objectives to determine its functionality and success. Chapter 7 answers RQ VI, focusing on the broader applicability and performance of the DSS across different cargo airlines. Chapter 8 summarises the key findings of the research answering the RQs and the MRQ. Chapter 9 presents a critical discussion of the research, offering insights into the broader context and implications of the study. Finally, the appendices contain all supporting documentation and additional material underlying the research.

2

Theoretical background

The theoretical background of this research involves multiple key concepts, which are the basis for the context and objectives of the study. Initially, a literature review was conducted based on a search string, as shown in Appendix A. In Chapter 2.1, an overview of sustainability will be given, focusing on the trade-off involved and how developing countries should be considered. There will also be elaborated on *green washing*, as this topic is emerging. In continuation of Chapter 1, the theoretical background of PRM is introduced (Chapter 2.2), emphasising its role in promoting collaboration with the partners to achieve sustainability goals. How PRM is currently used in research and how this will be applied in this research will be illustrated. After that, Chapter 2.3 explains the choice for DSS as the used system. As indicated, the DSS to support PRM is demarcated to the operations of partners involved in the global supply chain of cargo airlines.

2.1. Sustainability

Sustainability is often defined as "*development that meets the needs of the present generation without compromising the ability of future generations to meet their needs*" (Thomsen, 2013, p. 2358). This broad concept ensures the reconciliation of three key pillars: social, economic, and environmental. These pillars are not mutually exclusive and can be mutually reinforcing. This means that focusing on one pillar does not prevent attention from being paid to the others. In fact, focusing on one pillar can also enhance the other two, creating a mutual effect that leads to more overall sustainability. (Thomsen, 2013)

While specific sustainability goals often emphasise one pillar more than the others, the interdependence of the pillars requires that progress in one area does not come at the expense of another. For example, prioritising environmental sustainability should not result in neglecting social sustainability. Instead, when pursuing improvement in one pillar, the other two should remain constant or should also (indirectly) improve. Whatever sustainability goal is chosen, it is crucial to ensure that none of the three pillars worsens, ensuring they either improve or remain constant. This interdependence suggests that positive developments in one sustainability pillar can lead to long-term improvements in the others as well due to their connections.

2.1.1. Triple Bottom Line

In a business context, sustainability is often framed using the Triple Bottom Line (TBL), which measures business success in three key areas (the three P's), comparable to the three pillars: Profit, Planet, and People. Profit refers to economic sustainability, ensuring that businesses remain financially viable. Planet focuses on environmental sustainability, focusing on practices that reduce ecological impact. People represent social sustainability, advocating for fair labour practices and social responsibility. By evaluating the performance of the three pillars, businesses can better understand and optimise their overall impact concerning sustainability. (Elkington, 1997)

2.1.2. Sustainable Supply Chain Management

SSCM incorporates the principles of sustainability and the TBL, and applies it to supply chains. It involves integrating the social, environmental, and economic considerations into Supply Chain Management (SCM) practices to remain economically viable in the long term while minimising negative social and environmental impacts. SSCM is important for industries such as cargo airlines, where complex global supply chains involve many different partners. By aligning SCM with certain sustainability goals, companies can ensure that their operation contributes to a sustainable future while also achieving business success. (Chauhan, Kaur, Arrawatia, Ractham, & Dhir, 2022)

2.1.3. Trade-off

Companies face the challenge of adopting SSCM practices due to financial constraints, illustrating the common trade-off between the economic side of sustainability and the social and environmental side of sustainability (Sajjad, Eweje, & Tappin, 2015). Companies prioritise sustainability within tight margins of their business models (Mc Loughlin, Lewis, Lascelles, & Nudurupati, 2023). Taylor and Rosca (2023) explored that various organisational responses to sustainability trade-offs suggest that choices which favour sustainability indicate an intrinsic motivation and also indicate leadership in integrating marginalised stakeholders and in advancing SSCM.

The complex trade-off between profitability and sustainability within global supply chains is extensively argued for. Often, enhancing sustainable practices initially leads to cost reductions, for example, by reducing waste, resource conservation, land management or increased operational efficiency (Pullman, Maloni, & Carter, 2009). However, at a certain point, further enhancing sustainability does not reduce costs but may lead to increased expenses, even when considering the long-term financial impacts. This illustrates that beyond a certain threshold, sustainability initiatives require intrinsic motivation rather than being purely economically driven. In this context, benchmarking emerges as a possible tool. While this is not a direct economic driver, benchmarking can assist companies in creating competitive advantage through continuous improvement in sustainable practices (Hong, Roh, & Rawski, 2012).

2.1.4. Developing countries

In developing countries, the existing trade-off between the economic side of sustainability and the social and environmental side of sustainability becomes even more pronounced for most companies. These countries present a complex trade-off when enhancing sustainability within their supply chains, as the primary focus is often not on sustainability but rather on economic development. Technological innovations should, therefore, be prioritised by investors and project managers in developing countries as a way to enhance sustainability practices (Akomea-Frimpong et al., 2023). This approach serves as an example of creating incentives for partners in developing countries that do not yet focus on sustainability.

Goods are also transported to less developed areas in the world, which shows the importance of including these developing countries in the PRM when considering global supply chains (Mc Loughlin et al., 2023). These partners presumably need a different strategy when managing them; otherwise, sustainability goals cannot be achieved, or to a lesser extent. Raising sustainability awareness among partners in these regions can be achieved by providing education and training on sustainable practices (Siems & Seuring, 2021).

2.1.5. Greenwashing

When discussing sustainability and practices to improve it, one must be aware of greenwashing. Greenwashing is defined as ”*act of disseminating disinformation to consumers regarding the environmental practices of a company or the environmental benefits of a product or service*” (Baum, 2012, p. 424). As companies enhance sustainability, they logically want to inform their customers about their efforts to demonstrate environmental responsibility. However, greenwashing should never be the method to promote these initiatives or to strengthen competitive advantage by misleading consumers.

An illustrative example is provided by the Authority for Consumers & Markets (2024), where European consumer authorities have called on twenty European airlines to adjust their misleading sustainability claims. When focusing on PRM for the operations of partners of cargo airlines to achieve sustainability goals, it is important to consider that greenwashing is not a legitimate way to promote sustainability

efforts. Instead, transparency and commitment to environmental practices are essential to achieve the sustainability goals which are aimed for.

2.2. Partner Relationship Management

PRM is about "*how to build collaborative relationships with partners through effective and reliable processes* (Suh et al., 2005, p. 50). It is recognised in the literature as a value-creating strategy, where both the company and its partners gain mutual benefits from improved relationships. Within this research, the value-creating strategy of PRM is specifically targeted at enhancing the sustainability of operations through collaboration. PRM involves not only managing these relationships but also categorising partners to create tailored strategies. How the partners should be managed to realise the most efficient collaboration within these relationships to enhance sustainability can be supported by PRM. In the context of global supply chains, PRM is crucial for managing partners effectively by establishing reliable relationships. Since the results within global supply chains are highly dependent on the partners involved, these partners must be managed well to achieve the best possible results. (Suh et al., 2005)

Partners within these global supply chains can be strategically chosen based on their performance and alignment with the company's goals. This selection process is part of PRM, involving the evaluation of potential partners. To facilitate tailored strategies for existing partners, it is important to first categorise partners based on characteristics, criteria, or conditions. When partners still need to be selected, scoring potential partners based on several criteria which are important to assess the performance of the partners can be used. This helps to gain insights into the possibilities of partner selection. These criteria can support evaluating the partners, enabling informed decisions about which relationships should be entered into. When looking at sustainability, this selection can also partly or completely be focused on sustainability performance, dependent on the criteria taken into account.

It is clear that within PRM, relationships must be managed based on the partner's characteristics. Otherwise, the strategy to manage the partner could not be applicable to that partner. While it is possible to assess partners individually, a more structured approach becomes necessary under certain conditions: when managing a large number of partners, when reproducibility of strategies is required, and when multiple people are involved in partner management, necessitating alignment of different perceptions. Therefore, categorising the partners based on criteria, as done for partner selection, is essential. This structured process will be discussed in the following chapters, based on the literature.

2.2.1. Partner selection

Within PRM, partner selection reflects the company's priorities and interests. The partner selection criteria can vary widely, depending on the company's strategic goals. When looking at SSCM, partner selection is a core conceptual element and sustainability is represented by the selection criteria for the partner (Seuring et al., 2022). (W. Y. Wu, Shih, & Chan, 2009)

According to C. Wu, Lin, Barnes, and Zhang (2020), the decision-making process in partner selection is important for ensuring that the choices made lead to sustainable partners. When sustainability criteria are considered, this process not only assesses potential partners based on their current capabilities and performances but also on their alignment with sustainability goals. Effective partner selection, therefore, involves not just evaluating new partners but also segmenting existing partners to gain insights into their performance within the global supply chain. The segmentation allows for customised strategies that address the different characteristics of the partners.

2.2.2. Partner segmentation

Partner segmentation within PRM is a strategic process introduced by Kraljic (1983) in a purchasing portfolio model. This model segments suppliers based on two key dimensions: profit impact and supply risk. By plotting these dimensions on a 2x2 matrix, partners can be divided into four categories, each requiring different strategies. This segmentation approach has been widely adopted and adapted in scientific research.

Rezaei and Ortt (2012) adopted the model by identifying 'capabilities' and 'willingness' as important axes for supplier evaluation. Segmentation based on these criteria allows for a detailed evaluation of existing partners, focusing on what partners can do (capabilities) and their motivation to align with

certain goals (willingness). This approach can also be useful when evaluating partners based on sustainability. By assessing both capabilities and willingness, companies can identify which partners are able and willing to enhance or not enhance sustainability objectives. This segmentation requires the creation of specific sustainability criteria that align with these two dimensions. A more targeted and effective evaluation of current partners can be achieved, ensuring tailored PRM strategies.

The definition of the capabilities and the willingness of a partner to enhance sustainability can be adapted and specified from Rezaei and Ortt (2012) and defined as follows:

Capabilities: *The capabilities of a partner to enhance sustainability are complex bundles of skills and accumulated knowledge, exercised through organisational processes that enable firms to coordinate activities and make use of their assets in different business functions with the goal to engage in sustainability practices.*

Willingness: *The willingness of a partner to enhance sustainability is confidence, commitment and motivation to engage in sustainability practices.*

2.2.3. Criteria

As demonstrated in the context of partner selection and partner segmentation, criteria can play an important role in identifying the best partners for a given situation. Besides that, when creating tailored strategies for existing partners, criteria can be useful for segmenting the partners. Similarly, when considering sustainability goals, applying specific criteria can help evaluate partners' capabilities and willingness to enhance sustainability practices. In the case of existing relationships, criteria can serve as a guideline for assessing how partners perform regarding their sustainability initiatives. Existing partners are probably not or are just partially selected based on sustainability objectives. By evaluating these partners based on specific sustainability criteria, existing partners can be segmented, and their sustainability performance can be assessed.

This chapter provides an overview of the criteria for assessing partners' capabilities and willingness to enhance sustainability. These criteria are based on existing partner selection criteria and an extensive additional literature review. Some of the criteria from the literature have been adapted to focus on enhancing sustainability rather than solely selecting partners. These criteria should cover the broadest possible selection of sustainability aspects. The capabilities and willingness criteria to enhance sustainability presented in Table 2.1 are subtracted from the table of Rezaei and Ortt (2013a, p. 76-77) and supplemented with the researches of de Almeida, Gohr, Morioka, and Medeiros da Nóbrega (2021), Corral (2003), Meier, Gruchmann, and Ivanov (2023), and Kannan and Tan (2002).

Table 2.1: A list of capabilities and willingness criteria to enhance sustainability

Capabilities criteria	Willingness criteria
Collaboration: absorptive capability	Attitude
Collaboration: external capability	Commitment to continuous improvement in process
Collaboration: integrative capability	Dependency
Financial position	Economic opportunities
Geographical location capability	Environmental concerns (public concerns/public pressure)
Innovation management capability	Ethical standards
Knowledge management capability	Flexible contract terms and conditions
Management and organisation	Government grants
Measurement capability	Honest and frequent communications
Position in industry	Long-term relationship
Technological capability (technical capability)	Market pressure
	Mutual respect and honesty
	Regulatory pressure (legal pressure)
	Relationship closeness
	Willingness to co-design and participate in new sustainability practices
	Willingness to invest in specific equipment
	Willingness to share information, ideas, and technology

The following sections will explain each capability and willingness criteria, providing a basis for the DSS for evaluating partners' capabilities and willingness to enhance sustainability. The criteria are chosen

to cover the broadest possible range of aspects, addressing the three pillars of social, economic, and environmental sustainability. Criteria from the list can cover one or multiple pillars, although the criteria probably reflect multiple pillars due to the high interdependence explained in Chapter 2.1. So, this generalised set of sustainability criteria aims to cover the broadest possible range of aspects, offering a practical tool for guiding PRM. By understanding and applying these criteria, the sustainability practices of partners can be assessed more easily and possibly be improved, contributing to the achievement of their sustainability goals.

It is important to note that some of the criteria are proxy attributes. A proxy attribute, as defined by Fischer, Damodaran, Laskey, and Lincoln (1987), "*reflects the degree to which an associated objective is met but does not directly measure the objective*". Proxy attributes are indirect measures used when direct quantification of an objective is not possible. These attributes are needed within the sustainability assessment by criteria where direct outcomes can be hard to measure. For example, 'market pressure' is seen as a proxy attribute for assessing a partner's willingness to enhance its sustainability practices. Market pressure may not directly measure a company's commitment to sustainability, but it influences the partner's behaviour. In environments with strong market demand for sustainable practices, companies are more likely to adopt these practices not necessarily out of intrinsic motivation but as a response to external pressures. This results in a higher willingness of the partner to enhance sustainability.

Capabilities

- **Collaboration: absorptive capability**
  As part of the collaboration (or collaborative capability), the absorptive capability is a partner's ability to adopt sustainability initiatives enabled by inter-organisational learning. This means that the partner can extract knowledge from at least one other organisation outside the (parent) organisation that is considered.
- **Collaboration: external capability**
  As part of the collaboration (or collaborative capability), the external capability is the ability of a partner to develop strong informal relationships with partners in their own network. This can also be called the 'network embeddedness'. This means that the partner is developing these strong relationships within the (parent) organisation that is being looked at.
- **Collaboration: integrative capability**
  As part of the collaboration (or collaborative capability), the integrative capability is the ability of partners to cooperate with sustainability practices, which a single partner can not achieve. Within supply chains, integrative capability is about integrating distributed resources to beneficiate partners to reach sustainability goals.
- **Financial position**
  The financial position of the partner, including the partner's credit rating, relative to the financial position of other partners within the network.
- **Geographical location capability**
  The influence of the geographical location of the partner. This is purely about the geographical location, so it is not about the influence of the government or the public in that area.
- **Innovation management capability**
  The capability of the partner to ease innovation processes while generating new ideas and creating new business opportunities to enhance sustainability.
- **Knowledge management capability**
  The capability of the partner to acquire new knowledge and to evaluate current knowledge about sustainability practices. This is also called 'industry knowledge', with industry referring to the knowledge of sustainability practices.
- **Management and organisation**
  The management and organisation of the partner in relation to the acceptance of sustainability practices.
- **Measurement capability**
  The extent to which the partner can measure their performance based on sustainability. Knowing

to what extent certain practices are sustainable contributes to actually enhancing sustainability practices.

- **Position in industry**
  The partner's position in the industry in comparison with other competitors in the same industry, including the reputation of this partner.
- **Technological capability (technical capability)**
  The capability of the partner to implement technologies to enhance sustainability.

Willingness

- **Attitude**
  The attitude of the partner towards sustainability.
- **Commitment to continuous improvement in process**
  The level of commitment of the partner to continuously improve the current processes.
- **Dependency**
  The level of dependency of the partner on the organisation which is looked at.
- **Economic opportunities**
  The level at which sustainable practices could lead to economic opportunities for the partner. The return of a sustainability investment could be higher for one partner in comparison with another partner.
- **Environmental concerns (public concerns/public pressure)**
  The level of environmental concerns (which can also be seen as public concerns and public pressure) of the public in the area where the partner operates. These concerns are purely focused on the opinion of the public.
- **Ethical standards**
  The level of adoption of ethical standards by the partner.
- **Strict contract terms and conditions**
  The strictness of the contract's terms and conditions with the partner regarding implementing sustainability practices. This means that the higher the strictness, the higher the willingness for sustainability since implementing these sustainability practices is forced by the contract's terms and conditions.
- **Government grants**
  The level of opportunities in which the government supports sustainable practices with grants or other tax rebates, which could motivate the partner to implement these sustainable practices.
- **Honest and frequent communications**
  The frequency and the honesty of the communication with the partner.
- **Long-term relationship**
  The length of the existing relationship with the partner.
- **Market pressure**
  The level of pressure by the market to implement sustainable practices. This is purely focused on the market, which means that other companies can, for example, put pressure on the partner to implement sustainable practices.
- **Mutual respect and honesty**
  The level of mutual respect and honesty with the partner.
- **Regulatory pressure (legal pressure)**
  The level of pressure by regulations to implement sustainable practices. This is purely focused on the pressure put by the government with regulations on the partner.
- **Relationship closeness**
  The closeness of the relationship with the partner.
- **Willingness to co-design and participate in new sustainability practices**
  The partner's willingness to co-design and participate in new sustainability practices.

- **Willingness to invest in specific equipment**
  The willingness of the partner to invest in specific equipment for sustainable practices.
- **Willingness to share information, ideas, and technology**
  The willingness of the partner to share information, ideas, and technology to enhance sustainability.

2.2.4. Strategies based on segmentation

Using partner segmentation based on different criteria is a strategic approach that helps categorise partners into distinct segments. This method is particularly ideal for situations where a large number of partners need to be managed (Panizzolo, 1998). By efficiently categorising partners, segmentation supports the PRM process, ensuring that tailored strategies can be developed and implemented for each segment.

In the work of Kraljic (1983), Rezaei and Ortt (2012) further refined this model by categorising partners based on capabilities and willingness criteria. As introduced above, these criteria provide a framework for evaluating partners' ability and motivation to enhance sustainability. In the context of this research, the segmentation model based on capabilities and willingness enables a structured approach to PRM, ensuring that strategies are aligned with the specific characteristics of each partner segment. This approach enhances the efficiency of PRM by allowing for the development of uniform strategies that address the common characteristics and needs of partners within each segment. By leveraging these strategies, cargo airlines can effectively guide their PRM efforts towards achieving their sustainability goals.

Strategies for managing partners in different segments have already been developed in the literature. These strategies can be adapted to fit the specific context of cargo airlines with sustainability goals. During the design of the DSS, these existing strategies from the literature can be tailored and specified to meet the needs of this research.

2.3. Decision Support System

A DSS can be defined as "*computer-based systems that bring together information from a variety of sources, assist in the organisation and analysis of information and facilitate the evaluation of assumptions underlying the use of specific models*" (Baizyldayeva et al., 2013, p. 1725). In the context of supply chain management, a DSS plays a role in aiding the decision-making process, particularly when choosing the right partner from several candidates (Zhang & Xi, 2005).

Although DSSs are primarily used for partner selection, they can also play a role in achieving the broader goal of merging relevant information into a model to facilitate informed decision-making. This research focuses on how a DSS can guide the management of existing partners rather than selecting new ones. By evaluating partners against the defined criteria, the DSS provides structured insights into the capabilities and willingness of partners to enhance sustainability. The DSS will support cargo airlines in assessing partners and aligning them with their specified sustainability goals. (Baizyldayeva et al., 2013)

3

Research approach and methodology

This chapter delves into the research approach utilised in Chapter 3.1, providing a framework for the study. It includes the limitations discussed in Chapter 3.2, ensuring a clear understanding of the study's scope and potential constraints. Based on the MRQ, the RQs will be formulated and presented in Chapter 3.3. Chapter 3.4 outlines the specific methods employed for the research, offering detailed insights into the techniques and procedures to be followed. Chapter 3.5 presents a conceptual overview of the research, illustrating the overall design and structure. Finally, Chapter 3.6 discusses the data management plan, highlighting the strategies for handling and protecting the data collected throughout the research process.

3.1. Research approach

The MRQ shows the need for a design of a DSS. Hence, the chosen research methodology is the *design approach*. This research approach bridges the gap between theory and practice, offers practical outcomes, and gives valuable scientific insights (Bakker & van Eerde, 2015). The complex socio-technical system, which is trying to achieve sustainability goals involving multiple partners worldwide, aligns well with the holistic nature of the design approach, as proposed by Plomp and Nieveen (2007).

The problem-solving methodology of the design approach is based on the following six key steps (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2007):

1. Problem identification
2. Designing solution objectives
3. Design and development
4. Demonstration
5. Evaluation
6. Communication

The RQs will be aligned with these key steps, aiming to comprehensively explore the identified issue.

3.2. Research limitations

As shown by Hevner, March, Park, and Ram (2004), the design-science paradigm attempts to expand the boundaries of human and organisational capabilities by creating new and innovative artefacts. In alignment with this paradigm, the chosen design approach for this research seeks to address the identified gap to create a DSS which guides PRM to reach sustainability goals. However, despite the potential advantages of the design approach, certain limitations must be acknowledged.

While the design approach aims to bridge the gap between theory and practice, there exists a challenge in its applicability across diverse settings (Johannesson & Perjons, 2014). Focusing on KLM Cargo may introduce a limitation, as the specific characteristics and operational nuances of KLM Cargo might differ

significantly from other cargo airlines. The generalisability may, therefore, be constrained. By ensuring that the choices based on the operations of KLM Cargo are carefully documented, it will be easier to generalise the findings to other cargo airlines with similar characteristics. This detailed documentation of the application can help overcome the limitation, facilitating broader application and comparison, even when future research aims to extend generalisation to other sectors.

Another limitation could be that it is very uncommon to both create and reassess a design within one research (Hevner et al., 2004). Realising this from the beginning resolves unrealistic expectations where there is the idea that much iteration is possible within just one research.

3.3. Research Questions

Six RQs have been created to answer the MRQ. Since the design approach will be used for the research, the six RQs will cover a phase of the design approach (Peffers et al., 2007).

RQ I
Problem identification
Which aspects should be incorporated in the DSS to guide PRM for the operations of partners through MCDM?

The first RQ delves into the aspects which should be incorporated in the DSS. The DSS should guide PRM, specifically for the operations of partners of cargo airlines. The aspects should be chosen such that Multi-Criteria Decision Making (MCDM) can be applied when using the DSS.

Conducting desk research will be the research method to explore the aspects which should be incorporated in the DSS. Shortcomings of current frameworks and models will be part of the outcome of this RQ. The aspects and the shortcomings will be important for the design of the DSS during the design and development phase.

RQ II
Designing solution objectives
Which objectives should the DSS achieve to guide PRM for the operations of partners?

This RQ focuses on establishing a set of objectives for the DSS to guide PRM for the operations of partners of cargo airlines. How the objectives should be accomplished will be studied during this RQ. A desk research will be used to gather these insights. By avoiding direct reliance on the first RQ outcomes, the aim is to generate the objectives independently. The deliverable will serve as a foundation for the next phase, the design and development phase.

RQ III
Design and development
How can the identified aspects be integrated into a DSS that guides PRM through MCDM for achieving sustainability goals?

The third RQ aims to design an initial DSS with the aspects gathered in the first RQ, which tries to achieve the objectives as investigated in the second RQ. The initial DSS will be created based on desk research while allowing MCDM as a research method to be applied to the DSS when putting it into practice. Therefore, MCDM will be the second research method for this RQ to make sure the DSS is compatible using this quantitative method.

RQ IV
Demonstration
How can the designed DSS be applied to KLM Cargo's ground operations of GHAs at outstations to achieve zero emissions and zero waste?

The fourth RQ uses the initially created DSS on KLM Cargo as a use case for the demonstration phase. The characteristics of KLM Cargo will be investigated based on desk research. The ground operations of GHAs at outstations will be defined, as well as the specific sustainability goals of zero emissions and zero waste. The DSS will be used as a framework with specified partners and sustainability goals for the operations of KLM Cargo. The MCDM method will be applied for the decision-making steps of the DSS, which requires input from experts through semi-structured interviews to select the criteria and

find the trade-off between the criteria. Also, a focus group will be organised to specify the strategies for the GHA of KLM Cargo.

RQ V
Evaluation
How can the effectiveness of the DSS be assessed in terms of its functionality within KLM Cargo, based on the validation of the results and on the objectives stated in RQ II?

Based on the outcomes of the application of the DSS on KLM Cargo and on the objectives as created during RQ II, the fifth RQ assesses the effectiveness of the DSS. Possible shortcomings of the DSS can be documented and possibly be changed in the DSS if iteration is possible. The outcomes of the focus group will support the assessment of the effectiveness of the DSS.

RQ VI
Evaluation
What adjustments are needed to enhance the DSS's applicability and performance across cargo airlines in general?

The last RQ makes sure the MRQ can be answered by checking whether the DSS is applicable to other cargo airlines' partners, achieving sustainability goals which could possibly differ from the ones from KLM Cargo. The outcomes of the other RQs will show the generalisability of the DSS. The outcome will be a set of adjustments that must be applied to the DSS to make it applicable to other cargo airlines. Another possible outcome could be that some clear guidance is given on what adjustments should be made to make it even further applicable to other sectors in future research.

The sixth and last phase is the **communication**. Since the thesis itself aims to communicate how the DSS is created and how it should be used, the whole research (which includes the MRQ can be seen as the communication phase. The communication via the thesis is mainly directed to other researchers to conduct further research and also to practitioners to apply the research in practice. For completeness, the MRQ is presented below:

MRQ
Communication
How can a Decision Support System (DSS) be developed to guide Partner Relationship Management (PRM) for the operations of existing partners of cargo airlines to achieve sustainability goals?

3.4. Methods

As shown in the previous section, different methods will be used within the research to answer the RQs. The main focus of the DSS is the use of MCDM, with expert interviews and a focus group as supporting methods for the input of the MCDM.

3.4.1. Multi-Criteria Decision Making

Chapter 2 shows that several sustainability criteria can be found in the literature aimed at achieving various sustainability goals. These criteria can be used to score partners, with the goal of managing relationships with these partners effectively. To do this, the relevant criteria need to be chosen and weighted in a structured manner. This ensures reproducibility and acknowledges that different criteria have varying levels of importance. Similar to how MCDM is used for segmenting partners during selection, it can also be employed to evaluate the sustainability performance of existing partners. "*MCDM is concerned with structuring and solving decision and planning problems involving multiple criteria. The purpose is to support decision-makers facing such problems.*" (Majumder, 2015, p. 35)

MCDM enables selecting criteria, scoring partners based on those criteria, and illustrating the trade-offs between different criteria (Rezaei, 2020). For this research, the criteria have been selected to reflect both willingness and capabilities to enhance sustainability. This allows for creating a matrix to segment the partners into different categories (structuring decision problems), following a framework similar to the Kraljic Matrix (Kraljic, 1983). By creating a matrix and segmenting partners based on their willingness and capabilities, cargo airlines can adopt strategies to guide PRM toward achieving sustainability goals.

The use of criteria may be clear, just like the process of assigning scores to those criteria. However, determining the importance of the criteria also needs to be addressed. This could be done by simply ranking the criteria and then assigning relative weights, but this approach lacks nuance. Alternatively, not assigning different weights at all is another option, but this, too, fails to capture nuances since the chosen criteria will likely not have the same importance. Therefore, there is a need for an MCDM method that allows for the assignment of weights to criteria in a manner that is both easy to use and reproducible. Once the weights are determined, no specific method is required for further analysis, as the weights can be multiplied by the assigned scores for each criterion. Normalising these will result in two aggregated scores for the capabilities and willingness of a particular partner to enhance sustainability.

So, an MCDM method is needed to determine the relative importance of different criteria. Stojčić, Zavadskas, Pamučar, Stević, and Mardani (2019) shows that the MCDM methods used in the sub-area of supply chain management are Analytic Hierarchy Process (AHP), Analytic Network Process (ANP), Best-Worst Method (BWM), Decision-Making Trial and Evaluation Laboratory (DEMATEL), Fuzzy Preferences Programming (FPP), and Simple Multi-Attribute Rating Technique (SMART). More methods were named within the sub-area of supply chain management, but those were not focused on assigning the weights, so they are not mentioned here. Taherdoost and Madanchian (2023) provides a quantitative overview of 60 different methods, indicating the popularity of these methods. Combining the sources gives the order of the six methods based on the number of results found in the articles: AHP (15,452), ANP (3,126), DEMATEL (1,378), BWM (867), SMART (646), with FPP not discussed. Hafezalkotob, Hafezalkotob, Liao, and Herrera (2019) was used to check whether the weighting methods can be used as subjective weighting methods since the relative importance of the criteria is based on input from experts (Chapter 3.4.2). Also, it was checked whether it could be used for 'operations research and decision-making'. FPP is again not discussed, so it is left out, and ANP is a general extension of AHP, which is why only AHP is considered.

AHP uses pairwise comparisons between the criteria to acquire the relative weights of the criteria (Mastrocinque, Ramírez, Honrubia-Escribano, & Pham, 2020). BWM also uses pairwise comparisons, but only based on comparing the best criteria to the other criteria and the other criteria to the worst (Rezaei, 2020). DEMATEL allows for creating weights by looking at causal relationships and the interdependence among the criteria, also with the use of pairwise comparisons (Yang & Tzeng, 2011). SMART involves assigning performance ratings to the alternatives in order of subjective importance (Taherdoost & Mohebi, 2024). All four methods use pairwise comparisons to determine the weights. AHP and DEMATEL both require a full matrix comparison, which takes more time than BWM and SMART since BWM and SMART require fewer comparisons. SMART uses a single vector, making it very data and time-efficient, although it does not allow checking for the consistency of the pairwise comparisons. On the other hand, BWM is as data and time-efficient as possible while still enabling checking for the consistency of the pairwise comparisons. This makes the evaluation process more efficient and manageable, particularly when dealing with a large number of criteria. (Rezaei, 2020)

Besides that, BWM allows decision-makers to conduct comparisons systematically by identifying the most important (best) and least important (worst) criteria, which also gives the expert a clear understanding of the range of evaluation, which enhances the reliability of the pairwise comparisons. Another advantage is the output of BWM, which is always consistent due to its unique comparison structure. By comparing each criterion only to the best and worst criteria, BWM minimises the inconsistencies that often occur in other pairwise comparison methods. This leads to more reliable and accurate decision-making outcomes. Rezaei (2016b) provides an Excel solver which supports the straightforward application of the method. Combining these advantages, using BWM leads to efficiently gathering more reliable and accurate results. (Rezaei, 2020)

However, it is important to note that the process of making comparisons can introduce bias. Two possible biases are 'anchoring bias' and 'equalising bias'. Anchoring bias occurs when an initial piece of information disproportionately influences subsequent judgements. Equalising bias happens when decision-makers tend to distribute weights more evenly than warranted. According to Rezaei (2021), BWM mitigates anchoring bias and is less affected by it compared to methods with a single reference point like SMART and Swing (Swing is not discussed further as it was not mentioned in the other papers). Rezaei, Arab, and Mehregan (2022) states that AHP and BWM have less equalising bias than SMART.

Therefore, considering all these factors, BWM is justified as the most suitable MCDM method for this research.

Best-Worst Method (BWM)

Rezaei (2015, p. 51) gives an overview of the five steps which have to be executed to obtain the weights for the chosen criteria within the BWM. These steps are shown in Figure 3.1.

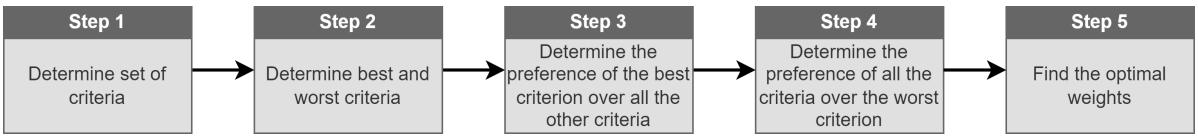


Figure 3.1: BWM steps

An overview of the steps and formulas is presented below, subtracted from Rezaei (2015).

Step 1: From the list of capabilities and willingness criteria, a set of relevant criteria needs to be determined for capabilities $\{C_1^C,\ C_2^C,\ ...,\ C_n^C\}$ and for willingness $\{C_1^W,\ C_2^W,\ ...,\ C_n^W\}$.
Step 2: The best and the worst criteria have to be determined based on the set of chosen capabilities criteria and based on the set of willingness criteria.
Step 3: The preference of the best criterion over all the criteria is determined. This is done by scoring the best criterion with a score from one to nine over the other criteria. A score of 'one' means that the best criterion is of equal importance to the other criteria. A score of 'nine' means that the best criterion is absolutely more important than the other criterion. The definition of the scale from one to nine is provided in the Excel sheet. The best-to-others vector which is obtained from this step is: $A_B = (a_{B1},\ a_{B2},\ ...,\ a_{Bn})$ with a_{Bj} is the preference from one to nine of the best criterion B over criterion j.
Step 4: For the worst criterion, the same needs to be done for the preference of the other criteria over the worst criterion with a score from one to nine. The others-to-worst vector from this step is: $A_W = (a_{W1},\ a_{W2},\ ...,\ a_{Wn})^T$.
Step 5 (non-linear): The optimal weights $(w_1^*,\ w_2^*,\ ...,\ w_n^*)$ for the criteria can be calculated with the following formulas.

$$\begin{gathered}\min \max_j \left\{ \left| \frac{w_B}{w_j} - a_{Bj} \right|, \left| \frac{w_j}{w_W} - a_{jW} \right| \right\}, \text{ such that} \\ \sum_j w_j = 1 \\ w_j \geq 0, \text{ for all } j\end{gathered} \tag{3.1}$$

Transforming Formula 3.1 results in:

$$\begin{gathered}\min\ \xi, \text{ such that} \\ \left| \frac{w_B}{w_j} - a_{Bj} \right| \leq \xi, \text{ for all } j \\ \left| \frac{w_j}{w_W} - a_{jW} \right| \leq \xi, \text{ for all } j \\ \sum_j w_j = 1 \\ w_j \geq 0, \text{ for all } j\end{gathered} \tag{3.2}$$

When Formula 3.2 is solved, the optimal weights $(w_1^*,\ w_2^*,\ ...,\ w_n^*)$ and ξ^* are acquired. This is the outcome of step 5, which utilises a non-linear optimisation process to determine the weights for each criterion. Rezaei (2016b) supports the execution of the five steps with an Excel solver, which uses a

linear model of BWM to facilitate the calculations. Rezaei (2016a, p. 130) provides the linear model of BWM.

Step 5 (linear): The optimal weights (w_1^*, w_2^*, ..., w_n^*) for the criteria can be calculated with the following formulas.

$$\begin{gathered} \min \max_j \left\{ \left| w_B - a_{Bj} w_j \right|, \left| w_j - a_{jW} w_W \right| \right\}, \text{ such that} \\ \sum_j w_j = 1 \\ w_j \geq 0, \text{ for all } j \end{gathered} \tag{3.3}$$

Transforming Formula 3.3 into a linear programming problem:

$$\begin{gathered} \min \ \xi^L, \text{ such that} \\ \left| w_B - a_{Bj} w_j \right| \leq \xi^L, \text{ for all } j \\ \left| w_j - a_{jW} w_W \right| \leq \xi^L, \text{ for all } j \\ \sum_j w_j = 1 \\ w_j \geq 0, \text{ for all } j \end{gathered} \tag{3.4}$$

When Formula 3.4 is solved, the optimal weights (w_1^*, w_2^*, ..., w_n^*) and ξ^{L*} are acquired. The Excel solver automatically calculates the optimal weights after steps 1 to 4 have been executed by the expert. The solver supports evaluating three to nine criteria (more than nine criteria are possible, but clustering is recommended). Additionally, the solver calculates the input-based consistency ratio, which indicates the consistency level of the input provided by the expert. This ratio is crucial for verifying the logical consistency of pairwise comparisons, ensuring reliable results. While the consistency index measures the consistency of a comparison in non-linear models, only the consistency ratio is relevant for the linear model used for this research. The input-based consistency ratio is calculated as follows (Liang, Brunelli, & Rezaei, 2020, p. 3):

$$\begin{gathered} CR^I = \max_j CR_j^I, \text{ where} \\ CR_j^I = \begin{cases} \frac{|a_{Bj} \cdot a_{jW} - a_{BW}|}{a_{BW} \cdot a_{BW} - a_{BW}} & a_{BW} > 1 \\ 0 & a_{BW} = 1 \end{cases} \end{gathered} \tag{3.5}$$

Table 3.1 shows the thresholds for the input-based consistency measurement. This threshold value depends on the number of criteria evaluated and the scale evaluation. The pairwise comparison consistency level is considered acceptable if the input-based consistency ratio, which can be calculated using Formula 3.5, is lower than the threshold found in the table. (Liang et al., 2020)

Table 3.1: Thresholds for the different combinations of input-based consistency ratio

Scales	**Criteria**						
	3	**4**	**5**	**6**	**7**	**8**	**9**
3	0.1667	0.1667	0.1667	0.1667	0.1667	0.1667	0.1667
4	0.1121	0.1529	0.1898	0.2206	0.2527	0.2577	0.2683
5	0.1354	0.1994	0.2306	0.2546	0.2716	0.2844	0.2960
6	0.1330	0.1990	0.2643	0.3044	0.3144	0.3221	0.3262
7	0.1294	0.2457	0.2819	0.3029	0.3144	0.3251	0.3403
8	0.1309	0.2521	0.2958	0.3154	0.3408	0.3620	0.3657
9	0.1359	0.2681	0.3062	0.3337	0.3517	0.3620	0.3662

Appendix B provides a detailed look at the Excel solver, which requires input for steps 1 to 4 from the expert (set of criteria, the best and worst criteria, the preference of the best criteria over the others, and the preference of the other criteria over the worst). The Excel solver then calculates the weights and the input-based consistency ratio, making BWM easy to apply.

When multiple experts are used to determine the weights, the geometric mean of the weights can be employed to consolidate the input. The geometric mean is particularly suitable for combining expert opinions as it minimises the influence of extreme values and is useful for representing the average of a series of values that are always multiplied (Vogel, 2022). The geometric mean can be calculated using Formula 3.6, where w_i represents the individual optimal weights calculated by the BWM for each expert and n is the total number of experts:

$$\text{Geometric Mean } (w_i^{GM}) = \sqrt[n]{w_{i,1} \cdot w_{i,2} \cdot \ldots \cdot w_{i,n}} \tag{3.6}$$

When the geometric mean is calculated, the weights must be normalised again to ensure they sum up to one. This normalisation ensures that the combined weights appropriately reflect the relative importance of each criterion as agreed upon by the experts. Normalised weights can be calculated according to Formula 3.7, where w_i^{GM} represents the geometric mean of the individual weights assigned to each criterion:

$$\text{Normalised weight } (w_i^N) = \frac{w_i^{GM}}{\sum_{j=1}^{n} w_j^{GM}} \tag{3.7}$$

Using the Simple Additive Weighting (SAW) method, the aggregated criteria scores can be calculated for each partner (Taherdoost, 2023). This method provides a measure of each partner's overall performance based on the criteria scores. Formula 3.8 calculates the aggregated score S of a set criteria for partner j, where w_i^N represents the normalised weight of criterion i, s_{ij} is the assigned score of partner j for criterion i, and n is the total number of criteria:

$$\text{Aggregated score } (S_j) = \sum_{i=1}^{n} (w_i^N \cdot s_{ij}) \tag{3.8}$$

These generic forms of the formulas will be applied during the application phase of this research. During the application in Chapter 5, these formulas will be specified according to the set of capability and willingness criteria identified for the context of KLM Cargo.

3.4.2. Expert interviews

The qualitative data required for the BWM will be collected through both semi-structured and fully structured interviews with relevant experts. This way, the DSS can be applied to the operations of KLM Cargo. Semi-structured interviews allow for a flexible dialogue, where the interviewer can explore specific topics in depth while allowing experts to introduce and elaborate on topics they perceive as important (Adams, 2015). In contrast, fully structured interviews involve standardised questions, required probes, and responses, ensuring consistency (Rogers & Wupperman, 2007).

The interviews will serve four primary purposes:

1. **Reviewing and selecting the sustainability criteria**
   The first set of semi-structured expert interviews will focus on reviewing the list of sustainability criteria based on capabilities and willingness that have been extracted from the literature. First, the criteria will be validated by the experts, and subsequently, the criteria necessary for the operations of KLM Cargo will be chosen.
2. **Scoring of the partners**
   The second set of semi-structured interviews will gather expert evaluations for scoring the partners. The relevant partners will be assessed based on the selected sustainability criteria. Experts will use their knowledge and experience to score the partners, providing an assessment that reflects each partner's capabilities and willingness to engage in sustainable practices.

3. **Making the trade-off between the chosen criteria**
   The third set of interviews will be fully structured. This is because creating the trade-off with the BWM in the Excel solver is standardised, requiring the same generated responses. The same experts from the first set of interviews will compare the selected capabilities and willingness criteria to enhance sustainability in the context of KLM Cargo. Using a standardised method allows for a systematic evaluation of the criteria, ensuring consistency and reliability in determining the weights of the criteria.
4. **Validation of the results**
   The fourth interview is fully structured. Validation will be done by asking an expert whether partners are correctly segmented. The same expert will be used from the selection of and the trade-off between the criteria. This ensures consistency in the validation process and confirms the accuracy of the segmentation results.

3.4.3. Focus group

As the second qualitative research method, a focus group will be conducted to develop customised strategies for the different partners. A focus group involves gathering a select group of individuals who are experts within the research field. In this case, these experts will be from the organisation of KLM Cargo with knowledge about the partners and sustainable strategies. This method uses interaction within the group to generate data. The facilitator leads the group through the different segments, encouraging participants to discuss and debate. This interaction reveals individual opinions and highlights consensus and differences that may exist among the participants. (Leung & Ratnapalan, 2009)

3.5. Research Flow Diagram

A schematic overview of the relations between the RQs and the deliverables are presented in the Research Flow Diagram (RFD) in Figure 3.2. The research methods are shown, including the way the data is going to be analysed.

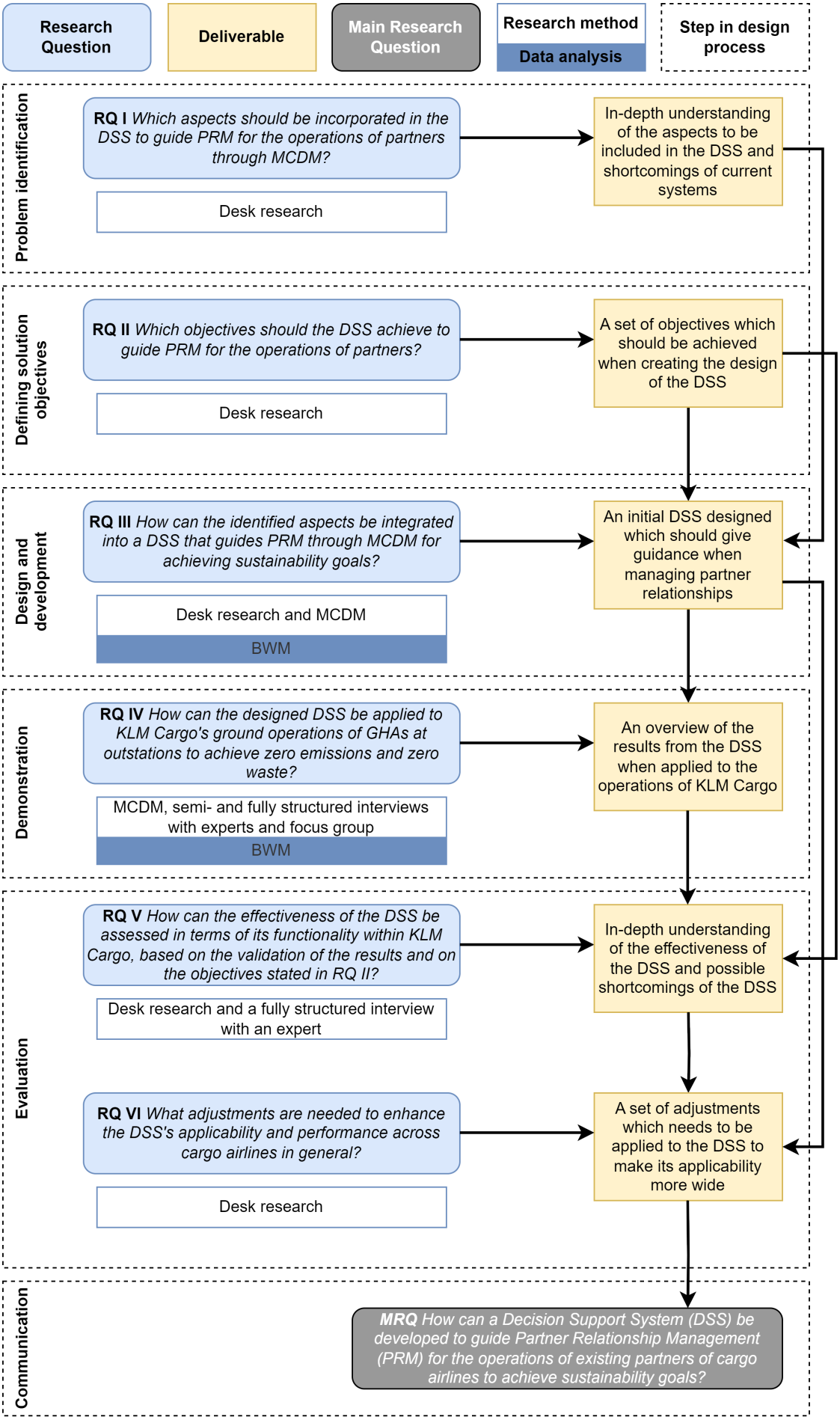


Figure 3.2: Research Flow Diagram

3.6. Data management

The research involves two data-gathering methods involving human participants: interviews and a focus group. The interviews are essential for selecting criteria, scoring partners, creating trade-offs between criteria, and validation. The focus group is essential for specifying the strategies.

A data management plan was developed, including risk analysis and mitigation strategies to ensure data integrity and confidentiality. A detailed risk analysis was conducted to identify potential risks associated with the data-gathering process. Participants had to sign informed consent forms to ensure they understood the research and their involvement (Appendix C). Additionally, all experts received a summary of their interview for verification, ensuring the accuracy of the data collected and that participants' views were accurately represented.

4

The Decision Support System

This chapter will describe the creation of the DSS. To create the DSS, several steps have to be taken: problem identification, designing solution objectives, and the actual design and development of the DSS. These steps align with the first three RQs and will be discussed within this chapter.

First, Chapter 4.1 describes aspects of the DSS that should be included. Chapter 4.2 outlines the objectives the DSS should achieve. Combining this information, Chapter 4.3 will present the DSS which has been developed. The chapter will be finalised with a summary of the key points and findings in Chapter 4.4.

4.1. Aspects of the Decision Support System

This chapter aims to address the first RQ, which forms the basis of problem identification for developing the DSS.

RQ I
Problem identification
Which aspects should be incorporated in the DSS to guide PRM for the operations of partners through MCDM?

To answer this RQ, this chapter is divided into three different sections. First, what necessities need to be assessed for a DSS to meet the requirements of a DSS will be discussed. Then, how the DSS can provide guidance for PRM will be researched. Finally, a description will be given of how MCDM will be used within the DSS.

4.1.1. Integration of the Decision Support System aspects

As discussed in Chapter 2.3, Baizyldayeva et al. (2013, p. 1725). describes a DSS as "*computer-based systems that bring together information from various sources, assist in the organisation and analysis of information and facilitate the evaluation of assumptions underlying the use of specific models.*" More specifically, Liu, Duffy, Whitfield, and Boyle (2010, p. 280) sums up that a DSS exists of the following three aspects:

- A DSS is decision-focused;
- A DSS is user-initiated and controlled;
- A DSS combines the use of models and analytical techniques with traditional data access and retrieval functions.

Each component is crucial for developing a DSS that supports decision-making and enhances sustainability practices within partner relationships.

Decision-focused
The DSS is decision-focused, emphasising the development of tailored strategies for different segments. By segmenting partners based on specific criteria, the system allows for formulating strategies suited for each category. The output of the DSS should be tailored strategies for all evaluated partners based on the sustainability goals the company wants to achieve. When these strategies are specified, they provide clear guidelines on steps to be taken and probably in which order, ensuring that the DSS is decision-focused.

User initiated and controlled
User initiation and control are important to the operation of the DSS. The system responds to user input, allowing decision-makers to specify and prioritise different sustainability goals. Based on these goals, users (the experts) can select the most relevant criteria from the list provided (as shown in Chapter 2.2.3). The importance of each criterion and the scoring of partners are also determined by user input. This is crucial since the sustainability goals initiated by the user influence the criteria selection and weight determination through the BWM process.

Use of models and analytical techniques with traditional data access and retrieval functions
The core model employed within the DSS is the BWM as part of the broader MCDM method. This model uses analytical techniques to process the input data, including setting criteria weights and scoring partners. The Excel solver can be used as a model for BWM, providing an efficient way to calculate criteria weights. The data access involves information about partners, and the scoring of these partners leads to the segmentation. This integration of analytical techniques with traditional data access and retrieval functions ensures that the DSS can effectively analyse and utilise user-provided data.

By ensuring that these aspects are incorporated in the DSS, the system can provide a systematic approach to managing partner relationships in the context of sustainability within the operations of cargo airlines.

4.1.2. Integration of Partner Relationship Management within the Decision Support System

The integration of PRM within the DSS is designed to enhance the management of the partner's operations. The goal of incorporating PRM into the DSS is to guide the management of relationships with several partners, particularly focusing on achieving sustainability objectives. Given the vast number of partners involved in global supply chains, it is impractical to develop individualised strategies for each partner. To address this challenge, segmentation is employed as a tool within the DSS. By segmenting partners into distinct groups based on sustainability criteria, the system allows for the creation of components of strategies for different segments. This approach ensures that strategies are focused on overarching sustainability goals.

Once the segment-based strategies are established, they can be applied to create a step-by-step strategy to manage partners accordingly. The strategy of each segment aligns with its characteristics, ensuring that PRM efforts are targeted and effective. While these strategies are initially designed for segments, they allow for further customisation to the specific needs of individual partners within each segment if necessary.

This segmentation and strategy application form the basis of PRM within the DSS. The outcome of this integration is clear guidance for decision-makers on how to engage with different partners to achieve the specified sustainability goals. By doing so, the DSS ensures that PRM is not only about maintaining relationships but actively enhancing them through decision-making processes. These processes support partner management and also the effectiveness of enhancing sustainability.

4.1.3. Integration of Multi-Criteria Decision Making within the Decision Support System

The integration of MCDM, specifically using the BWM, within the DSS, is an important component designed to enhance the effectiveness of PRM. MCDM supports the assessment and segmentation of partners by allowing for evaluation and comparison based on chosen criteria.

The first step in the MCDM process within the DSS involves selecting appropriate sustainability criteria for the given situation. Those criteria can be chosen from the list of sustainability criteria, as given in the theoretical background (Chapter 2.2.3). Once the criteria are chosen, MCDM facilitates the scoring of partners based on these criteria. This scoring determines how well each partner aligns with the specified sustainability goals and to what extent they meet the expected standards of performance.

To reveal the trade-off between the different criteria, BWM will be used. BWM helps the experts understand the relative importance of each criterion in the context of the specified sustainability goals in the given situation. Combining the scores of the partners from the capabilities and willingness criteria with the weights of the criteria, each partner is given a position in the matrix that reflects their overall alignment with the desired sustainability performance. This scoring mechanism allows partners to be segmented within the DSS. Segmentation is based on how well partners score against the established criteria, grouping them in a way that reflects their capabilities and willingness to enhance sustainability.

For the MCDM component of the DSS, the input will be a list of sustainability criteria and a list of the partners to be evaluated. Another input is the specific sustainability goals since those specific goals of the organisation directly influence the choice of criteria. Based on these inputs, BWM processes the data to segment the partners within the capabilities and willingness matrix, which allows for specified strategies for the different segments. Regardless of the number of criteria, the nature of the partners, or the number of partners to be evaluated, BWM can be consistently applied. This flexibility ensures that the DSS remains effective across various contexts and scales.

4.2. Objectives of the Decision Support System

This chapter aims to identify the objectives that the DSS should achieve. This is part of designing solution objectives and will focus on the objectives the output should achieve.

RQ II
Designing solution objectives
Which objectives should the DSS achieve to guide PRM for the operations of partners?

To answer the RQ, the chapter is divided into two sections. First, a closer look will be taken at the output of the DSS. Secondly, the initial components of strategies per segment can be defined, but they are not focused on specific partners.

4.2.1. Output objectives

This section delineates the objectives of the DSS, specifically focusing on the sustainable strategies for each segment, which is the output of the DSS. The strategy for a segment of the capabilities and willingness matrix can be used for the partners categorised in that particular segment. These strategies are designed to achieve specific objectives aligning with sustainability goals.

Based on the principles discussed by Danciu (2013), sustainable strategies should adhere to the framework's objectives of the 4 C's: clear purpose, changes, collaborative co-creation, and clear communication. These elements serve as guidelines for formulating sustainable strategies:

1. **Clear purpose**
   The strategies developed from the DSS should have a clear purpose, aligning with the company's sustainable competencies, culture, values, challenges, and overall business strategy. The chosen sustainability goals inputted into the DSS should reflect and support these elements, ensuring each strategy is tailored to enhance the company's sustainable performance.
2. **Changes**
   Sustainable strategies should facilitate significant changes across various organisational dimensions to support sustainability ambitions. These changes should be embedded within the partner's operations, ensuring the sustainable transformation lasts.
3. **Collaborative co-creation**
   A key objective of the strategies should be to foster collaborative co-creation by involving external stakeholders in the innovation process. Therefore, the strategies should not only focus on what the partners should do but mostly on collaboration to achieve the sustainability goals.

4. **Clear communication**
   The strategies must ensure continuous and clear communication of both successes and failures to internal and external stakeholders. Effective communication also facilitates feedback from stakeholders, allowing for timely adjustments to strategies.

By incorporating these guidelines into the strategies which are part of the DSS, the system ensures that sustainable practices are effectively implemented. The strategies should guide how partners can execute their roles within the sustainability framework and how they can interact with the organisation to enhance sustainability efforts over time.

4.2.2. Initial components of strategies per segment

The DSS facilitates the segmentation of partners with a strategy for every segment as output. This is inspired by the Kraljic matrix (Kraljic, 1983), a tool used in strategic sourcing and supply chain management. For the purposes of this research, the matrix is adapted to segment partners based on their sustainability capabilities and willingness. The initial segmentation within the DSS divides partners into four primary categories based on the two dimensions of capabilities and willingness:

- **Type I:** Low capabilities and low willingness
- **Type II:** Low capabilities and high willingness
- **Type III:** High capabilities and low willingness
- **Type IV:** High capabilities and high willingness

While the 2x2 matrix with four segments is initially chosen, since differentiation based on low and high is clear, it is important to acknowledge that other matrices could be created to achieve more detailed segmentation. For instance, adding a 'medium' category to either or both dimensions could create a 3x2 matrix (six segments) or a 3x3 matrix (nine segments), providing a more nuanced understanding of the different partners. However, distinguishing between low, medium, and high can be challenging. Therefore, the initial choice is a 2x2 matrix. This approach can be adjusted based on practical experiences and the specific needs identified during the application of the DSS.

Day, Magnan, and Moeller (2010) has reviewed supplier segmentation, showing that almost all segmentation is based on four categories. These are mostly based on Kraljic (1983), which shows the solid foundation of its work. Bai, Rezaei, and Sarkis (2017) uses three categories (low, medium, and high) based on capabilities and willingness. This can, for example, be done by clustering techniques or by using diagonal lines which divide the partners into three different categories. Since the approach for partners with high capabilities and low willingness and for partners with low capabilities and high willingness is clearly different as shown in the initial components of strategies below, the choice has been made to use four quadrants based on the literature.

This needs to be validated while applying the method and also for evaluating the DSS. It has to be researched whether using four segments is the right choice and, for generalisation, whether this is always the best choice. The question should be asked how this should be chosen.

For each of the four segments, initial components of strategies are created based on the literature about supplier segmentation of Rezaei and Ortt (2013a), Rezaei, Wang, and Tavasszy (2015), Rezaei and Fallah Lajimi (2019), and Bai et al. (2017). This supplier segmentation is also based on the two dimensions of low and high capabilities and willingness. These strategies can be made more specific when applying them, but the literature already provides information about possible components of strategies. Initial components of strategies will support specifying those later on. Besides that, when generalising the results in the end to make the DSS useful for broader applications, those initial strategies can be refined.

Type I: low capabilities and low willingness

For this segment, the primary component of the strategy is to consider replacement due to their limited utility in advancing sustainability goals (Rezaei & Ortt, 2013a; Rezaei et al., 2015; Rezaei & Fallah Lajimi, 2019; Bai et al., 2017). However, if immediate replacement is not feasible (e.g., because of supply chain constraints), implement developmental measures which are aimed at gradually improving both the partner's willingness and capability (Rezaei & Ortt, 2013a; Rezaei & Fallah Lajimi, 2019). According

to Rezaei et al. (2015), it is advisable to first improve the willingness of partners in this segment before improving capabilities. This could involve partner assessment and feedback mechanisms, small-scale financial incentives, or technical support that introduces basic sustainable practices (Rezaei & Ortt, 2013a). Basic sustainability development activities might make these partners minimally compliant with certain sustainability goals, thus improving their sustainability performance.

Type II: low capabilities and high willingness
This segment, characterised by its high willingness but low capabilities, is ideal for substantial development investments. Tailored training programs that focus on sustainable practices, technical assistance and sharing of best practices can be highly effective (Rezaei et al., 2015; Bai et al., 2017). Forming cross-functional teams to address specific sustainability challenges collaboratively can also be beneficial (Rezaei & Ortt, 2013a). This approach enhances their capabilities but also reinforces their commitment to sustainability, using the partner's willingness to improve.

Type III: high capabilities and low willingness
Partners in this segment possess the required capabilities but lack the motivation to align these with sustainability goals. Strategies should, therefore, focus on incentivising engagement through mutually beneficial sustainability initiatives (Rezaei & Ortt, 2013a). Encouraging a partnership by demonstrating loyalty and offering long-term commitments can be effective (Rezaei et al., 2015). Additionally, engaging partners in strategic decision-making processes may help in aligning their objectives with sustainability goals, as they see the direct benefits of their involvement and the importance of those goals (Rezaei & Fallah Lajimi, 2019).

Type IV: high capabilities and high willingness
Partners in this segment are the most aligned with the organisation's sustainability goals and, thus, should be engaged in strategic collaborations. Initiatives include co-developing new sustainable products, sharing resources for joint sustainability research, and integrating them into the core processes of the company's sustainability agenda (Rezaei & Ortt, 2013a; Bai et al., 2017). Maintaining these relationships through regular recognition programs, shared successes, and even co-marketing initiatives can reinforce their commitment and show their role as sustainability leaders within the supply chain (Rezaei et al., 2015).

Table 4.1 provides a clear overview of the initial components of strategies within the 2x2 matrix, summarising the key actions and focus areas for each segment type based on the introduced strategies from the literature.

Table 4.1: Matrix with an overview of the initial components of strategies per segment

Willingness	**Capabilities: Low**	**Capabilities: High**
High	*Type II* • Development investments • Tailored training programs • Technical assistance • Sharing best practices • Cross-functional teams • Collaborative sustainability challenges	*Type IV* • Strategic collaborations • Co-develop new sustainable products • Joint sustainability research • Integrate into core processes • Regular recognition programs • Shared successes • Co-marketing initiatives
Low	*Type I* • Consider replacement • Developmental measures • Improve willingness first • Partner assessment • Feedback mechanisms • Small-scale financial incentives • Technical support • Basic sustainable practices	*Type III* • Incentivise engagement • Mutually beneficial initiatives • Demonstrate loyalty • Long-term commitments • Strategic decision-making • Align objectives with sustainability goals

4.3. The design of the Decision Support System

Chapter 4.1 and Chapter 4.2 provide the information for the actual design and development of the DSS, which will be done in this chapter.

RQ III
Design and development
How can the identified aspects be integrated into a DSS that guides PRM through MCDM for achieving sustainability goals?

To answer this RQ, a conceptual overview of the DSS will be created accordingly. Thereafter, the use of the BWM solver in Excel will be explained, which is part of the DSS. A conclusion will finalise this chapter.

4.3.1. Conceptual overview of the Decision Support System

Combining the aspects with the objectives which need to be incorporated in the DSS leads to the conceptual overview of the DSS as given in Figure 4.1.

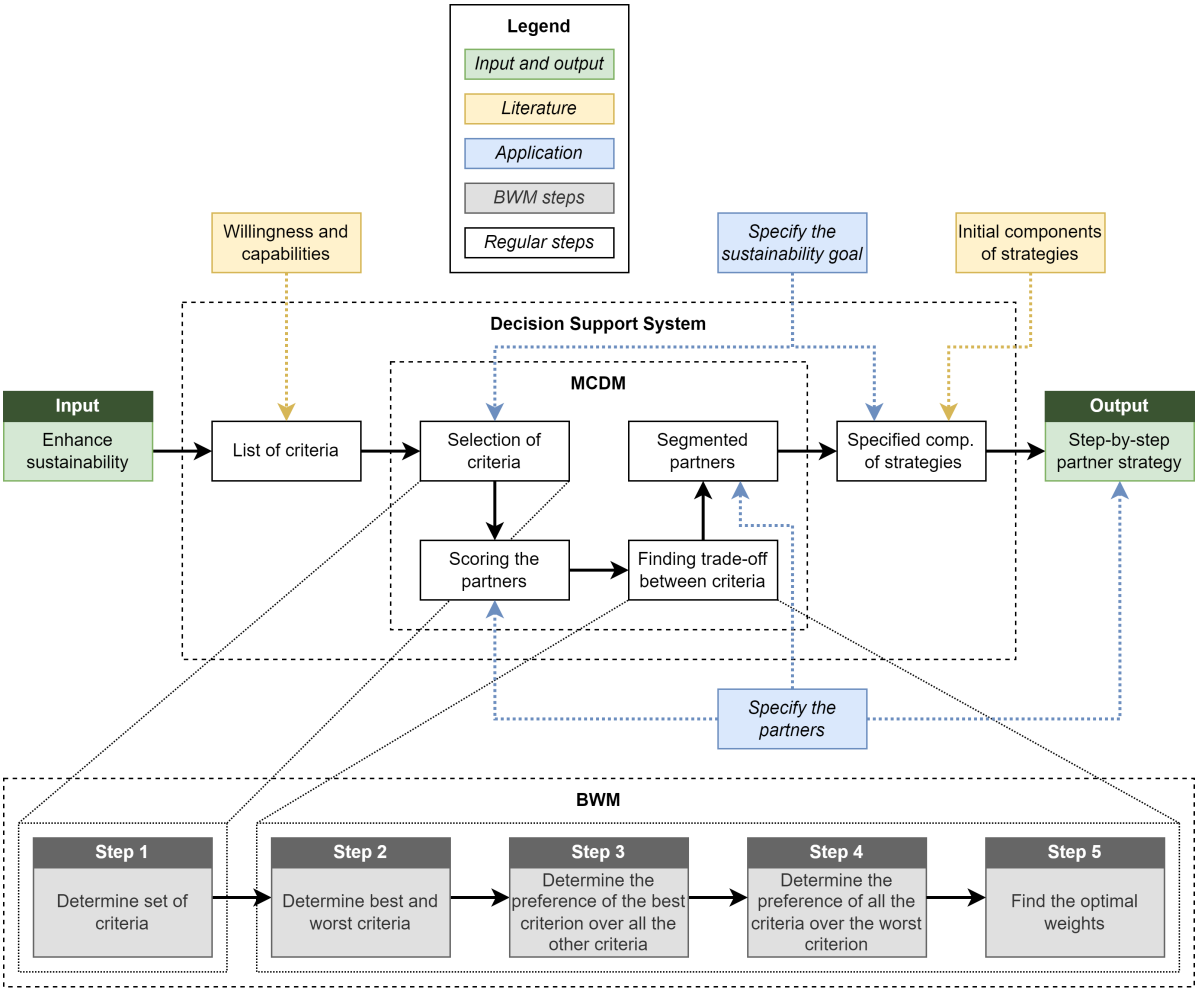


Figure 4.1: Conceptual overview of the general DSS

The input of the DSS, the green box, is the overarching goal of the system, which is to enhance sustainability. This goal guides all necessary aspects of the system and sets the foundational criteria for inputs and processes within the DSS.

The blue boxes are also input outside the DSS, which specifies the sustainability goals and the partners. The specific sustainability goals influence several components within the DSS. These goals guide the

selection of the criteria used in the MCDM, ensuring alignment with the desired sustainability outcomes. Additionally, the goals are the input for developing specific strategies for partners, ensuring that each strategy is tailored to meet the sustainability goals. The other blue box specifies the partners which are included in the DSS. It influences which partners are going to be scored and segmented and also which partners the strategies are going to be developed for.

Derived from the literature and focused on the capabilities and willingness (yellow box, which focuses on the literature) as sustainability criteria, this list of criteria serves as the initial input for the MCDM process. This set of criteria is based on the literature review as outlined in Chapter 2. Additionally, the initial components of strategies are based on the literature, as shown in Chapter 4.2.2, and serve as input for the DSS. As indicated in the yellow box, these initial components of strategies flow into the 'specified components of strategies' box after the partners are segmented.

The MCDM process begins with the selection of the set of criteria from the initial list, focusing on those that best align with the specified sustainability goals. When the BWM is considered, this can also be seen as the first step of BWM (as shown in the grey boxes). Partners are then scored against these selected criteria. This scoring is conducted before finding the trade-off between the criteria to prevent bias in scoring based on perceived importance. Therefore, the trade-off between the criteria is determined after the scoring of the partners, which involves calculating the optimal weights for each criterion (Chapter 3.4.1). Finding the trade-off between the criteria involves step 2 until step 5 of the BWM.

Using the scores and weights obtained from the BWM, partners can be positioned within the capabilities and willingness matrix, typically formatted as a 2x2 matrix using a scale of low and high for both axes. This segmentation is crucial for specifying the components of strategies. The specified sustainability goals play a significant role in shaping these strategies, ensuring that the components are precisely aligned with the desired outcomes. Also, the initial components of strategies are used as input to create the specified components of strategies for the different segments.

In this step, the components of strategies need to be developed, incorporating detailed information about the company's sustainability goals and its partners. This ensures that the strategies are well-suited to each partner's context. The segmented partners, as the basis for the specified components of strategies, serve as input to generate the final output.

The output of the DSS, illustrated in the green box, is a step-by-step strategy for all partners. The specified components of strategies provide a clear overview of possible actions to enhance the sustainability of a partner in the associated segment. Although these components are detailed, they do not constitute a complete strategy. Therefore, the output is a comprehensive step-by-step strategy based on these specified components of strategies. This strategic output aims to enhance the sustainability of each partner, providing the necessary guidance on PRM to achieve the specified sustainability goals. By addressing the unique needs and capabilities of each partner, this step-by-step strategy optimises their contributions towards the overarching sustainability objectives.

4.4. Key insights

The development of the DSS in this chapter aims to enhance partners' sustainability by integrating multiple key aspects and objectives into its design. The primary input of the DSS is its goal to improve partner sustainability, which forms the basis for its functionalities. This goal is operationalised by mapping out the current sustainability status of partners using a list of criteria derived from an extensive literature review (Chapter 2.2.3). These criteria focus on assessing partners' capabilities and willingness to enhance sustainability, critical attributes for understanding their current sustainability levels.

The MCDM process is central to the DSS, using predefined criteria to evaluate and gain insights into partners' capabilities and willingness. These evaluations allow for segmenting partners into different categories based on their sustainability profiles, following a methodology similar to strategic partner selection processes (Chapter 2.2.2). This segmentation is based on the scoring results from the BWM and allows for categorising partners into different segments according to their sustainability profiles.

The DSS' primary objective is to guide PRM for partner operations by developing tailored strategies for each segment within the capabilities and willingness matrix. These components of strategies, initially

derived from the literature, are aligned with the specific sustainability goals of the company to ensure relevance and effectiveness. The strategies must adhere to four guidelines, which incorporate the principles of the 4 C's framework: clear purpose, changes, collaborative co-design, and clear communication. These elements are essential for the strategies to support the company's sustainability goals effectively.

The actual design and development of the DSS are presented through a conceptual overview. This includes integrating aspects such as decision focus, user initiation and control, and the use of models and analytical techniques with data access and retrieval functions. The conceptual overview illustrates how these elements come together to create a DSS that guides PRM through MCDM, facilitating the achievement of sustainability goals.

In conclusion, the DSS is designed to provide tailored strategies for each partner based on their segmentation within the capabilities and willingness matrix. This structured approach ensures that when applying the system, a company can effectively manage its partners and drive sustainability initiatives across its operations, contributing to its overall sustainability objectives.

5

Application on KLM Cargo

The DSS designed in Chapter 4.3 will now be applied to the use case of KLM Cargo to demonstrate its practical implementation.

RQ IV
Demonstration
How can the designed DSS be applied to KLM Cargo's ground operations of GHAs at outstations to achieve zero emissions and zero waste?

To answer this RQ, first, the DSS will be updated to reflect the specific operations of KLM Cargo, incorporating the sustainability goals and the partners involved. The updated system will be presented in Chapter 5.1. Following this, Chapter 5.2 will provide detailed information about the changed partners, focusing on the GHAs at the outstations. In Chapter 5.3, the specific sustainability goals of 'zero emissions' and 'zero waste' will be outlined.

According to the DSS, the several steps can be executed. The selection of criteria, based on the list of sustainability criteria from the literature, will be described in Chapter 5.4. This will be followed by Chapter 5.5, which will explain the scoring process for the partners. Chapter 5.6 will then determine the trade-off between the criteria, leading to the segmentation of the partners in Chapter 5.7.

With the MCDM part of the DSS completed, Chapter 5.8 will interpret the results before moving on to the components of strategies. Based on these interpretations and the outcomes of the segmentation, Chapter 5.9 will specify the initial components of strategies.

Finally, Chapter 5.10 will provide a step-by-step strategy which can be applied to the partners of KLM Cargo as the final output of the DSS. The key insights from this application and the overall outcomes will be summarised in Chapter 5.11, providing a comprehensive overview of the process and its results.

5.1. Conceptual overview of the Decision Support System for KLM Cargo

Figure 5.1 shows the DSS applied to the operations of KLM Cargo.

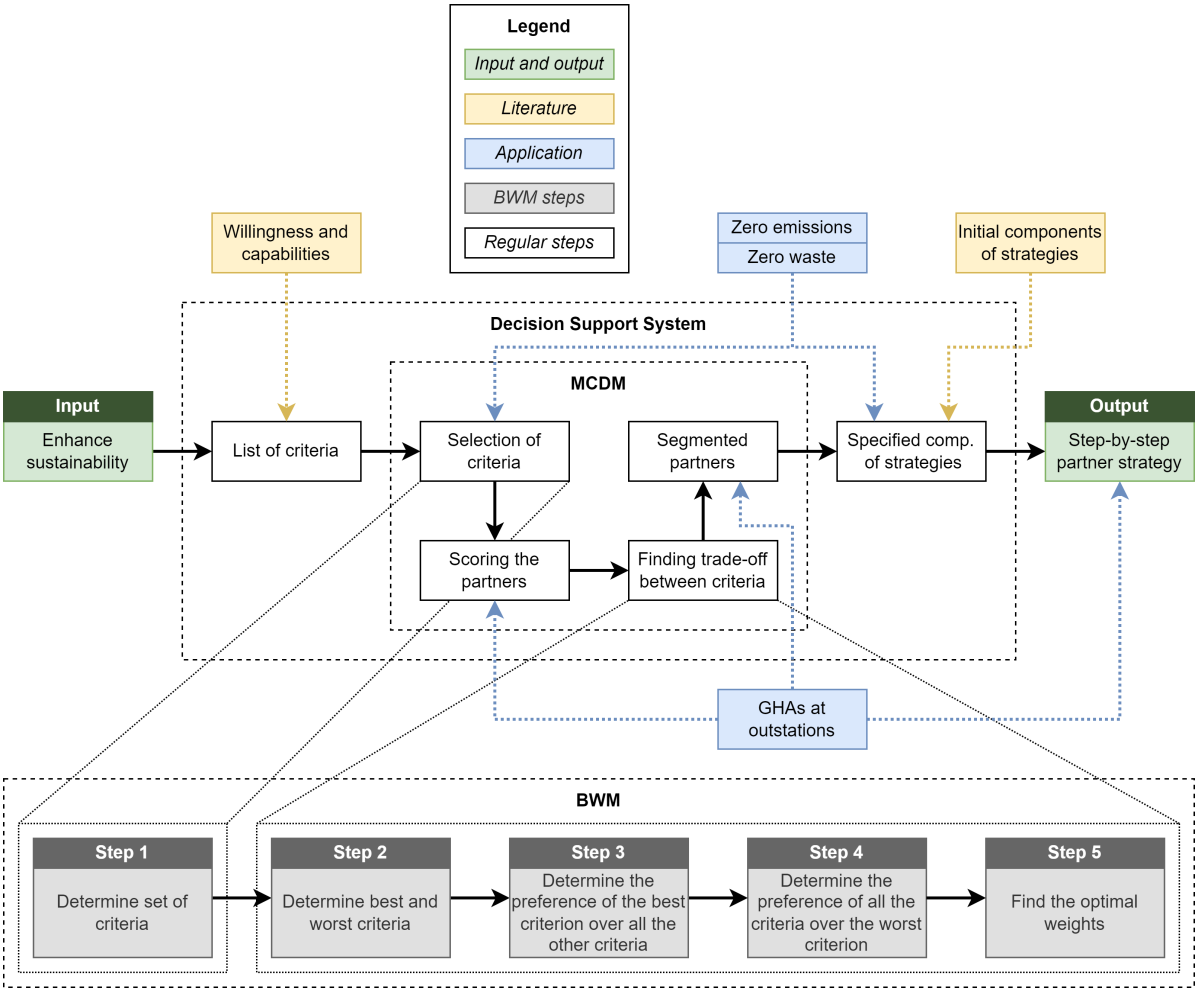


Figure 5.1: Conceptual overview of the DSS for KLM Cargo

In the conceptual model applied to the operations of KLM Cargo, the modifications are aligned to address the sustainability challenges faced by KLM Cargo at its various outstations. The blue boxes in the model, previously showing the generic application of 'partners' and 'sustainability goal', are now customised to reflect the operations of KLM Cargo, particularly focusing on the GHAs who manage the ground operations at outstations.

The sustainability goals within the model are specifically tailored to KLM Cargo's objectives of 'zero emissions' and 'zero waste' for the ground operations which are conducted by GHAs at these outstations. These goals are part of the broader ambitious sustainability goals of KLM.

5.2. Ground Handling Agents of cargo airlines at outstations

The DSS is applied to the operations of KLM Cargo, which specifies the partners to GHAs. A GHA is a service provider that manages various ground support services at airports, essential for both passenger and cargo airlines. Within this research, since the application is on KLM Cargo, the focus will be the services for cargo handling. GHAs ensure the functioning of airline operations on the ground, enabling airlines to maintain their schedules and to ensure the correct handling of the cargo. An example of a GHA is Swissport, which is a leader in the airport ground services and air cargo handling sector. Swissport operates across numerous airports globally, providing the mentioned services. (Swissport, n.d.)

An outstation refers to any airport that an airline operates from other than its main base or hubs. For KLM Cargo, the outstations are the airports they send cargo to or receive cargo from. A GHA at an

outstation acts as the airline's local partner, handling all ground operations. Partnerships are important as they extend the airline's operations to international locations.

It is important to explicitly mention that a GHA, like Swissport, can operate at different outstations worldwide. Despite the GHA being the same, its performance based on the different criteria may also depend on the specific outstation where the GHA is operating. Therefore, when scoring the partners based on the sustainability criteria, this study looks at how a GHA specifically scores at the different outstations.

5.3. Sustainability goals of KLM Cargo

In the commitment to sustainable practices, KLM Cargo has established a set of sustainability goals throughout its global operations, focusing on reducing environmental impacts. These goals are divided into two main tracks: 'reduce now' and 'mission zero'. The 'reduce now' track aims for a reduction in CO_2 emissions from flight operations, with the objective to decrease a 30% in revenue tonne-kilometres by 2030 compared to 2019. The 'mission zero' track is more focused on ground operations, particularly at Schiphol Airport as a hub, with the goal of achieving zero ground emissions by 2030. Additionally, KLM Cargo is committed to achieving zero waste, with the planned year to achieve this still being in consideration. Beyond Schiphol Airport as the primary goal, the 'mission zero' track extends to all partners in KLM Cargo's operations, including trucking firms and outstations. Specifically, for outstations, the ground operations performed by the GHAs, the aim is to eliminate both emissions and waste.

5.3.1. Zero emissions

For KLM Cargo, the 'zero emissions' goal is focused on its operations at hub Schiphol and at outstations where its partners operate. Defined precisely, KLM's objective is: "*No CO_2 emissions in The Netherlands from ground operations and airport-related buildings in 2030.*" (KLM, 2023b, p. 4). Ground operations include all processes on the airport ground, such as maintenance, energy supply, and the handling of aircraft, alongside the transport of passengers, employees, baggage, and cargo at the airport that do not involve taxiing aircraft. Airport-related buildings are specified as those that primarily facilitate aviation services or support aviation activities. Within KLM Cargo, the focus of ground operations is on cargo handling activities, and the airport-related buildings are those that facilitate these operations. (KLM, 2023b)

The overarching aim is to replicate this zero emissions goal at the outstations where KLM Cargo's partners operate. Therefore, the objective for achieving 'zero ground emissions' across all partners can be summarised as: "*No CO_2 emissions from ground operations and airport-related buildings of GHAs at outstations where KLM Cargo is operating.*" This objective extends the scope from the local operations at Schiphol Airport to a global scale through its network of outstations. It, therefore, aligns with KLM's broader environmental commitments.

5.3.2. Zero waste

KLM Cargo's commitment to sustainability includes waste management initiatives, particularly focusing on 'zero waste' at its hub, Schiphol, with again the ambitions to replicate these practices at outstations. KLM defines the objective as follows: "*At KLM, we reduce waste as much as possible and focus on getting the most value from the materials we use, with the lowest impact on people and planet* (KLM, 2023c, p. 6). Zero waste at Schiphol is approached as zero residual waste, which is defined as any waste material that is not separated for recycling. This kind of waste material is typically incinerated, which contributes to greenhouse gas emissions. To achieve zero residual waste, KLM focuses on waste avoidance strategies and using circular materials. Waste avoidance involves reducing the generation of waste materials at the source, whereas circular materials emphasise reusing resources and recycling materials to minimise waste output. (KLM, 2023a)

The same zero waste principles applied at Schiphol are intended for implementation at the outstations where KLM Cargo operates. Therefore, the zero waste objective for KLM Cargo, when focused on its GHAs at outstations, can be stated as: "*No residual waste as a result of the handling of cargo by the GHA at the outstations where KLM Cargo is operating.*" Again, this goal extends the scope from the local operations at Schiphol Airport to a global scale through its network of outstations.

5.4. Selection of the criteria

In applying the DSS on the operations of KLM Cargo, the next step is selecting the relevant capabilities and willingness criteria to enhance sustainability. This selection process is the first step within the MCDM method (and also specifically within the BWM), where criteria are chosen based on their relevance to KLM Cargo's operational goals of achieving zero emissions and zero waste.

The method for choosing these criteria involves semi-structured interviews with experts. Initially, two experts are consulted to evaluate the potential sustainability criteria, which have been gathered from the literature review and detailed in Chapter 2. During the first interview, these experts are presented with the definitions or all sustainability criteria based on capabilities and willingness. They are asked to confirm the definitions of the literature and to suggest any additional insights they might have.

Subsequently, the experts assess each criterion's relevance to the operations of KLM Cargo and their applicability to the sustainability goals of zero emissions and zero waste by responding with 'yes', 'no', or 'maybe'. Criteria that both experts agree on, or where one expert says 'yes' and the other one says 'maybe', are included in the set with selected criteria. However, if the experts' opinions diverge significantly, in other words, one says 'yes' and the other one says 'no', these criteria call for further discussion.

In the second round of communication with both experts, these criteria are revisited. This was the case with 5 of the 28 criteria. Experts are asked to review their initial responses in light of the other expert's views and reasoning. This step is important for reaching a consensus or a more informed disagreement to refine the set of chosen criteria.

The final set of capabilities and willingness criteria derived from this process is then documented. The set forms the basis for further analysis in the DSS and the MCDM part to enhance the sustainability of KLM Cargo's operations. The entire criteria selection process, along with expert consultations and rationale for the decisions taken, is detailed in Appendix D. The list of chosen criteria is presented in Table 5.1.

Table 5.1: Selected sustainability capabilities and willingness criteria

	Selected capabilities criteria		**Selected willingness criteria**
C_1^C	Collaborative capability	C_1^W	Commitment to continuous improvement in process
C_2^C	Financial position	C_2^W	Economic opportunities
C_3^C	Knowledge management capability	C_3^W	Environmental concerns
C_4^C	Management and organisation	C_4^W	Ethical standards
C_5^C	Measurement capability	C_5^W	Government grants
C_6^C	Technological capability	C_6^W	Market pressure
		C_7^W	Regulatory pressure
		C_8^W	Willingness to invest in specific equipment

In refining the sustainability criteria for KLM Cargo, modifications were implemented based on expert feedback obtained during the interviews. These changes are made to enhance the clarity and applicability of the criteria, ensuring that they effectively align with the operations of KLM Cargo, especially concerning the sustainability goals of zero emissions and zero waste at the ground operations at outstations managed by GHAs.

One of the changes was the consolidation of three capabilities, absorptive capability, external capability, and integrative capability, into a single criterion named 'collaborative capability'. Both experts found the original categorisation confusing and overlapping. This input ensures that the evaluation process, when scoring the partners based on the selected criteria, is not unnecessarily complicated. Given the application of the BWM, where the trade-off between criteria will be analysed, it was considered efficient to have one clear criterion that summarises collaboration. If collaboration emerges as a significant criterion, it will naturally receive a higher weight in the BWM analysis, thereby simplifying the process without losing important criteria.

Further simplifications were made in the definitions of other criteria to enhance clarity. For instance,

multiple definitions concerning environmental impacts found in the literature, such as 'public concerns' and 'public pressure', were defined under 'environmental concerns'. Similarly, 'technical capability' was streamlined to 'technological capability', and 'legal pressure' was refined to 'regulatory pressure'.

Following these modifications, a detailed explanation of each criterion is provided, specifically tailored to the context of KLM Cargo's operations and sustainability goals. This includes how each criterion applies to the activities of a GHA at outstations, tying them directly to the operational realities and sustainability objectives of zero emissions and zero waste. Examples are provided for each criterion to illustrate their relevance and application, ensuring that when partners are scored, there is a good understanding of what each criterion entails.

Capabilities criteria

The explanation of the capabilities criteria has been specified for the operations of KLM Cargo. These descriptions will allow the experts who are going to score the different GHAs at the outstations to have a good understanding of what each criterion entails.

- C_1^C**: Collaborative capability**
  Collaborative capability is the ability of the GHA to adopt initiatives for sustainability with partners within the own network (*e.g. another GHA within the network of KLM Cargo*) or outside the own network (*e.g. a solar panel company*). It includes the ability of the GHA to cooperate with sustainability practices, which can not be achieved by a single GHA (*e.g. the re-use of circular products*).
- C_2^C**: Financial position**
  The financial position of the GHA, including the GHA's credit rating, relative to the financial position of other GHAs within the network of KLM Cargo (*e.g. the budget of the GHA which allows to invest in sustainable practices*).
- C_3^C**: Knowledge management capability**
  The capability of the GHA to acquire new knowledge and to evaluate current knowledge about sustainability practices (*e.g. the research capability of the GHA)*.
- C_4^C**: Management and organisation**
  The management and organisation of the GHA in relation to the acceptance of sustainability practices (*e.g. how does management feel about investing in solar panels)*.
- C_5^C**: Measurement capability**
  The extent to which the GHA can measure their performance based on sustainability. Knowing to what extent certain practices are sustainable contributes to actually enhancing sustainability practices (*e.g. the ability and the accuracy of the GHA to measure the amount of acquired green energy*).
- C_6^C**: Technological capability**
  The capability of the GHA to implement technologies to enhance sustainability (*e.g. the technological-related acceptance of the GHA to install solar panels*).

Willingness criteria

The explanation of the willingness criteria has been specified for the operations of KLM Cargo. These descriptions will allow the experts who are going to score the different GHAs at the outstations to have a good understanding of what each criterion entails.

- C_1^W**: Commitment to continuous improvement in process**
  The level of commitment of the GHA to continuously improve the current processes (*e.g. a GHA continuously optimising their logistic ground operations processes to contribute to sustainability)*.
- C_2^W**: Economic opportunities**
  The level at which sustainable practices could lead to economic opportunities for the GHA. The return of a sustainability investment could be higher for one GHA in comparison with another GHA (*e.g. the return of investment of solar panels by a GHA, without taking grants into account*).
- C_3^W**: Environmental concerns**
  The level of environmental concerns of the public in the area where the GHA operates. These

concerns are purely focused on the opinion of the public (*e.g. protests by the public against fossil fuels)*.

- C_4^W**: Ethical standards**
  The level of adoption of ethical standards by the GHA (*e.g. the GHA has active policies on a fair working environment*).
- C_5^W**: Government grants**
  The level of opportunities in which the government supports sustainable practices with grants or other tax rebates, which could motivate the GHA to implement these sustainable practices (*e.g. a grant for the GHA when solar panels are installed*).
- C_6^W**: Market pressure**
  The level of pressure by the market to implement sustainable practices. This is purely focused on the market, which means that other companies can, for example, put pressure on the GHA to implement sustainable practices (*e.g. pressures from the consumers and the competitors of the GHA to enhance sustainability practices)*.
- C_7^W**: Regulatory pressure**
  The level of pressure by regulations to implement sustainable practices. This is purely focused on the pressure put by the government with regulations on the GHA (*e.g. the GHA is required by the government to generate a certain proportion of the energy from renewable sources, such as solar panels*).
- C_8^W**: Willingness to invest in specific equipment**
  The willingness of the GHA to invest in specific equipment for sustainable practices (*e.g. the willingness of the GHA to invest in solar panels, regardless of the return of investment)*.

5.5. Scoring the outstations

In assessing the sustainability performance of KLM Cargo's outstations, a structured scoring process will be used. First, the list of all relevant outstations will be discussed. Next, a standardised approach to scoring will be described by establishing a clear and consistent understanding of the scoring scale across all the people evaluating the outstations. The scoring process itself is then detailed, explaining how evaluations are conducted. Finally, an overview of the scoring results will be given.

5.5.1. List of outstations

The first step in the evaluation process is compiling a list of outstations where KLM Cargo operates. For this purpose, the most recent version of an Excel sheet, dated December 2023, was obtained, detailing the network stations of KLM Cargo by market and area. This list was cross-referenced with a database and validated by an expert to ensure that this list is still as up-to-date as possible. Consequently, a total of 204 stations have been identified for consideration.

These outstations are categorised into four primary geographical areas: Asia, America, Europe, and Africa. Within each area, the stations are further divided into specific markets, which shows the reach of KLM Cargo's global network. The detailed distribution of these 204 stations across the different areas and markets is summarised in Table 5.2. This list and Excel sheet serve as the foundational dataset for the analysis and scoring of each outstation's sustainability performance based on the selected capabilities and willingness criteria.

Table 5.2: Distribution of 204 outstations per market and area

Area	Market	Number of stations	Total
Asia	Greater China	4	25
	Japan - Korea	6	
	Middle east	4	
	India	3	
	Southeast Asia	8	
Africa	Sub-Sahara	18	43
	Northwest Africa and Levant	12	
	Eastern and Southern Africa and Indian Ocean (ESAIO)	13	
America	North American Market	31	50
	South American Market	19	
Europe	Central and Eastern Europe (CEE)	15	86
	Iberia	7	
	Italy and Switzerland	10	
	German and Austria	14	
	Great Britain and Ireland (GBI)	14	
	Belgium, Netherlands and Luxembourgh (Benelux)	6	
	Nordic	9	
	France	11	
Total			204

Within the Excel sheet, the selected criteria were added as columns. The explanation of these criteria, as shown in the previous section (Chapter 5.4), was added as a comment in the Excel sheet so the description can always be seen while scoring the outstations.

5.5.2. Understanding of the scores

After compiling the list of outstations, a consensus on the scale of scores should be established to ensure consistency and reliability in the evaluations. A scale from 1 to 5 has been created, with (1) very low, (2) low, (3) medium, (4) high, and (5) very high, as it provides sufficient differentiation in nuances while maintaining clarity between each level. This scale ensures that a very high (5) is distinctly from a high (4), avoiding vague distinctions such as 'fairly high' versus 'more or less high'. (Joshi, Kale, Chandel, & Pal, 2015)

Given that different Area Operational Directors (AODs) will be responsible for scoring partners across various regions, it is important to reach a consensus on interpreting the scores. This consensus ensures that a high score from one person holds the same meaning as a high score from another, ensuring uniformity across evaluations. This can be seen as a reliability test.

To achieve this consensus within the context of KLM Cargo, the following best practices have been identified. It is important to use the highest best practice (lowest number) since it creates the best alignment. If that is not possible, continue to the next one to see if that one is possible. The last approach can be used in every situation:

1. **Score all outstations**
   Whenever possible, assign one person to score all outstations to prevent inconsistencies.
2. **One reference outstation**
   If multiple people are scoring, identify a reference outstation that all scorers are familiar with to standardise their understanding.
3. **More than one reference outstation but with the same GHA**
   If multiple people are scoring, identify if a single GHA operates across all areas, as their consistent operation practices can serve as a benchmark.

4. **Objective measures**
   If multiple people are scoring, create objective measures for as many criteria as possible. Objective measures can provide a guideline for when a certain score should be given. Even though not all criteria might have objective measures, creating those also fosters a clearer understanding of the scale from 1 to 5, which helps align the interpretations of the scores. If necessary, the next (and last) approach can be used in combination with this approach of creating objective measures.
5. **Discuss definitions**
   If multiple people are scoring and objective measures cannot be created (for some of the criteria), nothing much else can be done. Logically, the understanding of the scores (the scale from 1 to 5) needs to be as good as possible. Let the different people discuss the scale from 1 to 5 and discuss these definitions to ensure the best alignment possible. Even though it is about perception, it can still create more alignment with the scores besides the definitions of 'very low' to 'very high'.

The significance of a unified understanding of scores is further underscored by the varying levels of sustainability advancement in different regions, particularly in developing countries, which may be behind in sustainability practices. Inconsistent scoring relative to other stations in the same area could lead to incorrect results, showing the necessity for a standardised scoring approach. The approaches, as given above, ensure that evaluations are fair and comparable across all regions, with '1' being the most favourable approach and '5' the least favourable approach. However, using one of the approaches facilitates a more accurate assessment of each outstation's sustainability performance than using none.

5.5.3. The process of scoring the outstations

Based on the list of outstations and the need to ensure a consistent understanding of the scoring scale, an online meeting was held with one AOD from each region. Each participant attended from their own computer, and the interviewer shared the screen displaying the Excel list of outstations.

The meeting began with an explanation of the necessity and methodology of the scoring process. The scale from 1 to 5 was introduced, and the importance of establishing a reference point was emphasised, given that it was unfeasible for a single person to score all outstations. The interviewer then inquired whether any AODs had knowledge of outstations outside their own area, but it was confirmed that AODs only had knowledge about their specific areas.

However, it was noted that Swissport is the only GHA operating at outstations in every area. Each AOD was then asked to select an outstation handled by Swissport with which they were most familiar. These selected outstations served as the baseline for scoring consistency. This method aligns with the third approach to create the same understanding of the scores as explained above ('more than one reference outstation but with the same GHA').

The screen sharing was paused, and each AOD was first asked to look at the criteria and read the descriptions. If they had any questions about a criterion, they could unmute themselves and ask the question, which the interviewer could answer for everyone to hear in the online meeting. Then, each AOD was instructed to fill in scores for their chosen reference outstation independently, being able to see only their scores. After all AODs completed this task, the screen sharing resumed to allow for comparison of the scores. It was observed that for two criteria, 'management and organisation' (C_4^C) and 'environmental concerns' (C_3^W), all four outstations received the same scores (4 and 3, respectively). This can be seen in Table 5.3, which shows the scores of the reference outstations, with the same scores for the two criteria in red.

Table 5.3: Scoring of the four outstations which created the baseline

Area	Outstation	C_1^C	C_2^C	C_3^C	C_4^C	C_5^C	C_6^C	C_1^W	C_2^W	C_3^W	C_4^W	C_5^W	C_6^W	C_7^W	C_8^W
Asia	8	5	5	4	4	3	3	5	3	3	3	1	2	2	4
Africa	48	4	4	5	4	2	3	4	3	3	4	1	2	4	4
America	90	4	3	3	4	2	3	4	2	3	4	1	1	2	3
Europe	129	4	4	4	4	2	4	4	3	3	3	3	3	3	4

The interviewer then asked each AOD, in a random order, to explain their reasoning behind the scores for these two criteria. The explanations indicated a shared understanding of the scoring scale. To ensure no bias and full agreement, the interviewer asked if any AODs wished to change any of their scores after hearing the other AODs' explanation, but none chose to do so. Consequently, these four outstations were established as the baseline, ensuring consistency in scoring across different AODs.

To further consolidate their understanding, AODs were asked to score additional outstations of their own area, allowing for questions if needed. As no questions arose, the meeting concluded. The AODs were then tasked with scoring as many partners as possible, prioritising those with which they had the most knowledge, at their convenience. This approach ensures a thorough and consistent scoring process across KLM Cargo's extensive network of outstations worldwide.

5.5.4. Overview of the scores

After completing the scoring process, the scores for the outstations have been acquired. However, several outstations could not be scored for various reasons. Some stations were closed (despite the cross-referencing of the acquired Excel sheet with the network stations of KLM Cargo), others were out of scope for the current assessment, and in some cases, there was insufficient knowledge about the station among the AODs. Additionally, some outstations were left blank due to time constraints faced by the evaluators. All these unscored outstations have been excluded from the scope of this analysis. Table 5.2 has been updated accordingly, so Table 5.4 shows the distribution of the 168 scored outstations across different areas and markets.

Table 5.4: Distribution of the final 168 scored outstations per market and area

Area	Market	Number of stations	Total
Asia	Greater China	4	22
	Japan - Korea	4	
	Middle east	4	
	India	3	
	Southeast Asia	7	
Africa	Sub-Sahara	13	34
	Northwest Africa and Levant	8	
	Eastern and Southern Africa and Indian Ocean (ESAIO)	13	
America	North American Market	30	49
	South American Market	19	
Europe	Central and Eastern Europe (CEE)	12	63
	Iberia	5	
	Italy and Switzerland	4	
	German and Austria	11	
	Great Britain and Ireland (GBI)	10	
	Belgium, Netherlands and Luxembourgh (Benelux)	3	
	Nordic	8	
	France	10	
Total			168

An example of scores for four outstations (one for each area), which are also the outstations which create the baseline, is shown in Table 5.3. A complete overview of all the 168 scored outstations can be found in Appendix E. The four outstations which created the baseline, with the same GHA as reference, are also highlighted in bold and blue in this appendix. This table with a complete overview offers a summary of the sustainability performance across KLM Cargo's network, highlighting both areas of excellence and opportunities for improvement within the capabilities and willingness criteria, in alignment with the company's sustainability goals for zero emissions and zero waste.

5.6. Finding the trade-off between the criteria

To find the trade-off between the criteria, the BWM is used. An overview of the steps involved in this method is detailed in Chapter 3.4.1. The BWM process involves experts assigning relative importance to each criterion, and then these comparisons are used to calculate weights that represent the trade-offs between the criteria.

For this analysis, two experts, the same ones who previously selected the criteria, are engaged to determine the trade-offs. Table 5.5 shows the input-based consistency ratio of the pairwise comparisons. This is calculated in the Excel solver, dependent on the number of criteria and the scale used for scoring. The calculated input-based consistency ratio needs to be lower than the associated threshold (a complete overview of these thresholds was presented in Table 3.1). This is the case for all four inputs by the two experts, which means that the pairwise comparison consistency level is acceptable. For completeness, if the input-based consistency ratio was not lower than the threshold, the decision-maker would be asked to revise the judgement, as the judgement would be considered inconsistent (Liang et al., 2020). An overview of the four inputs provided by the experts in the Excel solver is shown in Appendix B.

Table 5.5: Input-based consistency ratio of the pairwise comparison

	Expert 1		**Expert 2**	
	Input-based CR	**Threshold**	**Input-based CR**	**Threshold**
Capabilities criteria	0.3000	0.3044	0.3036	0.3154
Willingness criteria	0.2619	0.3251	0.2222	0.3620

As explained within the methodology (Chapter 3), the geometric mean can be used to consolidate the input of the two experts. The geometric mean of the two weights can be calculated by taking the square root of the weight of Expert 1 multiplied by the weight of Expert 2, as shown in Formula 5.1 and 5.2:

$$w_{i,cap}^{GM} = \sqrt{w_{i,cap}^{E1} \cdot w_{i,cap}^{E2}} \tag{5.1}$$

$$w_{i,wil}^{GM} = \sqrt{w_{i,wil}^{E1} \cdot w_{i,wil}^{E2}} \tag{5.2}$$

After calculating the geometric mean, the weights must be normalised again to ensure they sum up to one. The normalised weights for the capabilities criteria can be calculated according to Formula 5.3 and for the willingness criteria according to Formula 5.4:

$$w_{i,cap}^{N} = \frac{w_{i,cap}^{GM}}{\sum_{j=1}^{6} w_{j,cap}^{GM}} \tag{5.3}$$

$$w_{i,wil}^{N} = \frac{w_{i,wil}^{GM}}{\sum_{j=1}^{8} w_{j,wil}^{GM}} \tag{5.4}$$

An overview of the resulting weights from the BWM for both capabilities and willingness criteria, including the geometric mean and the normalised numbers, can be found in Table 5.6 (capabilities) and Table 5.7 (willingness).

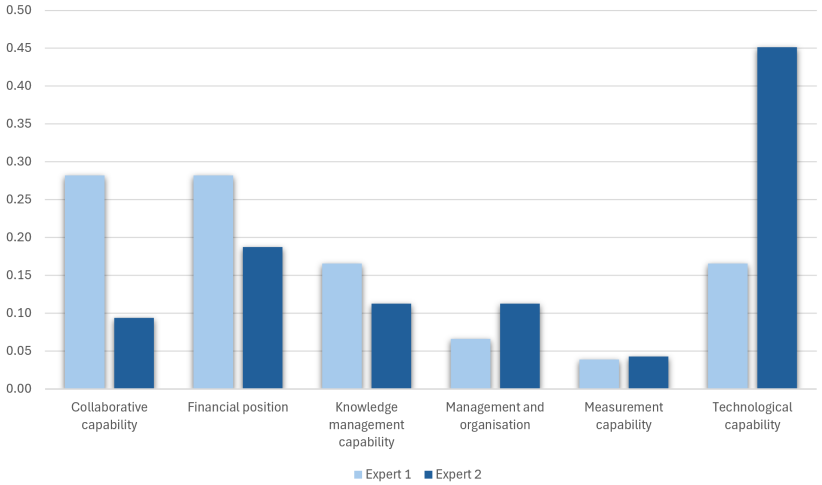
Table 5.6: Capabilities criteria weights

Capabilities criteria	Expert 1 ($w_{i,cap}^{E1}$)	Expert 2 ($w_{i,cap}^{E2}$)	Geometric mean ($w_{i,cap}^{E1}$)	Normalised weights ($w_{i,cap}^{N}$)
C_1^C	0.282	0.094	0.162	0.175
C_2^C	0.282	0.187	0.230	0.247
C_3^C	0.166	0.112	0.137	0.147
C_4^C	0.066	0.112	0.086	0.093
C_5^C	0.039	0.043	0.041	0.044
C_6^C	0.166	0.451	0.274	0.294

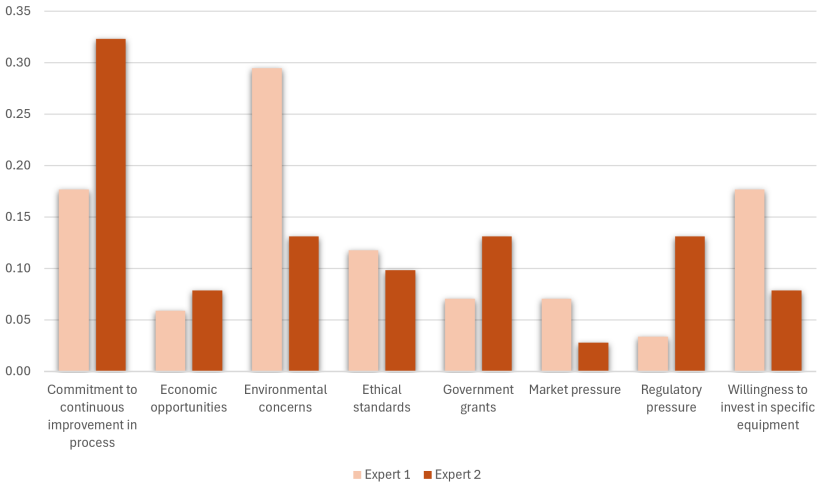
Table 5.7: Willingness criteria weights

Willingness criteria	Expert 1 ($w_{i,wil}^{E1}$)	Expert 2 ($w_{i,wil}^{E2}$)	Geometric mean ($w_{i,wil}^{E1}$)	Normalised weights ($w_{i,wil}^{N}$)
C_1^W	0.177	0.323	0.239	0.255
C_2^W	0.059	0.079	0.068	0.073
C_3^W	0.295	0.131	0.197	0.210
C_4^W	0.118	0.098	0.108	0.115
C_5^W	0.071	0.131	0.096	0.103
C_6^W	0.071	0.028	0.045	0.048
C_7^W	0.034	0.131	0.066	0.071
C_8^W	0.177	0.079	0.118	0.126

Figure 5.2 visualises the weights per expert for the capabilities and the willingness criteria, while Figure 5.3 illustrates the normalised, final weights for the capabilities and willingness criteria. These figures provide a clear summary of how each criterion is valued relative to the others.

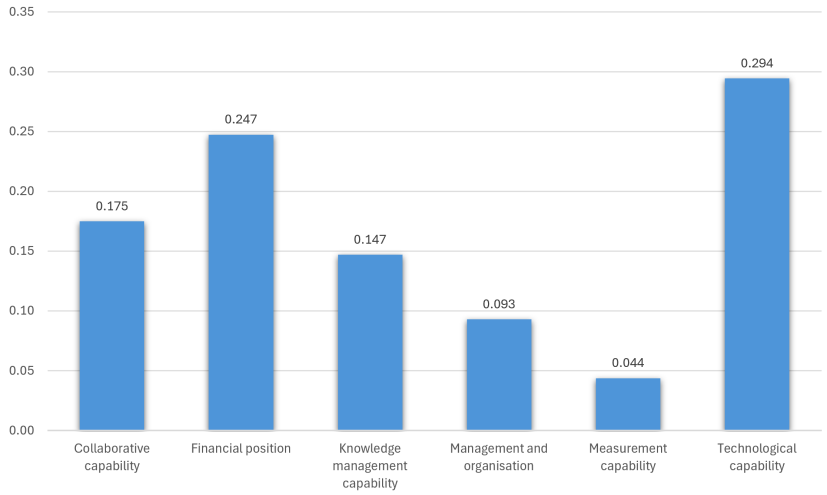


(a) Capabilities criteria

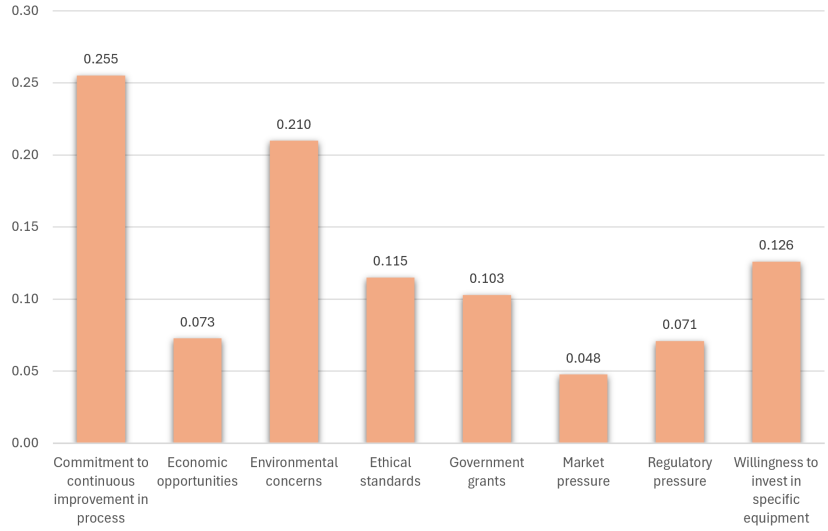


(b) Willingness criteria

Figure 5.2: The weights of the criteria of the two experts



(a) Capabilities criteria



(b) Willingness criteria

Figure 5.3: The normalised weights

5.7. Segmented partners

Combining the weights derived from the BWM with the scores assigned to each partner results in aggregated capabilities and willingness scores for each outstation. These aggregated scores measure each partner's overall performance in terms of their capabilities and willingness to enhance sustainability. Formula 5.5 and 5.6 show the equations to calculate the aggregated score of the six capability criteria and the eight willingness criteria, with s_{ij} representing the score of outstation j on the i-th capability or willingness criterion:

$$\text{Aggregated capability score } (S_{j,cap}) = \sum_{i=1}^{6} (w_{i,cap}^{N} \cdot s_{ij}) \tag{5.5}$$

$$\text{Aggregated willingness score } (S_{j,wil}) = \sum_{i=1}^{8} (w_{i,wil}^{N} \cdot s_{ij}) \tag{5.6}$$

Table 5.8 gives an overview of these scores, with the last rows presenting the average aggregated capabilities and willingness scores of the four areas and of all 168 outstations.

Table 5.8: Aggregated scores for the outstations capabilities and willingness

Area	No.	$S_{j,cap}$	$S_{j,wil}$	Area	No.	$S_{j,cap}$	$S_{j,wil}$	Area	No.	$S_{j,cap}$	$S_{j,wil}$	Area	No.	$S_{j,cap}$	$S_{j,wil}$
Asia	1	4.131	3.652	*Africa*	23	3.765	2.989	*America*	57	3.047	3.015	*Europe*	106	4.000	4.000
	2	4.131	3.652		24	2.662	2.149		58	3.000	3.165		107	3.131	2.790
	3	3.884	3.723		25	3.765	3.314		59	2.956	2.354		108	3.913	3.381
	4	3.884	3.723		26	3.765	2.989		60	3.415	2.724		109	4.000	4.000
	5	4.709	4.311		27	1.753	2.000		61	2.706	2.621		110	4.000	4.000
	6	4.534	4.311		28	2.662	2.149		62	3.120	2.525		111	4.000	4.000
	7	4.534	4.311		29	1.000	1.000		63	3.074	3.603		112	4.000	4.000
	8	4.084	3.312		30	1.000	1.000		64	3.175	2.996		113	4.000	4.000
	9	3.025	2.020		31	1.000	1.000		65	3.074	3.603		114	4.000	4.000
	10	4.000	3.546		32	1.000	1.000		66	2.928	2.996		115	4.000	4.000
	11	4.175	3.664		33	1.000	1.000		67	3.074	3.603		116	4.000	4.000
	12	4.175	3.664		34	1.000	1.000		68	3.365	3.489		117	3.224	2.743
	13	3.706	2.885		35	1.000	1.000		69	2.880	2.996		118	2.590	2.743
	14	3.706	2.885		36	2.000	2.000		70	3.074	3.603		119	3.569	3.639
	15	2.157	2.249		37	1.000	1.000		71	2.211	2.695		120	4.000	4.000
	16	4.084	3.312		38	1.000	1.000		72	3.175	2.949		121	3.044	3.555
	17	3.706	3.162		39	2.000	2.000		73	3.074	3.603		122	3.956	4.000
	18	3.964	2.275		40	5.000	3.636		74	1.458	2.170		123	4.000	3.745
	19	2.965	2.247		41	2.000	2.000		75	3.074	3.603		124	3.956	3.880
	20	2.965	2.247		42	2.000	2.000		76	3.074	3.603		125	3.781	3.719
	21	2.837	2.247		43	1.000	1.000		77	3.616	3.683		126	3.662	3.697
	22	2.965	2.247		44	3.124	2.805		78	4.124	2.626		127	3.635	3.897
					45	3.765	3.314		79	3.616	3.683		128	3.709	3.790
					46	3.765	3.314		80	3.000	3.000		129	3.913	3.381
					47	3.196	2.404		81	3.000	3.000		130	3.665	3.544
					48	3.765	3.314		82	3.000	3.000		131	3.131	2.790
					49	3.765	3.314		83	1.175	1.000		132	3.913	3.381
					50	3.765	3.314		84	1.422	1.000		133	4.000	4.000
					51	3.765	3.314		85	1.000	1.000		134	3.853	3.824
					52	1.175	1.000		86	1.000	1.000		135	4.000	4.000
					53	2.637	2.194		87	3.753	3.768		136	3.907	3.384
					54	2.861	2.431		88	4.240	4.188		137	4.000	4.000
					55	4.000	2.872		89	3.753	3.768		138	4.000	4.000
					56	4.000	2.282		90	3.224	2.926		139	4.000	4.000
									91	3.224	2.926		140	4.000	4.000
									92	3.224	2.926		141	4.000	4.000
									93	3.224	2.926		142	4.000	4.000
									94	3.131	3.172		143	3.224	2.743
									95	2.662	2.698		144	3.224	2.743
									96	3.224	2.998		145	3.394	3.288
									97	3.224	2.998		146	2.590	2.743
									98	2.977	2.903		147	3.569	3.639
									99	4.000	4.738		148	4.000	4.000
									100	4.000	4.738		149	3.044	3.555
									101	5.000	4.000		150	3.365	3.609
									102	4.000	4.809		151	4.000	3.712
									103	4.000	4.809		152	4.000	3.803
									104	3.706	3.372		153	3.365	3.639
									105	3.997	4.453		154	3.384	3.639
													155	3.678	3.372
													156	4.000	3.874
													157	3.219	3.616
													158	3.387	3.502
													159	4.000	4.000
													160	4.000	4.000
													161	3.515	3.433
													162	4.000	4.000
													163	3.913	3.429
													164	3.137	3.651
													165	3.513	3.328
													166	3.137	3.354
													167	3.820	3.429
													168	3.387	3.338
Average		**3.742**	**3.166**	**Average**		**2.499**	**2.150**	**Average**		**3.112**	**3.143**	**Average**		**3.689**	**3.640**
Average of all outstations														**3.287**	**3.131**

The next step involves plotting these outstations within a capabilities and willingness matrix. This visual representation allows for a clear differentiation between partners based on their aggregated scores. Given the partners' distribution within this matrix, a 2x2 segmentation appears highly applicable and practical for further analysis.

This segmentation divides the outstations into four distinct segments:

- **Type I:** Low capabilities and low willingness
- **Type II:** Low capabilities and high willingness
- **Type III:** High capabilities and low willingness
- **Type IV:** High capabilities and high willingness

An overview of the segmented outstations, showing which partners belong to each of the four segments, is illustrated in Figure 5.4 and detailed in Table 5.9. This segmentation facilitates targeted strategy development for each segment, ensuring that the specific needs and characteristics of each group are addressed effectively in the sustainability goals of KLM Cargo. It should be noted that some of the points are overlapped within the figures showing the segmentation, as some of the outstations received the exact same capabilities and willingness scores.

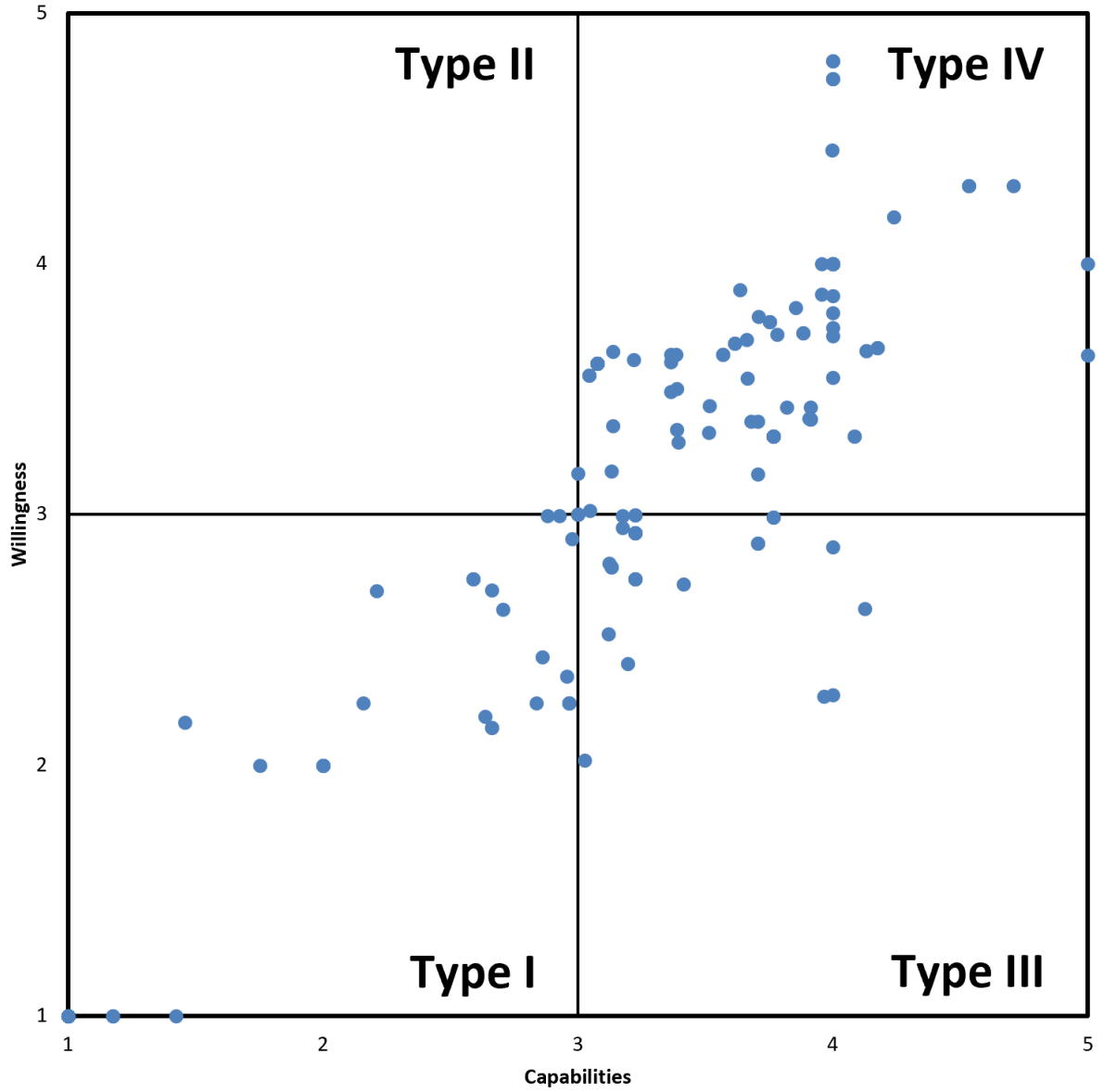


Figure 5.4: The segmented outstations

Table 5.9: The segmented outstations

Segments	No. of outstations	Outstation no.
Type I	39	15, 19, 20, 21, 22, 24, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 41, 42, 43, 52, 53, 54, 59, 61, 66, 69, 71, 74, 83, 84, 85, 86, 95, 98, 118, 146
Type II	0	-
Type III	26	9, 13, 14, 18, 23, 26, 44, 47, 55, 56, 60, 62, 64, 72, 78, 90, 91, 92, 93, 96, 97, 107, 117, 131, 143, 144
Type IV	103	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 16, 17, 25, 40, 45, 46, 48, 49, 50, 51, 57, 58, 63, 65, 67, 68, 70, 73, 75, 76, 77, 79, 80, 81, 82, 87, 88, 89, 94, 99, 100, 101, 102, 103, 104, 105, 106, 108, 109, 110, 111, 112, 113, 114, 115, 116, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 145, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168

5.8. Interpretation of the segmentation

Within the regular matrix, as shown in Figure 5.4, it can be seen that the majority of partners (around 61%) fall into the fourth segment (high capabilities and high willingness). None of the partners are in Type II, while approximately 23% and 15% are, respectively, in Type I and Type III. This suggests that most partners KLM Cargo is working with recognise the necessity of sustainability, given their high willingness and high capabilities. However, this does not mean they have already implemented sustainability practices towards achieving zero emissions and zero waste, but they are capable and willing to do so. This is a good starting point because cooperation is likely possible. This will be further discussed when examining the specified strategies in Chapter 5.9.

When looking at Table 5.8, it can be seen that some of the aggregated scores are round numbers (e.g., 3.000). This suggests that for these outstations, all the capabilities or willingness criteria received the same score. When examining Appendix E, it is confirmed that several outstations received the same score on every criterion within the capabilities or willingness criteria. Analysing these scores shows that 41 outstations received the exact same score on both the capabilities and willingness criteria. Another 14 outstations received the same score on the capabilities criteria (but varying scores within the willingness criteria), and 5 outstations received the exact same score on the willingness criteria (but varying scores within the capabilities criteria).

For these outstations, receiving the same score across several criteria means that using weights does not influence the aggregated score. In these cases, the BWM part, which determines the weights, would not have been necessary as the weights could be left out, yet it still provides the same results if the weights are used. Given that the majority of outstations received varying scores within the capabilities and willingness criteria, this method is still the right one to use. Therefore, it would not make sense to use different methodologies for different outstations. Before determining the weights with BWM, it was already clear that using weights made sense because the scores were already assigned to the outstations, showing that the criteria received different scores for the majority of the outstations.

It remains interesting that some outstations receive the same score on every criterion. This could be because sustainability is a subject that, in some cases, is very consistent across several capabilities and willingness criteria. It could also indicate some form of laziness or bias within the scoring process, which will be further discussed in the discussion (Chapter 9).

It can also be interesting to take a closer look at the distribution of these 168 outstations per area and per GHA. Figure 5.5 shows the segmentation based on the four areas (Figure 5.6 for the four areas split up in different matrix), and Table 5.10 and 5.11 provide the amount and percentage of outstations per segment for each area. Figure 5.7 shows the segmentation based on the different GHAs (Figure 5.8 for the GHAs split up in different matrix), and Table 5.12 and 5.13 present the amount and percentage of outstations per segment for each GHA. GHAs with ten or more outstations were considered as specific categories, which resulted in the inclusion of Menzies, Swissport, and WFS as GHA categories. In contrast, other GHAs at the outstations were clustered within the 'other' category. This is done to create valuable insights, as less than ten outstations for one GHA is not considered a big handling agent.

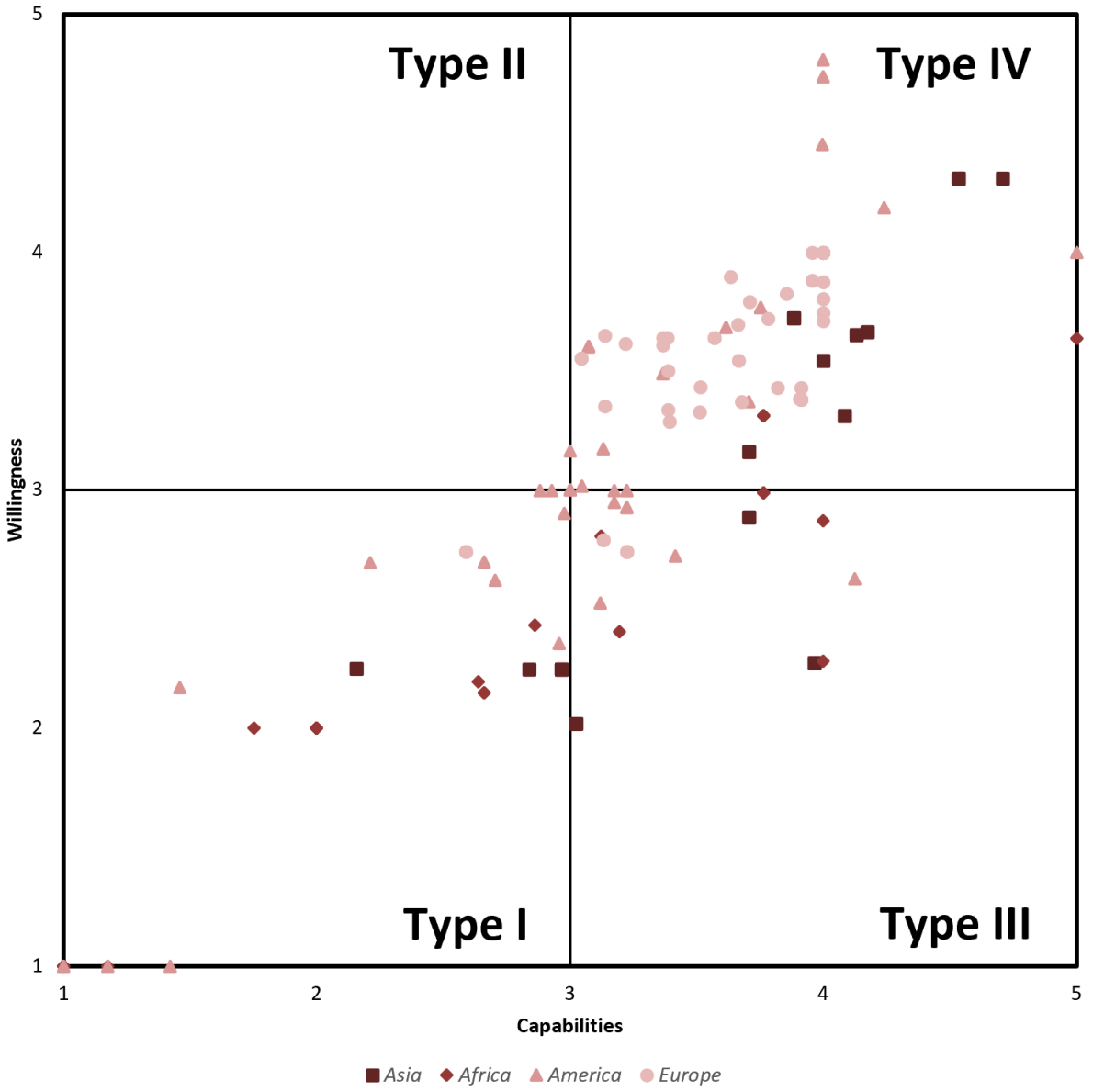
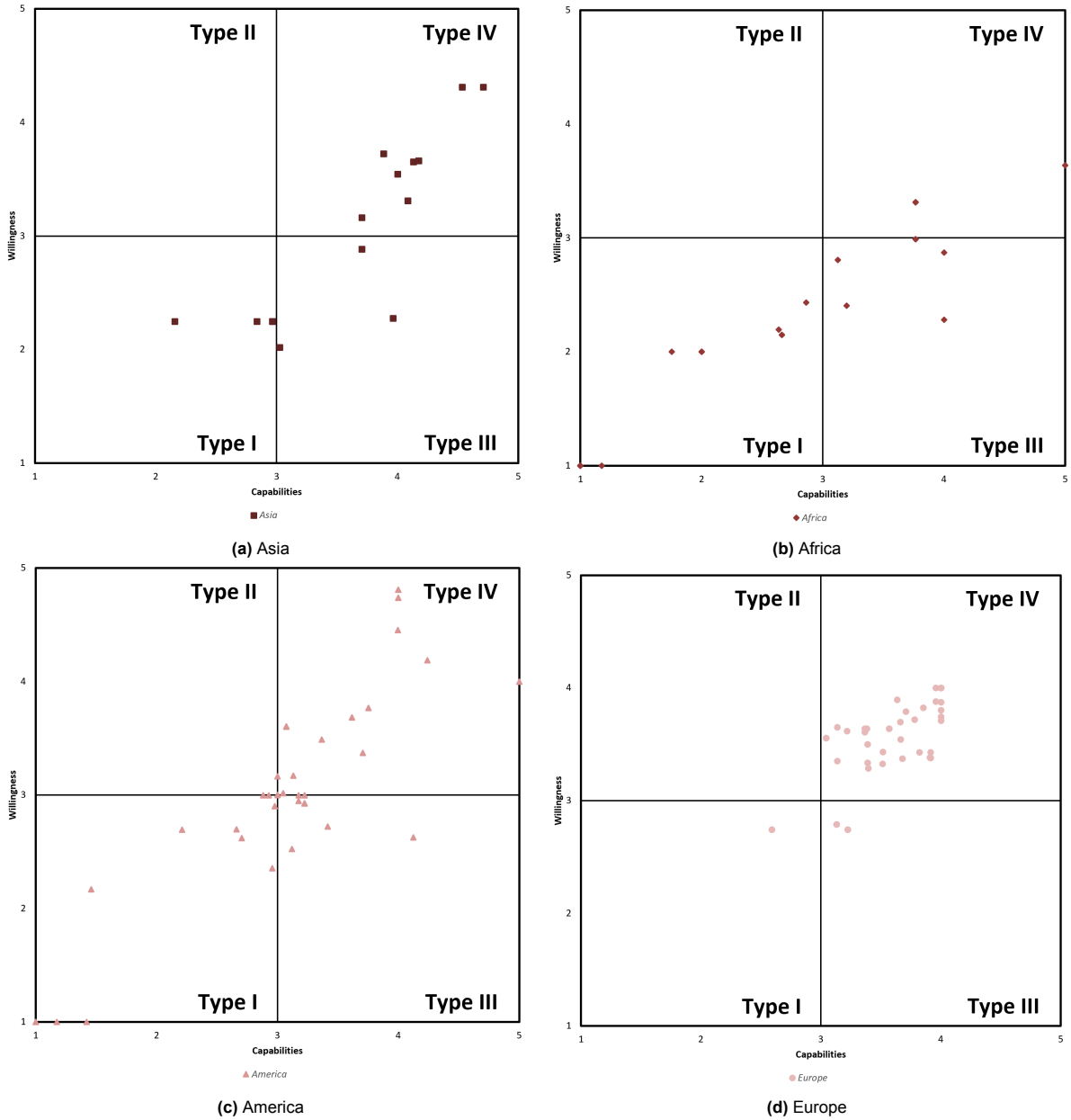


Figure 5.5: The segmented outstations per area



(a) Asia

(b) Africa

(c) America

(d) Europe

Figure 5.6: The segmented outstations separated per area

Table 5.10: The number of segmented outstations per area

	Asia	Africa	America	Europe
Type I	5	20	12	2
Type II	0	0	0	0
Type III	4	6	11	5
Type IV	13	8	26	56
Total	**22**	**34**	**49**	**63**

Table 5.11: The segmented outstations per area in percentage

	Asia	Africa	America	Europe
Type I	23%	59%	24%	3%
Type II	0%	0%	0%	0%
Type III	18%	18%	22%	8%
Type IV	59%	24%	53%	89%
Total	**100%**	**100%**	**100%**	**100%**

When looking at the percentages, it can be seen that Europe is performing the best, with almost 90% in the Type IV segment. Asia and America are scoring quite similarly, with around half of the outstation in the Type IV segment. The other half is as good as equally divided with outstations in the Type I and

Type III segments. Africa is scoring the worst, with more than half in the Type I segment. The remaining part is divided with around 20% between the Type III and Type IV segments.

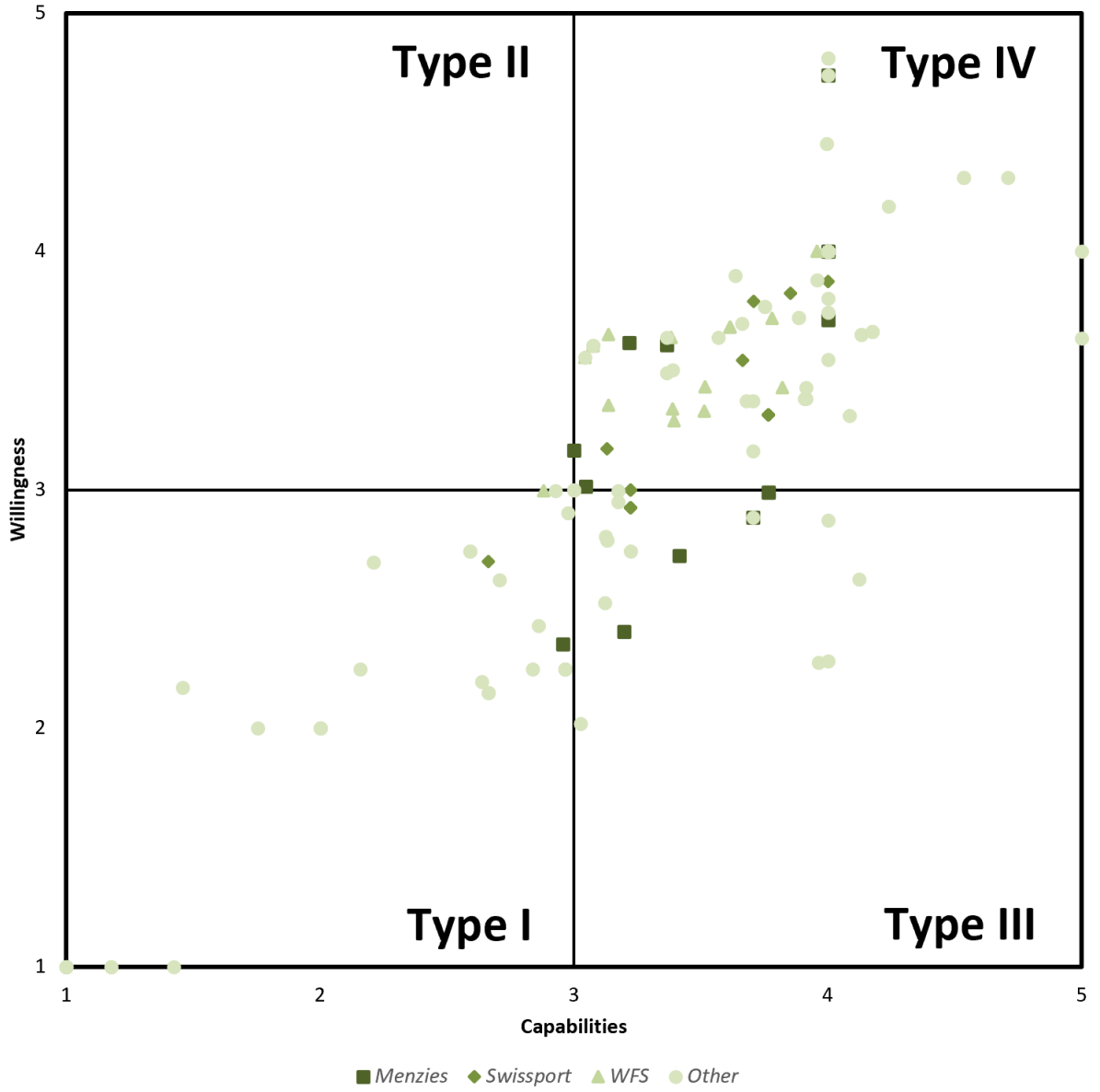
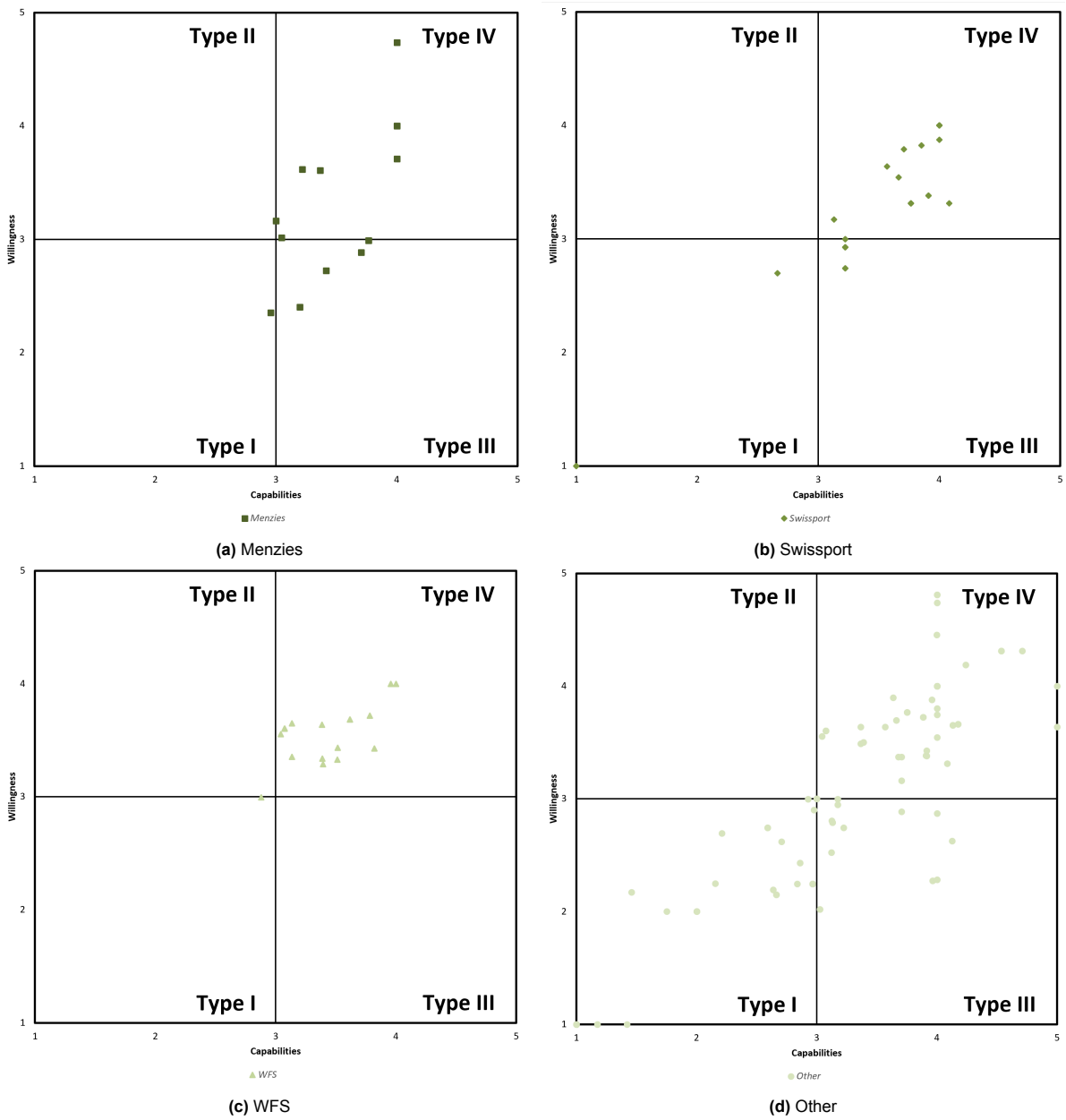


Figure 5.7: The segmented outstations per GHA



(a) Menzies

(b) Swissport

(c) WFS

(d) Other

Figure 5.8: The segmented outstations separated per GHA

Table 5.12: The number of segmented outstations per GHA

	Menzies	Swissport	WFS	Other
Type I	1	3	1	34
Type II	0	0	0	0
Type III	5	8	0	13
Type IV	8	24	18	53
Total	**14**	**35**	**19**	**100**

Table 5.13: The segmented outstations per GHA in percentage

	Menzies	Swissport	WFS	Other
Type I	7%	9%	5%	34%
Type II	0%	0%	0%	0%
Type III	36%	23%	0%	13%
Type IV	57%	69%	95%	53%
Total	**100%**	**100%**	**100%**	**100%**

For the GHAs, it is interesting to note that Worldwide Flight Services (WFS) is performing exceptionally well, with only one outstation not in the Type IV segment but in Type I. Following WFS is Swissport and then Menzies, with the other GHAs in a combined category as the worst performing group. This

suggests that the larger player tends to be more sustainability-oriented, exhibiting overall higher willingness and higher capabilities than the other GHAs. These insights can also be utilised to develop strategies.

5.9. Specified components of strategies

Based on the initial components of strategies per segment, the next step involves tailoring these components to the specific operations of KLM Cargo, with a particular focus on the sustainability goals of zero emissions and zero waste. To achieve this, a focus group with three of the AODs was organised to discuss the strategies for enhancing sustainability at the outstations.

In this focus group meeting, the process began with a short recap of the steps taken after scoring the partners. The weights of the criteria and the scores on the different capabilities and willingness criteria created an aggregated score on these two axes for all outstations, allowing the outstations to be segmented into different categories.

To ensure clear differences, the matrix was divided based on low and high capabilities and willingness, resulting in four segments: Type I (low capabilities, low willingness), Type II (low capabilities, high willingness), Type III (high capabilities, low willingness), and Type IV (high capabilities, high willingness). It was explained that this method is used in the literature, where strategies have also been developed based on these segments.

To help the participants understand the kind of strategies they should think of, the initial strategies as presented in Chapter 4.2.2 were shown. This was to provide a starting point for the experts. After presenting these initial strategies, the first question posed to the AODs was whether they thought the high-level initial strategy was correct. Following this, an overview was presented for the segment with one randomly chosen outstation for each of the four areas. For the Type II segment, no examples of outstations could be given because there were no outstations in this segment. After this, a discussion is facilitated among the participants in the online meeting to explore how they can enhance the sustainability of the outstations within the segment. This discussion focuses on identifying piratical steps to improve the capabilities and willingness of the partners, ensuring that the strategies are not only theoretically substantiated but also practically applicable and effective in achieving KLM Cargo's sustainability goals.

The process was repeated for each segment: the initial strategy for the next segment was presented, the AODs were asked for their agreement, an overview with a random outstation which belongs in that segment for every area was shown, and then the discussion was guided to tailor the strategies. At the end of the session, everyone had the opportunity to add general remarks and discuss those as well.

The following chapters will present the tailored strategies based on the information gathered from the focus group. First, for each segment, the initial strategy from Chapter 4.2.2 will be shown (without references). Then, it will be discussed whether the AODs agree with these initial strategies. Subsequently, the tailored strategies, reflecting the insights and inputs from the AODs, will be presented. For clarity, a summary of these tailored strategies will also be presented in a matrix with keywords. Finally, other remarks of the focus group will be discussed.

5.9.1. Type I: low capabilities and low willingness (n = 39)

This is the initial strategy: *For this segment, the primary component of the strategy is to consider replacement due to their limited utility in advancing sustainability goals. However, if immediate replacement is not feasible (e.g., because of supply chain constraints), implement developmental measures which are aimed at gradually improving both the partner's willingness and capability. It is advisable to first improve the willingness of partners in this segment before improving capabilities. This could involve partner assessment and feedback mechanisms, small-scale financial incentives, or technical support that introduces basic sustainable practices. Basic sustainability development activities might make these partners minimally compliant with certain sustainability goals, thus improving their sustainability performance.*

The focus group indicated that this initial strategy is correct. The tailored strategy, based on the insights from the focus group, is as follows:

First, a bonus-malus system could be introduced. This system incentivises outstations to meet specific sustainability goals by rewarding those who achieve or exceed these goals with bonuses, while outstations that fail to meet them may face penalties. Additionally, outstations who demonstrate significant progress in their sustainability practices could receive tokens or some kind of recognition, such as 'gift cards', to motivate and acknowledge their efforts. For example, a team currently working on a late flight sometimes receives a small gift card. These kinds of actions could also be used to promote sustainability.

The strategy could also include sending representatives from the central organisation to act as guest speakers, keynote speakers or lecturers at outstations. These visits will provide direct support, offer insights, and reinforce the importance of sustainability goals. This engagement would be more effective than just sending out one-pagers via email. These representatives could do a tour in certain areas, acting as keynote speakers or lecturers to engage the outstations more deeply. Although this seems more effective, one-pagers could still be used to highlight key sustainability practices and updates, ensuring outstations are continually informed and engaged.

Education is another important component of this tailored strategy. Master classes will be organised to educate outstations on sustainable practices and provide the technical support they need to implement these practices effectively. To better understand the current state of sustainability efforts, a detailed checklist will be distributed to all outstations (more information about this checklist is provided in Chapter 5.9.6). This survey will help to gather data on what GHAs are already doing and to identify areas where they need further support. This information will not only improve existing partnerships but also aid in the selection of new GHAs during the procurement process.

Lastly, a certification program could be developed to evaluate and recognise the sustainability efforts of GHAs at outstations. This certification could serve as a benchmark for sustainability, providing a clear standard for all outstations to strive towards and offering a valuable criterion when selecting a new GHA at an outstation.

5.9.2. Type II: low capabilities and high willingness (n = 0)

This is the initial strategy: *This segment, characterised by its high willingness but low capabilities, is ideal for substantial development investments. Tailored training programs that focus on sustainable practices, technical assistance and sharing of best practices can be highly effective. Forming cross-functional teams to address specific sustainability challenges collaboratively can also be beneficial. This approach enhances their capabilities but also reinforces their commitment to sustainability, using the partner's willingness to improve.*

The focus group indicated that this initial strategy is correct. The tailored strategy, based on the insights from the focus group, is as follows:

This strategy is further refined to include collaboration with local management and government to explore potential subsidies or grants, encouraging collective efforts towards sustainability. This approach can help to connect partners with financial resources without KLM Cargo having to bear the full cost.

Additionally, implementing capability-building initiatives that are not expensive, such as training sessions, best practice sharing, and masterclasses, can provide immediate benefits. These initiatives can show a favourable return on investment, such as recycling plastics or installing LED lighting, which contribute to sustainability while also offering cost-saving benefits.

KLM Cargo can play a catalytic role by helping outstations develop solid business cases that clearly demonstrate the potential benefits of sustainable investments, even if the initial financial expenses are modest. This can include showing the long-term benefits and cost savings associated with sustainable practices.

Furthermore, exploring partnerships with non-governmental organisations (NGOs) and local organisations committed to sustainability can provide additional support and resources. These partnerships can enhance the impact of sustainability initiatives and ensure that efforts are well-coordinated and effective. For example, teaming up with renowned NGOs can provide credibility and additional expertise to sustainability efforts for both organisations.

To ensure practical application, KLM Cargo can assist in making business cases for sustainability initiatives, demonstrating the benefits and encouraging investment without direct financial input for the company. This catalytic approach, combined with exploring local collaborations and providing tailored training, can significantly enhance the sustainability capabilities of outstations in this segment with low capabilities but high willingness.

5.9.3. Type III: high capabilities and low willingness (n = 26)

This is the initial strategy: *Partners in this segment possess the required capabilities but lack the motivation to align these with sustainability goals. Strategies should, therefore, focus on incentivising engagement through mutually beneficial sustainability initiatives. Encouraging a partnership by demonstrating loyalty and offering long-term commitments can be effective. Additionally, engaging partners in strategic decision-making processes may help in aligning their objectives with sustainability goals, as they see the direct benefits of their involvement and the importance of those goals.*

The focus group indicated that this initial strategy is correct. The tailored strategy, based on the insights from the focus group, is as follows:

This strategy is refined to also emphasise the return on investment of sustainability initiatives to influence willingness. Financial incentives can play a crucial role in changing partners' attitudes toward sustainability. If outstations understand that sustainability efforts can lead to cost savings and other financial benefits, they may be more inclined to engage. So, by explaining the financial benefits, such as cost savings and efficiencies gained through sustainable practices, outstations may become more willing to engage.

Additionally, implementing a contract strategy where outstations demonstrating strong commitments to sustainability are offered longer-term contracts of three or five years, while those without such commitments are only offered one-year contracts, creates a clear incentive structure. This approach ensures that sustainability commitments are a key factor in procurement decisions, with a significant part of negotiation focusing on sustainability. Standardising contracts to include mandatory sustainability commitments is also important, making the procurement negotiations more straightforward. Outstations who are unwilling to commit to sustainability practices should be informed that they will no longer be considered.

Furthermore, conducting a benchmark study to compare these outstations with other market players who prioritise sustainability can be enlightening. Highlighting the successes and positive outcomes of those who actively engage in sustainable practices can provide a case for why these outstations should increase their commitment. This can serve as a form of constructive pressure, showing outstations the potential advantages of aligning with sustainability goals.

5.9.4. Type IV: high capabilities and high willingness (n = 103)

This is the initial strategy: *Partners in this segment possess the required capabilities but lack the motivation to align these with sustainability goals. Strategies should, therefore, focus on incentivising engagement through mutually beneficial sustainability initiatives. Encouraging a partnership by demonstrating loyalty and offering long-term commitments can be effective. Additionally, engaging partners in strategic decision-making processes may help in aligning their objectives with sustainability goals, as they see the direct benefits of their involvement and the importance of those goals.*

The focus group indicated that this initial strategy is correct. The tailored strategy, based on the insights from the focus group, is as follows:

The strategy also emphasises the importance of effective communication. Sharing best practices and success stories with customers and other partners can help benchmark performance and promote the value of sustainable practices. By publicly recognising these well-performing outstations, KLM Cargo can create a positive feedback loop that motivates continuous improvement and encourages a culture of sustainability. Communicating these successes makes it appealing for outstations and others to join in these sustainability efforts. Sharing the stories with outstations who are not in this Type IV segment and showcasing them to customers further enhances the visibility and impact of the achievements of the outstations in this segment.

Moreover, in regions where KLM Cargo operates multiple stations, there may be opportunities to leverage the success of these well-performing outstations to inspire and improve the performance of outstations in lower-performing segments. For example, showcasing the achievements and benefits experienced by outstations in this segment can serve as a good example for outstations in segments Type II and Type III. This approach not only demonstrates that high levels of sustainability are achievable but also highlights the visible benefits, thereby motivating other outstations to enhance their own practices. Using high-performing outstations as leverage, especially in similar markets, can serve as practical examples and inspiration for others. For instance, it may not make sense to show an outstation in Mumbai the achievements of an outstation in Frankfurt, but demonstrating the success of one German outstation to another within Germany could be highly effective.

5.9.5. Matrix with tailored strategies

Table 5.14 provides a clear overview of the tailored strategies within the 2x2 matrix, summarising the key actions and focus areas for each segment type based on the strategies specified according to the information from the focus group.

Table 5.14: Matrix with an overview of the tailored strategies per segment

Willingness	Capabilities: Low	Capabilities: High
High	*Type II* • Local collaboration • Subsidies or grants • Capability-building initiatives • Training sessions • Best practice sharing • Master classes • Indicate return on investment • Business case development • Partnerships with NGOs	*Type IV* • Effective communication • Sharing best practices • Success stories • Public recognition • Positive feedback loop • Levaraging high-performing outstations • Practical examples • Inspiration • Showcasing achievements
Low	*Type I* • Bonus-malus system • Tokens of recognition • Guest speakers • Keynote speakers • One-pagers • Master classes • Certification program	*Type III* • Indicate return on investment • Financial incentives • Longer-term contracts • Mandatory sustainability commitments • Standardised contracts • Benchmark study • Constructive pressure

5.9.6. Other remarks

In addition to the tailored strategies developed for each segment, the focus group provided several insightful remarks that can further enhance the effectiveness of the DSS and the overall approach to PRM. These remarks emphasise a more structured and collaborative approach to sustainability.

First of all, the focus group highlighted the importance of defining clear, actionable steps for each segment to facilitate continuous improvement. For each segment, a step-by-step approach can help guide outstations in progressively enhancing their sustainability practices. Also, a more general step-by-step approach for KLM Cargo, which shows which outstations to focus on first, could be useful to enhance sustainability and make an impact.

Besides, as previously mentioned in the Type I strategy, a detailed checklist should be a fundamental part of the process for all segments. This checklist would make an inventory of the current sustainability practices of GHAs. By gathering feedback and assessing what GHAs already have in place, such as LED lighting or solar panels, a more accurate evaluation can be made. This would help grade partners more fairly and identify areas for further improvement. Additionally, this checklist can be integrated into a certification program that evaluates how sustainable each partner is and identifies areas where

KLM Cargo can provide further assistance. Apart from the fact that capabilities and willingness to improve sustainability often correlate with already implemented sustainable initiatives, this is not always a given. It is possible that an outstation with low capabilities and low willingness might have LED lighting while an outstation with high capabilities and high willingness does not. Although these cases may be exceptions, it is crucial to identify them. Recognising these discrepancies allows for more specific strategies tailored to each outstation's actual practices. Additionally, it supports the step-by-step approach for outstations, which the focus group has emphasised as important, as shown in the previous paragraph.

Furthermore, the focus group identified the possibility of joint investments. As an example given during the focus group meeting, KLM Cargo could propose paying an additional 1 cent per kilo handled by outstations to fund sustainability initiatives. This joint investment approach would not only demonstrate KLM Cargo's commitment to sustainability but also foster a collaborative environment where both KLM Cargo and its partners are working towards common goals. This approach particularly impacts the Type I and Type II segments, where initial investments are crucial for driving change.

Finally, incorporating a joint investment strategy would also strengthen KLM Cargo's sales pitch to suppliers and customers. When asking partners to invest in sustainability, it is more compelling if KLM Cargo is also willing to invest. This demonstrates a shared commitment and enhances credibility. By leading by example, KLM Cargo can better advocate for sustainability and motivate partners to follow suit. This approach is again especially beneficial for the Type I and Type II segments, where the impact of investments is most significant.

Overall, these additional remarks from the focus group underscore the importance of collaboration, fair assessment, and shared responsibility in achieving sustainability goals. Implementing these insights can further enhance the DSS and PRM strategies, ensuring a more effective and comprehensive approach to sustainability within KLM Cargo's operations.

5.10. Step-by-step strategy

The previous chapter described the specified components of strategies for each segment based on the operation of KLM Cargo. Since the sustainability goals are ambitious, a comprehensive strategy could support the company in achieving these goals more effectively. This strategy should be structured as a step-by-step plan, ensuring clarity and actionable steps. The step-by-step plan will be based on the interpretations of the segmentation and the insights gained from the focus group discussions regarding the specified components of strategies. Figure 5.9 shows the step-by-step strategy for KLM Cargo, which will be explained in detail.

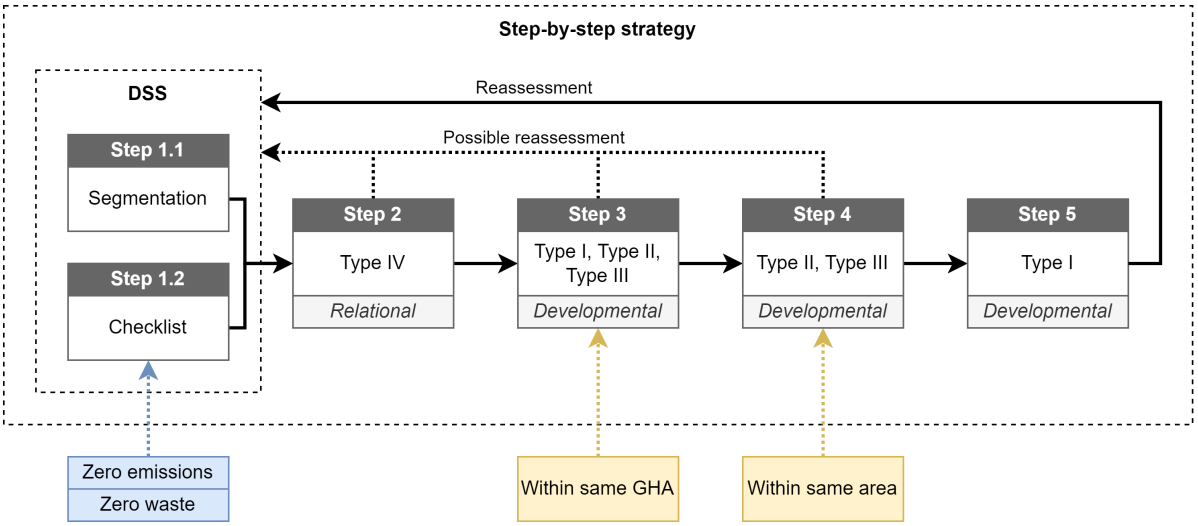


Figure 5.9: Step-by-step strategy for KLM Cargo

5.10.1. Step 1: Segmentation and checklist

First of all, as emphasised by the focus group, besides segmenting the partners, creating a checklist is a crucial initial step (Step 1.2). This should also be part of the DSS and will be added in Chapter 7 when looking at the broader application of the DSS. This checklist is essential for assessing what sustainability practices have already been implemented at each outstation. It is important to note that being in a particular segment does not necessarily mean that an outstation has already implemented sustainability practices. For example, an outstation segmented in the Type IV segment is capable and willing to enhance sustainability, but that does not guarantee current implementation. Conversely, a Type I outstation might have implemented some sustainability practices, even though they are not really capable and willing to enhance sustainability (as they are considered to have low capabilities and low willingness).

Therefore, a checklist should be created, covering all the elements which are required to fully achieve the sustainability goals of zero emissions and zero waste at an outstation. For example, achieving zero emissions could involve implementing LED lighting, installing solar panels, and using electric-powered forklifts. For zero waste, practices such as recycling or reusing plastic and wood should be included. The checklist should consider varying levels of implementation, such as the percentage of forklifts that are electrically powered. This allows for assigning a current sustainability score to each outstation, providing a clear overview of their current level of sustainability as well as their capabilities and willingness to enhance sustainability. Combining this information helps to specify the components of strategies for the different segments more accurately.

5.10.2. Step 2: Focus on Type IV segment

So, by combining the information about the capabilities and the willingness to enhance sustainability with the details gathered from the checklist regarding what outstations have already done to achieve the goals of zero emissions and zero waste, the next step can be initiated. This next step focuses on the Type IV segment outstations. The information gathered from the segmentation and the checklist highlights the importance of concentrating on these outstations because these partners are capable and willing to implement sustainability practices.

The focus should, therefore, be on the Type IV outstations that have not yet implemented many sustainability practices (have a low 'sustainability score'), as indicated by the checklist. By using the specified components of strategies for segment Type IV, KLM Cargo can ensure that these outstations start or continue implementing sustainability practices. The kind of strategy employed for these outstations is a relational strategy. Relational strategies emphasise mutual growth through collaborative efforts, where both parties share power and responsibility for progress (Bartley, Metz, & Fleming, 2022). These strategies acknowledge the interdependence and collective accountability inherent in the growth process. Unlike developmental strategies, which focus on building capabilities and willingness from a lower base (Type I, Type II, and Type III segments) (Heikkilä & Cordon, 2002), relational strategies leverage existing strengths and commitments to foster collaboration and integration.

Focusing on this Type IV segment first establishes a solid basis, creating outstations that can serve as examples for other outstations. It makes sense to prioritise this segment because the checklist will also show which outstations could implement more practices. Implementing these practices is easiest in this segment due to the high capabilities and high willingness, thus offering both high impact and ease of implementation.

Possible reassessment

Reassessment is a crucial component of the iterative process within the step-by-step strategy. It is possible after Step 2, Step 3, and Step 4. The need for reassessment should always be evaluated based on the number of outstations addressed with the strategy of the respective step. The more outstations a strategy is deployed on, the higher the likelihood that changes will be enforced, thus increasing the importance of reassessment. Additionally, the time passed before moving on to the next step is an important factor: the more time that has passed, the higher the likelihood that changes have occurred, thus increasing the importance of reassessment.

After addressing the Type IV segment within Step 2, the possibility arises for the first reassessment of the segmentation and the checklist. Focusing on the Type IV segment could directly influence the

capabilities, willingness, and sustainability practices of the outstations. Therefore, before proceeding to the next step, which involves different segments, a reassessment of the segmentation and the checklist is recommended. This reassessment ensures that the most current and accurate information guides the ongoing strategy implementation.

If the reassessment is conducted and the results align with the expectations, the next step can be initiated. The anticipated results will mostly be visible as an increased sustainability score, based on the reassessed checklist, for the Type IV outstations which are considered in this step. Improvements in capabilities and willingness scores will likely occur since implementing sustainable practices may further enhance scores on the capabilities and willingness criteria. However, since the Type IV segment is the 'highest' segment, outstations will not likely shift from one segment to another. It is also important to monitor which specified components of strategies for the Type IV segment are most effective, as this information will be valuable for repeating the steps in the future.

As this process is iterative, it is essential to continue supporting Type IV outstations that have not shown significant progress. These outstations may still require attention, focusing on the components of strategies tailored for Type IV outstations.

5.10.3. Step 3: Focus on Type I, Type II, and Type III segments within the same Ground Handling Agent

The next step involves addressing the outstations in the Type I, Type II, and Type III segments using developmental strategies. Although no Type II partners have been identified currently, this could change over time after reassessing. For now, the focus will be on the three largest GHAs: Menzies, Swissport and WFS. These GHAs generally exhibit high capabilities and high willingness, and since the overarching organisation is consistent across all outstations they handle, they represent the logical next focus area.

By leveraging the Type IV outstations within the same GHA as examples, KLM Cargo can inspire and motivate other outstations in different segments. The focus group emphasised using successful Type IV outstations to understand why other outstations are in different segments and to identify areas for improvement.

For outstations in Type I, Type II, and Type III segments, the components of the respective strategies should be employed to enhance their capabilities and willingness. These components are developmental strategies, focusing on growth and improvement over time (Heikkilä & Cordon, 2002). The ultimate goal is to elevate their sustainability levels, contributing to the sustainability goals of zero emissions and zero waste. For instance, only one of the 19 outstations handled by WFS is in the Type I segment, while the other 18 are in the Type IV segment (as shown in Table 5.10. Applying the specified components of strategies for the Type I segment and engaging in effective communication with the GHA could lead to quick wins and significant improvements.

Possible reassessment

Following Step 3, reassessment is possible again. Although based on the current segmentation focused on the GHAs, it looks like not many outstations will be addressed in this step. This could mean that reassessment is not needed, also depending on the time needed to deploy the strategies. However, reassessment could always be done to ensure accuracy. If the results align with expectations, the process can proceed to the next step. Expected results include increased capabilities and willingness scores for the outstations on which the strategies are deployed in the Type I, Type II, and Type III segments. There is a possibility that these outstations shift from one segment to another, such as from Type I to Type II or Type III (or even Type IV), and from Type II and Type III towards Type IV. Additionally, the sustainability scores based on the checklist should show improvement as an expected result.

5.10.4. Step 4: Focus on Type II and Type III segments within the same area

The next step focuses on Type II and Type III outstations within the same area. Although no Type II outstations are currently identified, this could change after reassessment, as mentioned. The reason for excluding Type I outstations at this stage is that addressing sustainability within the same GHA is more straightforward than within the same area.

The same area refers to the broader regions of Asia, Africa, America, and Europe. Even within these areas, significant differences exist among outstations. Hence, the choice to prioritise GHAs, including Type I, before examining outstations within the same area but excluding Type I.

Within the same area, the approach involves leveraging Type IV outstations as examples for Type II and Type III outstations. This strategy aims to demonstrate achievable sustainability practices and improvements. It is essential to compare outstations operating in the most similar conditions within the areas, making it easier to use successful outstations as examples and leverage their achievements.

Additionally, employing the specified components of strategies for Type II and Type III outstations, which are also developmental strategies, is crucial. These strategies focus on enhancing capabilities and willingness, fostering growth and improvement over time. This targeted approach ensures that outstations within the same area can learn from their peers and progressively align with KLM Cargo's sustainability goals.

Possible reassessment

After completing this step, reassessment could again be necessary before proceeding further. If the results are as expected, the process can move to the next step. The expected outcomes include increased capabilities scores for Type II outstations and increased willingness scores for Type III outstations, thereby moving these outstations into or closer to the Type IV segment. Additionally, increased sustainability scores based on the checklist could be expected for the outstations addressed within this step.

5.10.5. Step 5: Focus on Type I segment

The remaining outstations are those in the Type I segment. These outstations pose the greatest challenge in improving their sustainability scores and their capabilities and willingness to enhance sustainability. Although these outstations were not considered in the previous step when leveraging Type IV outstations within the same area for the Type II and Type III outstations, this approach could definitely be used for these outstations as well. Therefore, use Type IV outstations as examples. Use comparisons within the same area if these are possible; this makes the case stronger. Since these outstations could not be addressed within the same GHA, it indicates that the GHA of these outstations is not one of the 'big players'. Therefore, the outstations left in the Type I segment should be addressed using the specified components of strategies specific to the Type I segment. This includes considering replacement due to their limited utility in advancing sustainability goals or deploying developmental strategies to gradually improve their willingness and capabilities.

Reassessment

After this last step, reassessment is needed. An updated matrix with the segmented partners based on their capabilities and willingness will be created. Additionally, all the outstations should fill in the checklist with the sustainability score again. This reassessment ensures that the most current and accurate information is available, reflecting any progress or changes in the outstations' sustainability efforts.

Following the reassessment, the necessary steps can be executed again to improve the sustainability of the outstations that are not yet sustainable. Ideally, this process will eventually lead to a situation where all stations are in the Type IV segment. In this segment, all outstations are capable and willing to enhance sustainability. From there, the focus shifts to ensuring that all these outstations actually implement the necessary sustainable practices.

Ultimately, the goal is for all outstations to achieve the maximum sustainability score based on the checklist. This achievement signifies that the sustainability goals of zero emissions and zero waste for KLM Cargo are met. Through this iterative assessment process, strategy implementation, and reassessment, KLM Cargo can systematically improve the sustainability performance of its outstations, moving closer to its overarching sustainability objectives.

5.11. Key insights

The application of the DSS to KLM Cargo demonstrates the practical utility and adaptability of the system in achieving sustainability goals. The chapter illustrates the systematic approach taken to in-

corporate KLM Cargo's specific operational and sustainability goals into the framework of the DSS.

First, the conceptual model of the DSS was tailored to address KLM Cargo's ground handling operations at outstations, focusing on the sustainability goals of zero emissions and zero waste. This customisation ensured that the DSS was directly applicable to KLM Cargo's unique context, providing a specified framework for guiding PRM.

The next step was identifying and selecting relevant sustainability criteria through expert consultations. Initially, experts confirmed the list of capabilities and willingness criteria derived from the literature. These experts then selected the most relevant criteria, and a second round of communication was conducted to ensure alignment and consensus. Some criteria were modified based on expert feedback, and detailed explanations were created to contextualise these criteria for KLM Cargo's operations and sustainability goals. This process ensured that the selected criteria were both relevant and clear, providing a solid foundation for the subsequent scoring and evaluation processes.

The structured scoring process and the establishment of a consistent scoring scale were essential for ensuring reliable and comparable evaluation across KLM Cargo's extensive network of outstations. The trade-off between the criteria to acquire the relative weights of the criteria was done by using the Excel solver, which makes use of BWM. Then, the partners were segmented based on their aggregated capabilities and willingness scores.

The detailed interpretation of the segmentation results provided valuable insights into the distribution of sustainability performance across different areas and GHAs. Europe was performing the best, followed by Asia, then America, and lastly Africa. Among the GHAs, the three largest handlers operating at multiple outstations showed better sustainability performance than the smaller handlers. These interpretations were found to be useful for developing the step-by-step strategy, guiding the prioritisation and tailoring of sustainability practices.

The focus group discussions were instrumental in refining the initial components of strategies into specified components of strategies tailored to KLM Cargo's operations. The collaborative efforts and practical insights from these discussions ensured that the strategies were not only theoretically sound but also practically applicable.

Finally, the step-by-step strategy developed as the final output of the DSS is found crucial for creating an executable plan for enhancing sustainability in KLM Cargo's operations. While the specified components of strategies, derived from the initial components of strategies, provide more detailed guidance, they are still merely components. These components alone are not sufficient to form a complete, actionable strategy. Hence, it was necessary to compile a comprehensive step-by-step strategy as the final output based on the DSS.

By addressing the unique needs and characteristics of each partner segment, the step-by-step strategy ensures that KLM Cargo can effectively manage and enhance the sustainability performance of its outstations, ultimately working towards the ambitious goals of zero emissions and zero waste. This structured approach, built on the foundation provided by the DSS, transforms the specified components of strategies into a coherent, actionable plan that guides PRM to achieve sustainability goals.

6

Effectiveness

This chapter will focus on the evaluation, serving as a validation of the results and the application of the created DSS within the context of KLM Cargo. The following research question will be answered:

RQ V
Evaluation
How can the effectiveness of the DSS be assessed in terms of its functionality within KLM Cargo, based on the validation of the results and on the objectives stated in RQ II?

First, a sensitivity analysis will be conducted to check the sensitivity of the weights and the scoring (Chapter 6.1). Then, the results will be validated (Chapter 6.2). This involves checking some notable results with the literature. Additionally, correlations within the capability and willingness scores, as well as between the capability and willingness scores, will be examined to ensure the robustness of the findings. Following this validation, Chapter 6.3 will address the objectives stated in RQ II, assessing whether the DSS fulfils these requirements. This evaluation will determine the effectiveness of the DSS in guiding PRM of KLM Cargo towards achieving their sustainability goals. It can also highlight some possible improvements which can be used for the broader application of the DSS. Chapter 6.4 will provide the key insights from this chapter.

6.1. Sensitivity analysis

Sensitivity analysis is an essential tool for identifying critical control points, prioritising additional data collection or research, and validating a model's robustness (Frey & Patil, 2002). Within the domain of MCDM techniques, and more specifically in BWM, conducting a sensitivity analysis is a common practice (Rezaei & Ortt, 2013b; Safarzadeh, Khansefid, & Rasti-Barzoki, 2018; Jafarzadeh Ghoushchi, Dorosti, Khazaeili, & Mardani, 2021). Numerous methods exist to perform sensitivity analysis, each with its own strengths and applications. This sensitivity analysis will focus on two key areas: the sensitivity of the weights assigned to the criteria by BWM and the sensitivity of the scoring process for the outstations. By integrating these aspects, the overall sensitivity of the segmentation can be evaluated.

6.1.1. Sensitivity of the weights of the criteria

Sensitivity can play a significant role in the weights of the criteria, which are determined using the BWM, as they are influenced by the opinions of experts. Experts could have a different view on the importance of the criteria. In this analysis, the sensitivity of the weights of the criteria is considered to be the highest difference between a weight calculated by BWM for one of the experts and the actual normalised weight (which is based on the input of both experts). The rationale behind this approach is that the highest difference reflects the impact of incorporating another expert's opinions, thereby indicating the sensitivity.

It is important to acknowledge that changing the weight of one criterion will logically alter the proportions of the other criteria as well, given that the weights are normalised. However, for the purpose of this

analysis, this method provides insight into which outstations are most affected by the sensitivity of expert opinions in determining the weights for the criteria.

The largest difference for the capabilities criteria is 0.157 (see Table 5.6: $|w^N_{6,cap} - w^{E2}_{6,cap}| = |0.294 - 0.451| = 0.157$). For the willingness criteria, the largest difference is 0.085 (see Table 5.7: $|w^N_{3,wil} - w^{E1}_{3,wil}| = |0.210 - 0.295| = 0.085$). These differences highlight the sensitivity of the criteria weights to the expert opinions used in the BWM, which will be further interpreted in Chapter 6.1.3.

6.1.2. Sensitivity of the scoring of the partners

The scoring of partners, conducted by experts, is also subject to sensitivity. It is possible that a different person with similar knowledge might score the same outstation differently. When evaluating a large number of outstations, even the same expert might score an outstation differently during multiple assessments. However, a mutual understanding of the scoring criteria among experts ensures that these differences are not significant.

Given the limited scale (1 to 5), any difference in scoring is likely to be by only one point. For instance, one expert might give a score of 4 ('high') while another expert might give a score of 5 ('very high'). A difference of more than one point (e.g., 1 ('very low') and 3 ('medium') would suggest a lack of mutual understanding, which is not the case here. Therefore, the assumption is that the sensitivity of the scoring may vary by only one point.

To assess this sensitivity, the criteria with the highest weights for both capabilities and willingness are examined. Assuming that the sensitivity of the scoring process allows for a variation of plus or minus one point, the maximum deviation based on a single criterion is plus or minus the weight of the criterion with the highest weight. If other criteria scores change by +1 or -1, their impact will be smaller than that of the criterion with the highest weight. Thus, the focus is on the criterion with the highest weight.

It is acknowledged that other criteria could also be sensitive, potentially changing by +1 or -1. However, for this analysis, it is assumed that the sum of the other changes is zero. This means that the relative sensitivity is considered to be the change in the score of one criterion, with the highest possible change being the weight of the criterion with the highest weight. This approach also ignores possible correlations, as a +1 change in one criterion could increase the likelihood of another criterion being scored +1 as well.

The capabilities criterion with the highest weight is 0.294 (see Table 5.6: $w^N_{6,cap} = 0.294$), and the willingness criterion with the highest weight is 0.255 (see Table 5.7: $w^N_{1,wil} = 0.255$).

6.1.3. Sensitivity of the segmentation

Combining the sensitivity of the weights of the criteria and the sensitivity of the scoring of the partners allows to determine the ranges of aggregated scores within which outstations could easily move. An overview of the sensitivity for capabilities and willingness criteria, along with the corresponding ranges (which are twice the sensitivity), is presented in Table 6.1.

Table 6.1: Sensitivity for the capabilities and willingness criteria

	Capabilities criteria		**Willingness criteria**	
	Sensitivity	**Range**	**Sensitivity**	**Range**
Weights of the criteria	+/- 0.157	0.314	+/- 0.085	0.170
Scoring of the partners	+/- 0.294	**0.588**	+/- 0.255	**0.510**

For the continuation of the sensitivity analysis, the broadest ranges for the capabilities and willingness criteria are chosen (bold and blue in Table 6.1). In this case, both ranges are based on the sensitivity of the scoring of the partners. With two experts, this scenario is common. Only in exceptional cases, when the BWM results in a very high weight for one criterion and a very low weight for the same criterion by the other expert, the difference between the normalised weight and the weight from one expert might exceed the highest normalised weight. With more than two experts, this could occur more frequently. With only one expert, the sensitivity of the weights of the criteria must be measured differently since

this approach is not applicable (the difference will always be 0 because the weights of the single expert are the same as the normalised weights).

Thus, the ranges considered as the sensitivity reflect the broadest range within which the aggregated capabilities and willingness score could easily change. Plotting this range for each outstation individually is not effective. The segmentation is based on boundaries with a score of 3, so an aggregated capabilities and willingness score lower or higher than 3 determines the segment an outstation belongs to. If the range is plotted around the segment boundaries, the outstations within these ranges can be considered subject to sensitivity. This means these outstations could easily switch from one segment to another given the approach used for this sensitivity analysis. The other outstations will remain in the same segment even if the aggregated scores change according to the determined sensitivity.

This is visually shown in Figure 6.1, with the red crosses indicating the outstations within this range. Table 6.2 shows Table 5.9, but now the outstations within the range are marked in bold and red.

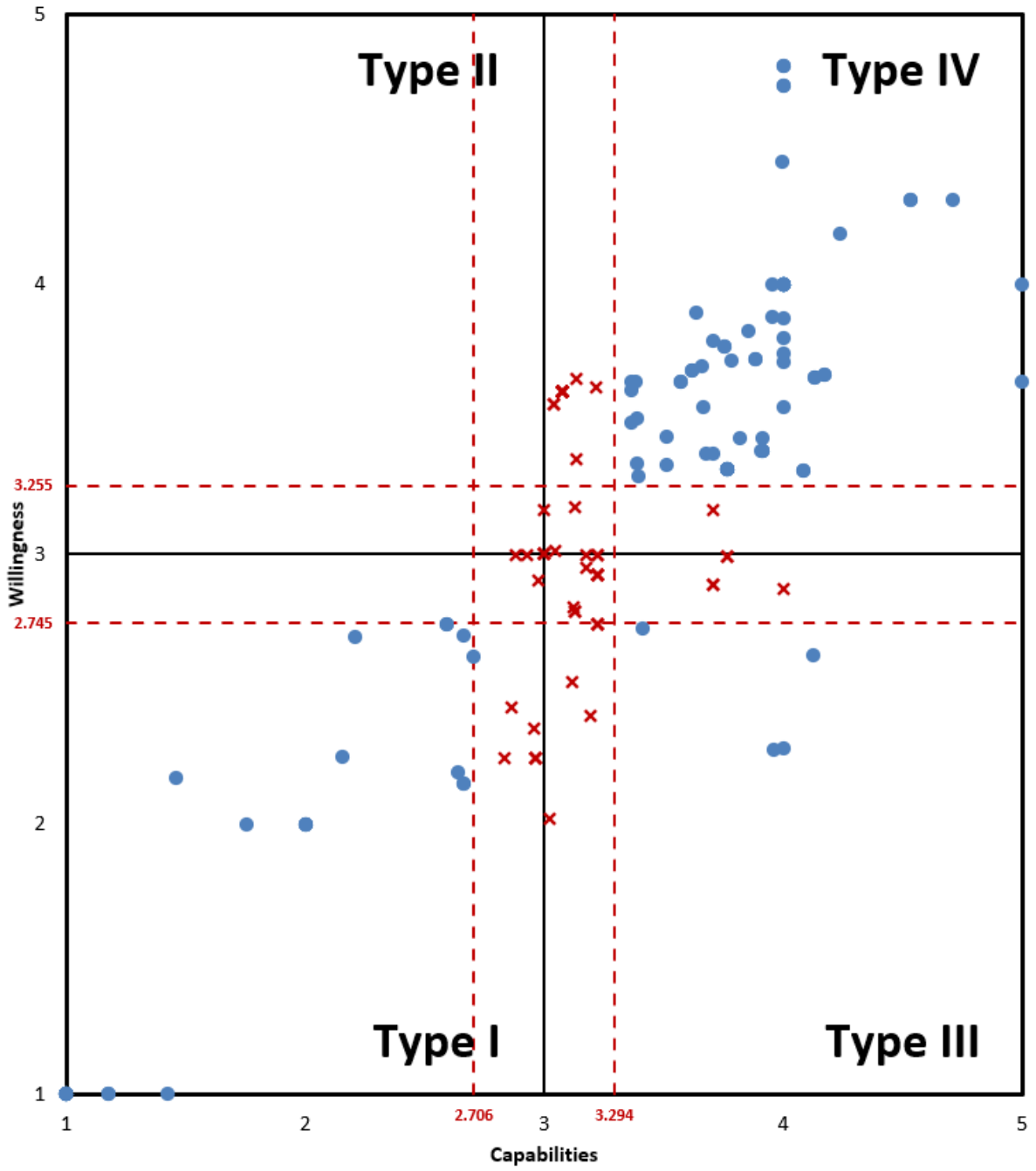


Figure 6.1: The segmented outstations with the sensitivity range

Table 6.2: The segmented outstations within the range

Segments	No. of outstations	Outstation no.
Type I	**9** of 39	15, **19**, **20**, **21**, **22**, 24, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 41, 42, 43, 52, 53, **54**, **59**, 61, **66**, **69**, 71, 74, 83, 84, 85, 86, 95, **98**, 118, 146
Type II	**0** of 0	-
Type III	**22** of 26	**9**, **13**, **14**, 18, **23**, **26**, **44**, **47**, **55**, 56, 60, **62**, **64**, **72**, 78, **90**, **91**, **92**, **93**, **96**, **97**, **107**, **117**, **131**, **143**, **144**
Type IV	**19** of 103	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 16, **17**, 25, 40, 45, 46, 48, 49, 50, 51, **57**, **58**, **63**, **65**, **67**, 68, **70**, **73**, **75**, **76**, 77, 79, **80**, **81**, **82**, 87, 88, 89, **94**, 99, 100, 101, 102, 103, 104, 105, 106, 108, 109, 110, 111, 112, 113, 114, 115, 116, 119, 120, **121**, 122, 123, 124, 125, 126, 127, 128, 129, 130, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 145, 147, 148, **149**, 150, 151, 152, 153, 154, 155, 156, **157**, 158, 159, 160, 161, 162, 163, **164**, 165, **166**, 167, 168

This analysis reveals that 50 of the 168 outstations (approximately 29.8%) are subject to the sensitivity defined in this analysis. Since these outstations are close to the boundaries that determine the segment they belong to, they should be handled more carefully. This caution is necessary because some of the specified components of strategies may not be as applicable to these outstations as they are to others further from the boundaries. On the other hand, the other outstations which are not affected by the sensitivity analysis can be considered well-placed within their corresponding segment, even when considering the sensitivity.

6.2. Validation of the results

In this chapter, the results obtained from implementing the DSS will be validated to ensure their reliability and alignment with established literature and expected outcomes. This validation process is important for assessing the effectiveness of the DSS in guiding PRM at KLM Cargo towards achieving the sustainability goals of zero emissions and zero waste. The validation will be conducted in three main areas: the validation of the scoring, the validation of the criteria, and the validation of the segmentation.

6.2.1. Validation of the scoring

By examining the average aggregated scores per area (Table 5.8), it shows that Europe scores the best (3.689 capabilities, 3.640 willingness), followed by Asia (3.742 capabilities, 3.166 willingness), then America (3.112 capabilities, 3.143 willingness), and Africa with the lowest scores (2.499 capabilities, 2.150 willingness). This can also be seen when looking at the segmentation per area (Figure 5.6 and Table 5.11). It can be observed that Europe has the most outstations in segment Type IV and the least in segment Type I, followed by Asia and America (which are quite similar), and then Africa. This segmentation reflects the distribution of sustainability performance across different regions.

These outcomes can be confirmed by (Sachs, Lafortune, Fuller, & Drumm, 2023), which presents the overall scores of the SDGs. According to this source, a world map with colour shades created by the SDG Transformation Center, Europe has the highest performance, followed by America, then Asia, and Africa has the worst performance. Although the SDGs cover a broader spectrum than the specific sustainability goals of zero emissions and zero waste within the operations of the GHAs at outstations, the general trend in sustainable development aligns well with the average capabilities and willingness of the outstations.

This comparison indicates that the scoring of the partners was accurate. It also validates the method used to ensure that all AODs have a consistent understanding of the scores. The scores across different areas indeed represent the performance accurately, not just within their respective regions but in comparison to the global context. This consistency supports the reliability of the segmentation and scoring partners used in the research.

It can also be expected that partners with whom KLM Cargo works at multiple outstations, namely the GHAs operating across several locations, will exhibit similar capabilities and willingness scores due to the overarching organisation. The shared company mission likely influences sustainability practices

consistently across all outstations, even though specific capabilities and willingness may vary. The expectation aligns with the vision of sustainability being comparable across the organisation's outstations, leading to similar segmentation results.

As illustrated in Figure 5.6, this is indeed the case. The outstations managed by one of the three major GHAs (Menzies, Swissport, and WFS) are more consistently grouped within the matrix. In contrast, outstations managed by other GHAs show a wider distribution. This consistency further validates the segmentation process, indicating that the scores reflect a coherent organisational approach to sustainability within these major GHAs.

6.2.2. Validation of the criteria

The criteria used for evaluating the capabilities and willingness of partners were chosen based on an extensive review of the literature. Each criterion was carefully selected to ensure it measured distinct aspects of capabilities and willingness, minimising overlap. Experts chose the criteria which should be considered for the application on the operations of KLM Cargo. To validate the selected criteria from the literature and for the application, Spearman's correlation was employed to analyse the relationships among the capabilities criteria, among the willingness criteria, and between the capabilities and willingness criteria. Spearman's correlation is a non-parametric measure of the statistical dependence between two variables. The coefficient ranges from -1 to 1. The greater the absolute value of the coefficient, the stronger the dependence between the variables. Specifically, values less than 0.3 indicate little correlation, values between 0.3 and 0.5 indicate low correlation, values between 0.5 and 0.7 indicate moderate correlation, values between 0.7 and 0.9 indicate high correlation, and values between 0.9 and 1 indicate very high correlation. (Spearman, 1910)

Correlation of the capabilities criteria

Table 6.3 shows the correlation coefficients among the capabilities criteria.

Table 6.3: Spearman's correlation coefficients of the capabilities criteria

	C_1^C	C_2^C	C_3^C	C_4^C	C_5^C	C_6^C
C_1^C	1.000	0.565	0.644	0.607	0.410	0.548
C_2^C		1.000	0.664	0.678	0.561	0.613
C_3^C			1.000	**0.704**	0.541	0.649
C_4^C				1.000	0.560	**0.745**
C_5^C					1.000	**0.701**
C_6^C						1.000

All p-values are lower than the level of significance ($a = 0.01$), which indicates that all correlations are highly statistically significant (see Appendix F). The average correlation of the capabilities criteria is 0.613, indicating a moderate correlation. The bold numbers in blue highlight the correlation coefficients higher than 0.7, which signifies a high correlation. This is the case for only 3 of the 15 correlations. It could be critical if the two criteria with high correlations also receive the highest weights after using the BWM. However, looking at Figure 5.3a, this is not the case, so there is no need to be concerned. The table shows that there are moderate to strong positive correlations among the capabilities criteria, which indicates that while some criteria are closely related, they are still distinct enough to provide valuable insights into different aspects of the partners' capabilities.

Correlation of the willingness criteria

Table 6.4 shows the correlation coefficients among the willingness criteria.

Table 6.4: Spearman's correlation coefficients of the willingness criteria

	C_1^W	C_2^W	C_3^W	C_4^W	C_5^W	C_6^W	C_7^W	C_8^W
C_1^W	1.000	0.557	0.612	0.662	0.279	0.389	0.390	**0.718**
C_2^W		1.000	**0.780**	0.671	0.626	0.680	0.516	**0.707**
C_3^W			1.000	**0.758**	0.644	0.672	0.615	0.634
C_4^W				1.000	0.447	0.507	0.471	0.685
C_5^W					1.000	**0.785**	**0.706**	0.480
C_6^W						1.000	0.692	0.651
C_7^W							1.000	0.564
C_8^W								1.000

All p-values are lower than the level of significance ($a = 0.01$), which indicates that all correlations are highly statistically significant (see Appendix F). The average correlation of the willingness criteria is 0.604, indicating a moderate correlation. The bold numbers in blue highlight the correlation coefficients higher than 0.7, which signifies a high correlation. This is the case for 6 of the 28 correlations. Again, after looking at Figure 5.3b, it can be seen that the two criteria with the highest weights are not two criteria with high correlation. Therefore, there is no need for concern.

Correlation between the capabilities and willingness criteria

Table 6.5 shows the correlation coefficients between the capabilities and the willingness criteria.

Table 6.5: Spearman's correlation coefficients between the capabilities and the willingness criteria

	C_1^W	C_2^W	C_3^W	C_4^W	C_5^W	C_6^W	C_7^W	C_8^W
C_1^C	**0.704**	0.495	0.443	0.534	0.201	0.266	0.243	0.588
C_2^C	0.615	0.594	0.485	0.449	0.333	0.490	0.370	**0.734**
C_3^C	**0.730**	0.607	0.619	0.610	0.332	0.485	0.556	**0.710**
C_4^C	0.681	0.666	0.539	0.609	0.327	0.479	0.393	0.673
C_5^C	0.546	**0.759**	**0.781**	0.569	0.654	0.640	0.499	0.540
C_6^C	0.654	**0.747**	**0.716**	0.626	0.584	**0.706**	0.480	0.697

All p-values are lower than the level of significance ($a = 0.01$), which indicates that all correlations are highly statistically significant (see Appendix F). The average correlation between the capabilities and willingness criteria is 0.557, indicating a moderate correlation. The bold numbers in blue highlight the correlation coefficients higher than 0.7, which signifies a high correlation. This is the case for 9 of the 48 correlations. Notably, the correlation between 'technological capability' (C_6^C) and 'environmental concerns' (C_3^W) is one of the high correlations. This is particularly interesting because 'technological capability' is the highest weighted capability criteria, and 'technological capability' is the second highest weighted willingness criteria. However, these criteria do not seem to be logically correlated, so this high correlation does not raise concern.

The average correlation between the capabilities and willingness criteria is lower than the correlations within the capabilities and within the willingness criteria, which is a positive aspect. Lower correlations between different dimensions (capabilities and willingness) suggest that the criteria measure distinct aspects, ensuring a comprehensive evaluation without redundancy. Therefore, based on the correlation coefficients, the criteria are validated.

It is important to note that, logically, capabilities and willingness are somewhat correlated. If a partner has the capabilities to enhance sustainability, they are more likely to also be willing to implement sustainable practices, as they have the necessary resources and skills. Conversely, if companies are willing to enhance sustainability, they are probably more focused on sustainability initiatives and, therefore, develop the required capabilities to support their willingness. This correlation is also confirmed by the results from the literature on supplier segmentation (Rezaei & Fallah Lajimi, 2019; Rezaei et al., 2015; Rezaei & Ortt, 2012, 2013b; Bai et al., 2017; Akhavan, Shahabipour, & Hosnavi, 2018).

Also, since all correlations are highly statistically significant, this indicates a true relationship among the correlated criteria. The relationship is, logically, stronger when the correlations are higher, as shown in the tables above. Another explanation for the high statistical significance is the large sample size ($n = 168$), which increases the power of the statistical tests and the likelihood of detecting significant relationships. (Columb & Atkinson, 2016)

6.2.3. Validation of the segmentation

Based on the segmentation, it can be observed that most outstations fall into the Type IV segment (103 outstations), followed by Type I (39 outstations), and Type III with 26 outstations (Figure 5.4 and Table 5.9). Notably, no outstations are classified in the Type II segment. In the literature on supplier segmentation, similar patterns can be found. Most segmentations show that the largest proportion of suppliers belong to either the Type I or Type IV segments. A smaller proportion is typically found in the Type II and Type III segments, with Type III often being significantly larger than Type II. This pattern is supported by findings in sources such as Rezaei and Fallah Lajimi (2019); Rezaei et al. (2015); Rezaei and Ortt (2012, 2013b); Bai et al. (2017), which highlight that suppliers with high capabilities and high willingness or low capabilities and low willingness dominate the segmentation aspect. This trend can be explained by the correlation between the capabilities criteria and willingness criteria, as discussed previously. Suppliers and partners that are either fully aligned or more or less misaligned with sustainability goals tend to dominate, with fewer partners exhibiting high willingness but low capabilities or high capabilities but low willingness.

For the validation of the results of the segmentation, another interview was held with an expert with sufficient knowledge about all areas (see Appendix G). This is done because it also validates whether the scoring and the weights of the criteria correctly represent the segmentation of the outstations. For the first part of the validation, a random outstation (but outside the sensitivity range) was chosen for every segment type and for every area. Since Type II does not exist, in total 12 outstations were validated (three outstations for all four areas). All outstations are correctly segmented according to the expert. For the second part of the validation, the expert was provided with the name of an outstation with the question to which segment this outstation should belong. This was done for three outstations, and all three outstations were segmented the same as the results (for one outstation, the expert doubted between two segments, but it was still one of those).

Therefore, the segmentation results in this study align well with established literature and are also confirmed by an expert, further validating the segmentation process of the outstations. The consistency with these documented trends supports the robustness and accuracy of the segmentation approach used in this research.

6.3. Objectives of the Decision Support System

The next chapter will assess whether the objectives of the DSS have been met to determine its effectiveness. The four output objectives are clear purpose, changes, collaborative co-creation, and clear communication.

6.3.1. Clear purpose

This is the explanation of the output objective: *The strategies developed from the DSS should have a clear purpose, aligning with the company's sustainable competencies, culture, values, challenges, and overall business strategy. The chosen sustainability goals inputted into the DSS should reflect and support these elements, ensuring each strategy is tailored to enhance the company's sustainable performance.*

Aligning with the company's sustainable competencies is achieved by designing the DSS to allow for the definition of specific sustainability goals as input. The criteria selection and partner scoring processes are based on input from the company, ensuring alignment with KLM Cargo's culture, values, challenges, and overall business strategy. The strategies are tailored through the creation of specified components of strategies, followed by a detailed step-by-step strategy plan. Therefore, this output objective is considered fully achieved.

6.3.2. Changes

This is the explanation of the output objective: *Sustainable strategies should facilitate significant changes across various organisational dimensions to support sustainability ambitions. These changes should be embedded within the partner's operations, ensuring the sustainable transformation lasts.*

The strategies focus on fostering long-term relationships and implementing lasting changes. They incorporate both relational and developmental strategies. Furthermore, the components of strategies address procurement by integrating sustainability commitments into contracts. One limitation is that the DSS does not inherently facilitate reassessment to account for the changes it induces. Although reassessment is included in the step-by-step strategy, it is not an integrated feature of the DSS itself. Therefore, this output objective is considered partly achieved.

6.3.3. Collaborative co-creation

This is the explanation of the output objective: *A key objective of the strategies should be to foster collaborative co-creation by involving external stakeholders in the innovation process. Therefore, the strategies should not only focus on what the partners should do but mostly on collaboration to achieve the sustainability goals.*

The DSS emphasises enhancing PRM, making collaboration a crucial component. Collaborative elements are integrated into the core components of strategies, involving external stakeholders such as local organisations or NGOs to assist in achieving sustainability goals. Therefore, this output objective is considered fully achieved.

6.3.4. Clear communication

This is the explanation of the output objectives: *The strategies must ensure continuous and clear communication of both successes and failures to internal and external stakeholders. Effective communication also facilitates feedback from stakeholders, allowing for timely adjustments to strategies.*

Communication is included in the components of strategies, though it is not an active part of the overall strategy. The step-by-step approach employs various communicative measures, yet a comprehensive communication strategy is not explicitly part of the DSS. The emphasis is on the use of communication within each strategic component rather than having a standalone communication plan. Therefore, this output objective is considered partly achieved.

6.4. Key insights

This chapter evaluated the effectiveness of the DSS for guiding PRM at KLM Cargo towards the sustainability goals of zero emissions and zero waste. A sensitivity analysis was conducted, and the validation of the results and the assessment of the DSS objectives were examined.

The sensitivity analysis revealed that the scores and weights used in the DSS are generally robust. It showed that approximately 29.8% of the outstations are subject to sensitivity, indicating that changes in the scoring or weighting could potentially shift these outstations from one segment to another. This highlights the importance of handling these outstations carefully, as they are more likely to fluctuate between segments. On the other hand, the remaining outstations are well-placed within their segments.

The validation confirmed that the scoring, criteria, and segmentation within the DSS align well with established literature and expected outcomes. The scoring reflected global sustainability trends according to the different areas, and the consistency among partners managed by the same GHA validated the methodology of ensuring different scorers had the same understanding of the scores. The criteria measured different aspects of the capabilities and willingness and were balanced, as shown by moderate correlations (all statistically significant), ensuring evaluation without redundancy. Additionally, the validation by an expert further confirmed the segmentation of outstations across all segments and areas and agreed with the segmentation of all these outstations.

Segmentation results matched the literature, with most outstations falling into Type I or Type IV segments. The concentration of outstations in these two segments also demonstrates the logical correlation between capabilities and willingness of partners, as confirmed by the literature. The consistency supports the reliability of the DSS in categorising partners based on capabilities and willingness.

The assessment of the DSS output objectives showed mixed results. The objectives of clear purpose and collaborative co-creation are fully achieved because of the alignment with KLM Cargo's sustainable competencies, culture, values, and strategy and the emphasis on collaboration with external stakeholders to meet sustainability goals. The objectives of changes and clear communication are partly achieved because the DSS lacks a standardised reassessment and also a standalone communication plan.

Overall, the DSS effectively guides PRM for KLM Cargo towards sustainability goals, highlighting areas for further refinement and broader application, which will be done in Chapter 7.

7

Broader application

This chapter addresses the broader application of the DSS, focusing on its generalisation and the enhancements required to improve its applicability and performance across cargo airlines. The RQ guiding this chapter is:

RQ VI
Evaluation
What adjustments are needed to enhance the DSS's applicability and performance across cargo airlines in general?

First, Chapter 7.1 will discuss the generalisation of the DSS based on the application of the system on KLM Cargo. The observations and the output objectives will provide valuable insides into how the DSS can be refined and adapted for use by other cargo airlines. Additionally, the specified components of strategies, as informed by the focus group, will be analysed to determine if these inputs can be utilised for broader application, allowing the initial components of strategies to be supplemented (Chapter 7.2). The step-by-step strategy will also be evaluated to understand if it can be generalised for the application in other areas, ensuring that the DSS remains adaptable and relevant across various operational environments. Finally, Chapter 7.3 will report the key findings for enhancing the DSS for broader use in the cargo airline industry.

7.1. Generalisation based on the application of the Decision Support System on KLM Cargo

During the application of the DSS on KLM Cargo, some observations were made. By combining these observations with the analysis of the two partly achieved output objectives, an updated DSS can be designed for broader application.

7.1.1. Observations

During the implementation of the DSS on the operations of KLM Cargo, four critical observations were made: one during the selection of criteria, two during the partner scoring step, and one during the specification of the components of strategies.

Selection of criteria

During the selection of criteria, the opinions of two experts were asked to validate and refine the initial list of sustainability criteria derived from the literature. Initially, the experts were asked to review the list to confirm whether they agreed with the criteria and identify potential omissions. The experts confirmed that no criteria were missing from the initial list. As reported in Chapter 5.4, the experts suggested consolidating the three collaborative capabilities ('absorptive capability', 'external capability', and 'integrative capability') into a single criterion, named 'collaborative capability'. Additionally, the experts recommended refining multiple definitions to ensure clarity and coherence. Specifically, 'public concerns' and 'public pressure' were merged into 'environmental concerns', 'technical capability' was

refined to 'technological capability', and 'legal pressure' was refined to 'regulatory pressure'. These modifications led to a more streamlined and precise set of capabilities and willingness criteria to enhance sustainability. Therefore, the refined list of criteria, as shown in Table 7.1, can be effectively used within the DSS in a broader context.

Table 7.1: The generalised list of capabilities and willingness criteria to enhance sustainability

Capabilities criteria	Willingness criteria
Collaborative capabilitiy	Attitude
Financial position	Commitment to continuous improvement in process
Geographical location capability	Dependency
Innovation management capability	Economic opportunities
Knowledge management capability	Environmental concerns
Management and organisation	Ethical standards
Measurement capability	Flexible contract terms and conditions
Position in industry	Government grants
Technological capability	Honest and frequent communications
	Long-term relationship
	Market pressure
	Mutual respect and honesty
	Regulatory pressure
	Relationship closeness
	Willingness to co-design and participate in new sustainability practices
	Willingness to invest in specific equipment
	Willingness to share information, ideas, and technology

Partner scoring

Firstly, the process revealed that the list of partners is not a given thing. It is essential to gather all necessary data to provide a clear and comprehensive overview of all partners. This includes not only identifying the partners but also collecting detailed information about them. In the case of KLM Cargo, details such as the geographical area and the GHA of each outstation were crucial. These details help formulate tailored strategies based on specific partner attributes.

The data collection step can be time-consuming, as it requires ensuring that the partner list is complete, up-to-date, and readily available for use in the DSS. Accurate and detailed partner information forms the basis of the partner scoring step, enabling a clear overview of how to score the partners.

The second observation pertains to the global nature of airline operations, which means that scoring partners may not be feasible for a single individual due to geographical dispersion and operational diversity. This necessitates involving multiple people in the scoring process, which introduces potential inconsistencies. To address these inconsistencies, best practices were developed during the application of the DSS on the operations of KLM Cargo. These best practices can be generalised as follows:

1. **Score all partners**
   Whenever possible, assign one person to score all outstations to prevent inconsistencies.
2. **One reference partner**
   If multiple people are scoring, identify a reference partner that all scorers are familiar with to standardise their understanding.
3. **More than one reference partner**
   If multiple people are scoring, identify an overarching organisation which operates within every area of the different scorers, as their consistent operation practices can serve as a benchmark.
4. **Objective measures**
   If multiple people are scoring, create objective measures for as many criteria as possible. Objective measures can provide a guideline for when a certain score should be given. Even though not all criteria might have objective measures, creating those also fosters a clearer understanding of the scale from 1 to 5, which helps align the interpretations of the scores. If necessary,

the next (and last) approach can be used in combination with this approach of creating objective measures.

5. **Discuss definitions**
   If multiple people are scoring and objective measures cannot be created (for some of the criteria), nothing much else can be done. Logically, the understanding of the scores (the scale from 1 to 5) needs to be as good as possible. Let the different people discuss the scale from 1 to 5 and discuss these definitions to ensure the best alignment possible. Even though it is about perception, it can still create more alignment with the scores besides the definitions of 'very low' to 'very high'.

Specification of the components of strategies

Another critical observation emerged during the focus group discussions on tailoring the components of strategies: it is essential to understand what sustainability initiatives and practices the partners have already implemented. Being capable and willing to enhance sustainability does not necessarily mean that sustainability practices have been executed. Conversely, a partner not deemed capable or willing might still have implemented certain sustainability practices. While capabilities and willingness are correlated with actual practices, they do not always align.

To address this, a checklist should be created, as already outlined in Chapter 5.9.6. This checklist is adapted to the specific sustainability goals of the organisation. These are the steps for the implementation of the checklist:

1. **Checklist development**
   The first step is to develop a checklist based on the sustainability goal. This checklist should cover all necessary items that need to be checked to achieve the specified sustainability goal.
2. **Define levels**
   The checklist should not be binary. Instead, it should include different levels for each item. For example, if an item on the checklist is achieved half, it should be captured by a percentage or a score to what extent this item was achieved.
3. **Partner completion**
   Partners are then required to fill in this checklist, providing detailed information about their current sustainability practices related to the sustainability goal.
4. **Assign scores**
   Based on the checklist responses, each partner is assigned sustainability scores. These scores reflect the extent to which each partner has implemented the necessary practices to reach the sustainability goal.

The strategies for partners, based on their segmentation, can then be refined using the checklist results. This allows for identifying specific practices that have not yet been implemented. The strategy for each partner is adjusted to focus on areas needing improvement while skipping steps that are already in place.

Incorporating these four observations ensures that the DSS also takes into account the acquirement of the list of partners, the creation of the same understanding during the scoring of the partners and that the actual sustainability practices which are already in place are considered, instead of only assessing the capabilities and the willingness of partners to enhance sustainability. Adding these observations into the DSS ensures that the system is also broadly applicable.

7.1.2. Output objectives

Two of the four output objectives were only partly achieved: 'changes' and 'clear communication'.

Changes

The problem with the 'changes' objective is that the DSS does not facilitate the reassessment of the segmentation and the checklist. This issue is addressed within the step-by-step strategy, which clarifies when reassessment should take place. Although the step-by-step strategy's generalisation will be discussed in Chapter 7.2, the specific nature of reassessment in this strategy makes it acceptable that the DSS does not inherently include reassessment.

It is crucial to recognise that reassessment should occur, regardless of the specific strategy employed. As time passes, circumstances can change, necessitating accurate and updated segmentation and sustainability scores (based on the checklist). Therefore, reassessment should be considered at least annually. The DSS offers straightforward guidelines for assessment, making reassessment easy once an initial assessment has been completed. Even though the DSS does not cover reassessment, it does facilitate easy re-execution to obtain updated results. This aspect of the DSS ensures that the system also covers for 'changes' within the broader application.

Clear communication

The DSS currently lacks a specific focus on communication. While the step-by-step strategy frequently references the use of components of the strategies for the different segments. These are the components emphasising clear communication through training sessions, master classes, guest speakers, keynote speakers, success stories, and sharing best practices, but these elements are not thoroughly integrated into the DSS itself.

The initial components of strategies do highlight some communicative measures, but they could be more explicit. Updating these initial components of strategies with the specified components of strategies is essential to ensure these communicative measures become part of the initial components of strategies within the DSS. The next chapter will address this integration to enhance the broader applicability of the DSS.

Despite this, it should be noted that the overall design approach includes a communication phase as the last phase. The thesis itself serves as part of this communication, aiding in clear communication with the company which will use the DSS and its partners. Therefore, expanding the initial components of strategies to focus on clear communication and incorporating this into the DSS as input for each segment's strategies will be a significant step towards fully achieving this objective for the broader application.

7.1.3. Updated Decision Support System

Figure 7.1 presents the updated DSS designed for broader application across cargo airlines. The key enhancements are:

- **List of partners**
  Added as an input for 'scoring the partners' to ensure the data collection of the partners.
- **Scoring the partners**
  Enhanced with additional information to ensure a consistent understanding of the scores among all scorers.
- **Checklist**
  Introduced as an input for the 'step-by-step partner strategy', along with detailed steps to gather the required information for this checklist.

These updates aim to enhance the DSS's applicability and effectiveness across different contexts. in Chapter 7.2, the components of the strategies will be evaluated to ensure their broader applicability.

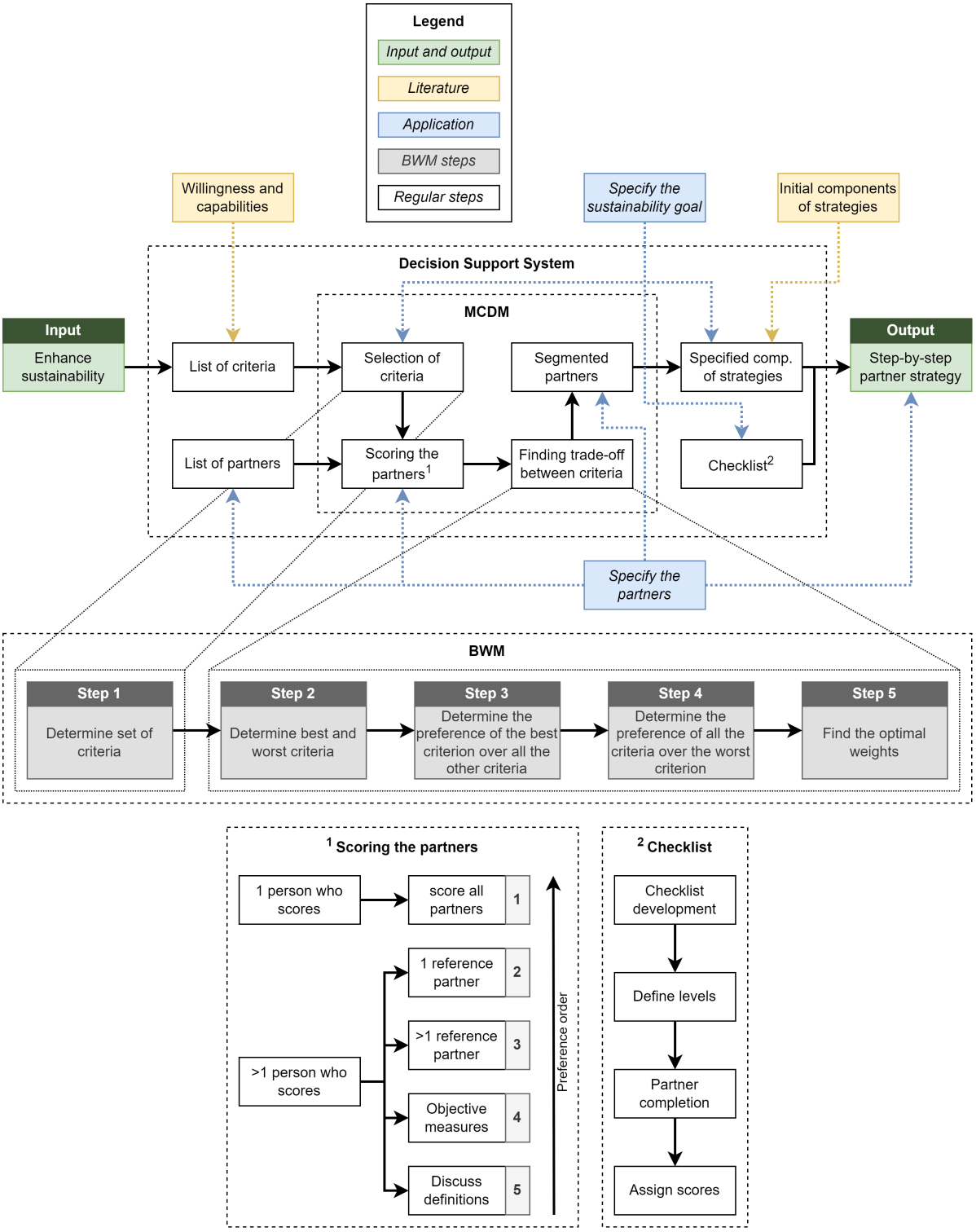


Figure 7.1: DSS updated for broader application

7.2. Generalisation of the strategies

This chapter will focus on the broader application of the DSS, incorporating insights from both the effectiveness of the DSS and observations made during its implementation with KLM Cargo. As discussed in Chapter 5.9, the initial components of strategies, derived from the literature, were specified for KLM Cargo's sustainability goals of zero emissions and zero waste through a focus group. However, these

components represent high-level strategies, prompting the creation of a detailed step-by-step strategy to effectively guide KLM Cargo partners towards these sustainability goals (Chapter 5.10).

7.2.1. Generalisation of the components of strategies

The initial components of strategies were analysed, recognising that the literature providing these components focuses on supplier segmentation. Though initially broad, the focus group specified these components for achieving the sustainability goals within existing partners. This detailed focus allows for a more actionable approach to sustainability within this context.

Although the focus was laid on the specific sustainability goals of zero emissions and zero waste, the specified components of strategies can still be generalised. These components address possible actions to achieve sustainability in the broadest sense for each segment, allowing all specified components of strategies in Table 5.14 to be generalised for use by cargo airlines. Within the DSS, the initial components of strategies are now updated according to these specified components. When applying the DSS in another context, these supplemented initial components of strategies still need to be specified based on the specific sustainability goals of that context to acquire the relevant specified components of strategies.

By repeating this iterative process and continually supplementing the initial components of strategies with the specified components of strategies which can be generalised, future applications of the DSS are supported. These continuously updated initial components of strategies serve as the input for the specified components of strategies. Combined with the checklist, as shown in the updated DSS in Figure 7.1, this foundation provides a basis for creating a step-by-step strategy to achieve sustainable outcomes.

7.2.2. Step-by-step strategy

The step-by-step strategy created for KLM Cargo's operations can be generalised, but this process is more complex due to the categorisation based on the GHAs and the areas. The generalisation of the strategy is illustrated in Figure 7.2.

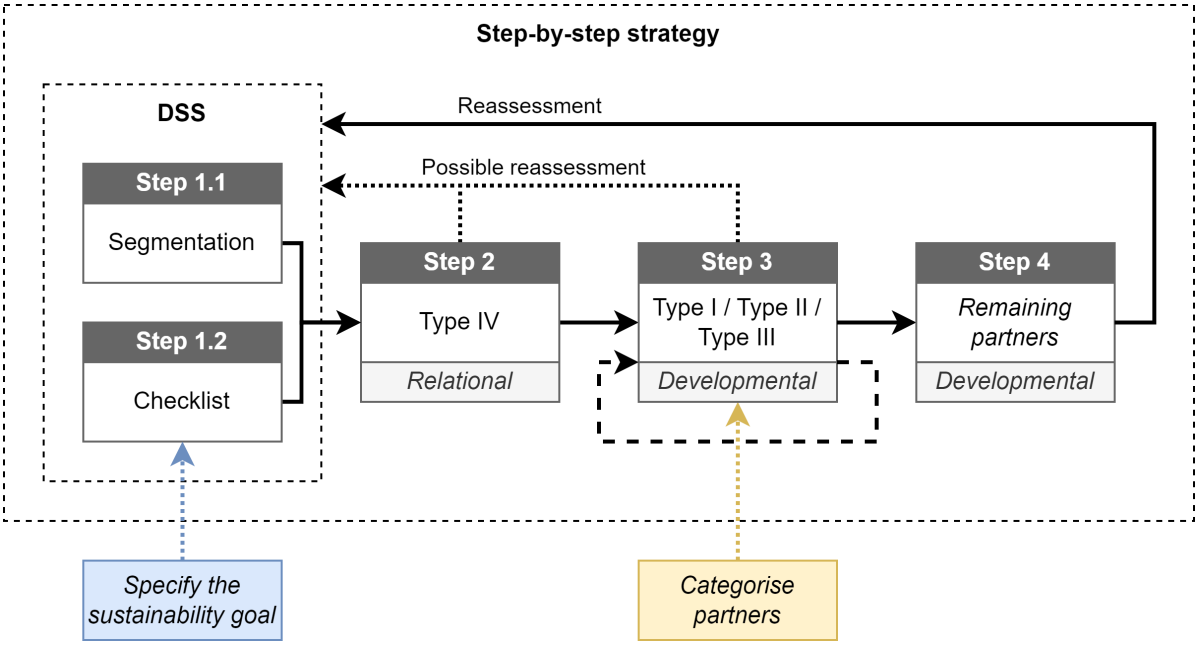


Figure 7.2: Step-by-step strategy updated for broader application

Step 1.1 and 1.2

Step 1.1 and step 1.2 have already been generalised above when explaining the generalisation of the DSS. The checklist is a very important part of the step-by-step strategy and is therefore incorporated

into the DSS during the generalisation. The checklist should be specified based on the sustainability goals that need to be achieved, as seen in Figure 7.2.

Step 2
One part of the generalisation is that the strategies for Type IV partners are mainly relational since these strategies emphasise mutual growth through collaborative efforts. Relational strategies leverage existing strengths and commitments to foster collaboration and integration. Strategies for the other three segments are mainly developmental, focusing on building capabilities and willingness from a lower base. Therefore, step 2 focuses on the relational strategy for the Type IV partners. Although these partners are willing and capable of implementing sustainability practices to achieve the specific sustainability goal, it does not necessarily mean they have done so, which will be revealed by the checklist. However, the actual impact (i.e. the enhancement of sustainability) can be made by implementing sustainability initiatives, for which Type IV partners are the easiest first step (a quick win).

Besides that, even though these partners are already performing well based on their capabilities and willingness scores to achieve specific sustainability goals, leveraging these partners is beneficial, especially when they can be categorised with partners from other segments in the next steps.

This generalisation is very dependent on the robustness of the categorisation. Otherwise, it could be questioned whether focusing first on the Type IV partners is the right step. This should be considered when applying the step-by-step strategy in a different context. Reassessment is possible to see whether the sustainability scores on the checklist have indeed increased.

Step 3
The next step, step 3, is where the categorisation of partners becomes very important. This step focuses on all other segment types (I, II, and III). As a developmental strategy for these partners, the strongest category that can be found should be considered first.

If the categories from the application on KLM Cargo are generalised, this results in the category of an overarching company or management which supervises or manages multiple partners. Within an international context, categorising based on (geographical) area is often applicable. This can include areas that are spread out but have a comparable context, making it possible to compare different partners across different segments. Even within a country, differences per area can influence sustainability performance, allowing for more nuanced and specific comparisons based on areas.

Categories that allow partners to be compared can be used in this step, making it possible to leverage partners that are performing better as examples (e.g., if a partner in segment Type IV can achieve sustainability goals under the same circumstances, why is another partner in a lower segment not able to?). Step 3 can be executed multiple times if different categories are found to compare the partners in different segments. During the application on KLM Cargo, this led to the fourth step, which focused on the category of the same area. For the generalisation, it is unknown how many categories can be found, so the iterative arrow is added in Figure 7.2 to indicate this step can be executed multiple times based on the number of categories. To maintain an overview and ensure that different strategies are not mixed up, it is recommended that these steps are carried out separately. A potential reassessment could also provide new segmentation and insights for applying the following category.

The category which is used to compare the partners determines the segment types that can be focused on. As shown during the application, the GHA category was considered strong, so Type I partners were directly included. For the category focusing on partners within the same area, this was seen as more difficult, so Type I partners were left out. It can be said that the 'stronger' the category, the better comparisons between partners can be made. In that case, Type I partners should also be considered, otherwise, only Type II and Type III.

It is also important to use the generalised components of the strategies for the corresponding segments, in addition to using the category to compare the partners. Reassessment is possible after this step before proceeding to the next step. The process can move to the next step if the results are as expected. The partners that are focused on should have increased capabilities and willingness scores and possibly even increased sustainability scores based on the checklist. A general rule for reassessment is when a lot of time has passed, it is important to segment the partners again and see how the partners score based on the checklist.

Step 4
Step 4 is the last step in the generalised step-by-step strategy and focuses on developmental strategies for the remaining partners that could not be addressed with the chosen categories. This will probably mainly involve Type I partners, which are the most difficult. The generalised components of strategies should be used for the execution of this step.

After the last step, a reassessment needs to be executed to determine the current state of the capabilities and willingness scores and the sustainability score based on the checklist. This continuous process ensures that all partners are progressively working towards the sustainability goals set by the organisation.

7.3. Key findings

This chapter has outlined the adjustments and enhancements needed to generalise the DSS for broader applications across cargo airlines. The primary focus was on incorporating observations from the application of the DSS on the operations of KLM Cargo.

Key observations during the application highlighted that the list of criteria was generalisable with some small adjustments. Additionally, the importance of a comprehensive and up-to-date list of partners and a standardised scoring approach was emphasised, especially in a global context where multiple scorers may be involved. Best practices were identified to ensure consistency and accuracy in partner scoring, which can be generalised for broader use.

Additionally, the need for a detailed checklist was emphasised to capture partners' current sustainability practices. This ensures that strategies are tailored not only based on capabilities and willingness but also on what has already been implemented. The checklist steps were outlined to guide the collection of relevant data, which informs the assignment of sustainability scores and the adjustment of strategies.

The chapter also addressed the partial achievement of two output objectives: 'changes' and 'clear communication'. The importance of reassessment was highlighted, suggesting it should be considered at least annually to keep segmentation and sustainability scores up to date. While the DSS itself does not facilitate reassessment, the step-by-step strategy includes it, ensuring the system's adaptability over time. For clear communication, the components of strategies were found to include various communicative measures. Still, these need to be more explicitly integrated into the DSS to ensure continuous and effective communication.

The generalisation of the step-by-step strategy for KLM Cargo's operations is essential. This process is more complex due to the categorisation based on the GHAs and the areas. However, the generalisation ensures that other cargo airlines can follow a similar path to achieve sustainability goals. The updated step-by-step strategy includes focusing first on Type IV partners, leveraging their strengths and collaborative efforts, before addressing the other segment types through categories that allow for meaningful comparisons and tailored strategies. This iterative approach ensures continuous improvement and reassessment to adapt to changing circumstances and maintain progress toward sustainability goals.

Finally, while the research focused on the generalisation of the DSS across cargo airlines, the principles and methodologies developed are applicable in a broader context. Any actor aiming to achieve sustainability goals by segmenting partners using MCDM can adopt these generalised components. The systematic approach to criteria selection, partner scoring, strategy specification and step-by-step implementation provides a robust framework for enhancing partner relationships and driving sustainability initiatives across various industries.

In summary, the broader application of the DSS requires specific adjustments to enhance its applicability and performance across different cargo airlines. By incorporating these observations and enhancements, the DSS can provide effective guidance for achieving sustainability goals in a wider range of contexts within the cargo airlines industry and beyond.

8

Conclusion

This conclusion will systematically address the RQs posed throughout this research. Each RQ will be answered individually to thoroughly evaluate the designed DSS and its application to KLM Cargo (Chapter 8.1 to Chapter 8.6). This approach ensures a comprehensive understanding of the research findings and their implications. Finally, these insights will be synthesised to answer the MRQ in Chapter 8.7, providing an overview of the study's outcomes.

8.1. Conclusion RQ I

The first phase of the design approach focuses on problem identification, determining the necessary aspects to incorporate into the DSS to address the problem effectively.

RQ I
Problem identification
Which aspects should be incorporated in the DSS to guide PRM for the operations of partners through MCDM?

To answer this research question, several key aspects from the literature were considered:

1. **A DSS is decision-focused**
   The DSS must be decision-focused, emphasising the development of tailored strategies for different segments of partners based on specific criteria. By segmenting partners, the system can provide actionable outputs directly aligned with the company's sustainability goals, ensuring a focused approach to the decision-making.
2. **A DSS is user-initiated and controlled**
   Users should have the ability to initiate and control the DSS. This includes specifying sustainability goals, selecting relevant criteria from a predefined list based on the literature, and determining the importance of each criterion. This user control ensures flexibility and adaptability to the specific needs of the decision-makers.
3. **A DSS combines the use of models and analytical techniques with traditional data access and retrieval functions**
   The BWM is specifically employed as MCDM method to process input data, including setting criteria weights and scoring partners. This integration ensures systematic and robust evaluation and segmentation of partners.

PRM is integrated to enhance partner management by focusing on sustainability objectives. Segmentation is employed to group partners based on sustainability criteria, allowing for the creation of targeted strategies for each segment. These segment-based strategies are then applied to manage partners effectively, aligning PRM efforts with sustainability goals. The integration ensures that PRM not only maintains relationships but actively enhances them through structured decision-making processes, supporting effective partner management and sustainability enhancement.

MCDM, specifically using BWM, is integrated to enhance the effectiveness of PRM. Appropriate sustainability criteria are selected, and partners are scored against these criteria. This scoring process determines partner alignment with sustainability goals. BWM helps understand the relative importance of each criterion and calculates optimal weights. By combining these scores and weights, partners are positioned within a capabilities and willingness matrix, allowing for the development of tailored strategies for each segment. This integration ensures a structured and systematic approach to achieving sustainability goals.

By integrating the three aspects from the literature, with PRM and MCDM as key concepts, the DSS can effectively guide PRM for the operations of partners, ensuring that sustainability goals are met through a structured and systematic approach.

8.2. Conclusion RQ II

The second phase of the design approach focuses on designing solution objectives, identifying objectives that the DSS should achieve to guide PRM effectively.

RQ II
Designing solution objectives
Which objectives should the DSS achieve to guide PRM for the operations of partners?

To answer this research question, the output objectives of the DSS are investigated. The DSS aims to develop sustainable strategies for each segment, ensuring these strategies align with the company's overarching sustainability goals. These sustainable strategies should adhere to the following framework:

1. **Clear purpose**
   The strategies should have a clear purpose, aligning with the company's sustainability goals.
2. **Changes**
   Sustainable strategies should be able to facilitate significant changes across various organisational dimensions to support sustainability goals.
3. **Collaborative co-creation**
   The strategies should not only focus on what the partners should do but mostly on the collaboration to achieve sustainability goals.
4. **Clear communication**
   The strategies must ensure continuous and clear communication.

The DSS facilitates the segmentation of partners, with a strategy for every segment as output. The segmentation divides partners into four categories based on their sustainability capabilities and willingness. The DSS should comply with the objective of creating these strategies per segment and can be supported by the initial components of strategies:

1. **Type I: low capabilities and low willingness**
   The primary component of the strategy for this segment is to consider replacement due to their limited utility in advancing sustainability goals. If immediate replacement is not feasible, developmental measures aimed at gradual improvement of both willingness and capability should be implemented.
2. **Type II: low capabilities and high willingness**
   This segment is ideal for substantial development investments. Tailored training programs focusing on sustainable practices, technical assistance, and sharing of best practices can be highly effective.
3. **Type III: high capabilities and low willingness**
   Strategies should focus on incentivising engagement through mutually beneficial sustainability initiatives. Encouraging partnerships by demonstrating loyalty and offering long-term commitments can be effective.
4. **Type IV: high capabilities and high willingness**
   Partners in this segment should be engaged in strategic collaborations. Initiatives include co-

developing new sustainable products and sharing resources for joint sustainability research. Maintaining these relationships through regular recognition programs and shared successes can reinforce their commitment.

These initial components of strategies provide a foundation for developing specific strategies tailored to the needs of each segment. The objective of the DSS is to create sustainable strategies for different segments, ensuring that these strategies achieve the output objectives of the 4 C's framework. By adhering to these objectives, the DSS will guide PRM for the operations of partners, effectively supporting the achievement of the organisation's sustainability goals.

8.3. Conclusion RQ III

The third phase of the design approach focuses on integrating the identified aspects into a DSS that adheres to the objectives and guides PRM through MCDM to achieve sustainability goals.

RQ III
Design and development
How can the identified aspects be integrated into a DSS that guides PRM through MCDM for achieving sustainability goals?

To answer this RQ, a conceptual overview of the DSS is presented in Figure 4.1. The main input is the overarching goal of enhancing sustainability, guiding all aspects of the DSS.

Inputs include sustainability goals and partners. These goals guide the selection of MCDM criteria, aligning them with sustainability outcomes. Further inputs based on the literature are the capabilities and willingness as foundations for the criteria and the initial components of strategies (as an answer of RQ II).

Criteria are derived from literature, which serve as the initial input for the MCDM process. This process begins by selecting criteria that align with sustainability goals, which is also the first step of the BWM. Partners are scored against these criteria before determining the trade-offs, ensuring unbiased scoring. Optimal weights for each criterion are calculated after scoring.

Using scores and BWM weights, partners are positioned in a capabilities and willingness matrix, guiding the development of strategies. The specified sustainability goals shape these strategies, ensuring they meet desired outcomes. Initial components of strategies are refined into specified components of strategies for each segment.

The output of the DSS is a step-by-step strategy for all partners. The specified components of strategies provide a clear overview of actions to enhance sustainability for each segment. Although detailed, these components do not form a complete strategy. Therefore, the output is a step-by-step strategy based on these components.

This strategic output aims to enhance each partner's sustainability, providing necessary guidance on PRM to achieve the specified sustainability goals. Adding all these identified aspects into a conceptual model, as done in Figure 4.1, creates a clear overview of what steps to take within the DSS. It also shows what input is based on the literature, what input is needed to use the DSS, what the output is, and when the steps of the BWM should be executed within the MCDM part.

8.4. Conclusion RQ IV

The fourth phase of the design approach focuses on demonstrating the designed system, which in this case is the DSS. This demonstration was conducted using KLM Cargo as a use case to investigate the practical application of the DSS in achieving sustainability goals.

RQ IV
Demonstration
How can the designed DSS be applied to KLM Cargo's ground operations of GHAs at outstations to achieve zero emissions and zero waste?

To answer this question, the DSS was adapted to the specific operation and sustainability goals of KLM Cargo. The conceptual model of the DSS was modified to address the operations of GHA at outstations,

with a particular focus on achieving zero emissions and zero waste. This adaptation ensured that the inputs of the DSS were based on KLM Cargo, which makes it directly applicable.

The process began with the identification and selection of relevant sustainability criteria through expert consultations. These experts with knowledge about the operations confirmed the initial list of capabilities and willingness derived from the literature and then selected the most relevant criteria. A second round of communication ensured alignment and consensus, and some criteria were modified to better fit KLM Cargo's operations and sustainability goals. This process provided a solid foundation for evaluating KLM Cargo's partners.

The structured scoring process and establishment of a consistent scoring scale were essential for ensuring reliable and comparable evaluation across KLM Cargo's global network of outstations. The trade-off between criteria was determined using the BWM, resulting in accurately weighted criteria. This enabled the segmentation of partners based on their aggregated capabilities and willingness scores, offering a clear overview of their sustainability performance.

Interpreting the segmentation results provided valuable insights. Notably, some outstations received the same score on every criterion, indicating either a uniform level of performance across all evaluated areas or potential biases in the scoring process. Although the weights of the criteria would not influence the aggregated scores of these partners, since the majority of outstations received varying scores on the criteria, the weights are used. A valuable insight is the distribution of the sustainability performance across different GHAs and areas. These findings were crucial for developing a targeted step-by-step strategy. The focus group discussions played a key role in refining the initial components of strategies into specified components of strategies, tailored to KLM Cargo's operations. Combining this information led to the final step-by-step strategy, developed as the output of the DSS, which is essential for creating an executable and practically applicable plan to enhance sustainability in KLM Cargo's operations.

In conclusion, the demonstration phase effectively illustrated how the designed DSS can be applied to KLM Cargo's ground operations of GHAs at outstation to achieve zero emissions and zero waste. By customising the DSS to KLM Cargo's context, selecting relevant sustainability criteria, scoring and segmenting partners, interpreting results, and developing a detailed step-by-step strategy based on the components of strategies, the DSS provides a practical roadmap when applied to KLM Cargo. This is done to systematically manage and enhance the sustainability performance of its outstations, ultimately working towards the ambitious sustainability goals.

8.5. Conclusion RQ V

The fifth phase of the design approach focuses on evaluating the DSS, tested on the operations of KLM Cargo as a use case. This evaluation addresses RQ V and RQ VI, examining both the effectiveness and potential for broader application. RQ V assesses the DSS's effectiveness based on result validation and the objectives stated in RQ II.

RQ V
Evaluation
How can the effectiveness of the DSS be assessed in terms of its functionality within KLM Cargo, based on the validation of the results and on the objectives stated in RQ II?

The effectiveness of the DSS was assessed through three main approaches: sensitivity analysis, validation of the results, and evaluation against the DSS's output objectives.

The sensitivity analysis revealed that approximately 29,8% of the outstations are subject to sensitivity, indicating that changes in the scoring or weighting could potentially shift these outstations from one segment to another. This highlights the importance of handling these outstations carefully, as they are more likely to fluctuate between segments. On the other hand, the remaining outstations are well-placed within their segments.

For the validation of the results the following can be concluded:

1. **Scoring validation**
   The segmentation of outstations by area reflected the expected sustainability performance, with

Europe performing best, followed by Asia, America, and Africa. This aligns with global sustainability trends as per literature. Partners managed by major GHAs, which are operating at multiple outstations, showed consistent capabilities and willingness scores, indicating the reliability of the DSS's scoring method.

2. **Criteria validation**
   The criteria used to evaluate capabilities and willingness were validated through Spearman's correlation, showing moderate correlations within capabilities (0.613) and willingness criteria (0.604). This suggests the criteria measured distinct aspects quite effectively. The correlation between capabilities and willingness criteria averages 0.557, confirming a logical relationship without redundancy, in line with supplier segmentation literature.
3. **Segmentation validation**
   The segmentation results showed most outstations in Type IV (high capabilities and high willingness) and Type I (low capabilities and low willingness), with fewer in Type III, and none in Type II. This distribution mirrors patterns in supplier segmentation literature, further validating the DSS's segmentation approach. The results were also validated by an expert, confirming the correctness of the segmentation for selected outstations and ensuring the reliability of the findings.

For the validation of the DSS's objectives as stated in RQ II:

1. **Clear purpose**
   The DSS aligns with KLM Cargo's sustainability goals. It integrates the specific sustainability goals and generates tailored strategies, fulfilling the clear purpose objective.
2. **Changes**
   The DSS supports long-term changes in partner operations through relational and developmental strategies. However, it lacks a built-in reassessment feature to track changes, making this objective only partly achieved.
3. **Collaborative co-creation**
   The DSS fosters collaboration with external stakeholders, involving them in achieving sustainability goals. This objective is fully achieved through its emphasis on collaborative elements in strategies.
4. **Clear communication**
   While communication is integrated into the components of strategies, a standalone communication plan is missing. This limits the DSS's ability to ensure continuous and effective communication, resulting in this objective being partly achieved.

In conclusion, the DSS effectively guides KLM Cargo's PRM towards sustainability goals. The sensitivity analysis and validation processes confirmed the robustness of the scoring, criteria, and segmentation methods. The DSS meets the objectives of clear purpose and collaborative co-creation fully while partially achieving the objectives of changes and clear communication. This evaluation highlights areas for further refinement, which are addressed in the next RQ, examining the adjustments needed for broader applicability. Overall, the DSS proves to be a valuable tool in enhancing KLM Cargo's sustainability performance.

8.6. Conclusion RQ VI

The last RQ also addresses the fifth phase of the design approach, the evaluation of the DSS. While the previous RQ focused on assessing the effectiveness of the DSS, this RQ evaluates the DSS for its broader application, particularly across cargo airlines, while also considering its potential applicability in other contexts. This evaluation addresses RQ VI, examining the adjustments needed to enhance the DSS for broader use.

RQ VI
Evaluation
What adjustments are needed to enhance the DSS's applicability and performance across cargo airlines in general?

To answer this RQ, the following adjustments are necessary to enhance the DSS's applicability and performance across cargo airlines:

- **List of partners**
  Comprehensive data collection about partners need to be ensured, including detailed information.
- **Scoring the partners**
  To ensure a consistent understanding of the scores, the following best practices can be generalised:
  1. Score all partners
  2. One reference partner
  3. More than one reference partner
  4. Objective measures
  5. Discuss definitions
- **Checklist**
  The checklist is necessary input for the 'step-by-step partner strategy', to see what sustainability practices partners already have implemented. The following generalised steps can be used:
  1. Checklist development
  2. Define levels
  3. Partner completion
  4. Assign score

The refined list of sustainability criteria, validated by experts and adjusted for clarity, can be effectively used within the DSS in a broader context across cargo airlines. Also, the specified components of strategies, derived from the initial components of strategies and tailored through focus group insights, are applicable in a broader context. These specified components of strategies address actions to achieve sustainability and can be generalised for use by other cargo airlines.

For the output objectives, it is important to note that the DSS should facilitate the reassessment of segmentation and the checklist at least annually, even though the DSS currently does not include this feature. The step-by-step strategy addresses this by clarifying when reassessment should occur. Also, supplementing the initial components of strategies with the specified components of strategies ensures that communicative measures are an integral part of the DSS. These communicative measures are part of the components of strategies as input of the DSS, ensuring continuous and effective communication.

The step-by-step strategy created for KLM Cargo can be generalised for broader applications across cargo airlines and potentially other contexts. The generalised step-by-step strategy includes:

1. **Step 1.1 and 1.2: initial steps**
   Executing the segmentation based on the DSS, including the development and implementation of a checklist based on the specific sustainability goals.
2. **Step 2: focus on Type IV partners**
   Strategies for Type IV partners are mainly relational, leveraging their existing strengths and commitments. This step focuses on achieving quick wins by implementing sustainability initiatives with willing and capable partners.
3. **Step 3: developmental strategies for partners in other segments** For Type I, II, and III partners, the strongest category for comparison (such as the same overarching company or geographical area) should be used to leverage better-performing partners as examples. This step can be repeated for multiple categories, focusing on developmental strategies to build capabilities and willingness.
4. **Step: addressing remaining partners**
   This step focuses on the remaining partners, particularly Type I partners, using developmental strategies to improve their sustainability performance, also using the specified components of strategies.

Reassessment
A reassessment should be executed to update the segmentation and sustainability scores. This continuous process ensures that all partners are progressively working towards the sustainability goals. Reassessment is also possible after step 2 and step 3.

While the research focuses on cargo airlines, the principles and methodologies developed are applicable in a broader context. Any organisation aiming to achieve sustainability goals by segmenting partners using MCDM can adopt these generalised components. The systematic approach to criteria selection, partner scoring, strategy specification, and step-by-step implementation provides a robust framework for enhancing partner relationships and driving sustainability initiatives across various industries.

In conclusion, the DSS can be effectively generalised for broader application across cargo airlines and other contexts. The adjustments made ensure its applicability and performance, providing effective guidance for achieving sustainability goals in diverse environments. By incorporating these observations and enhancements, the DSS proves to be a valuable tool in enhancing performance across various sectors.

8.7. Conclusion MRQ

The final phase of the design approach is the communication phase. This phase involves answering the main research question, which encompasses the entire thesis and the research questions. The elaborated thesis serves as communication towards both research for further academic exploration and practitioners for practical application.

MRQ
Communication
How can a Decision Support System (DSS) be developed to guide Partner Relationship Management (PRM) for the operations of existing partners of cargo airlines to achieve sustainability goals?

To address this MRQ, the design approach proves to be an appropriate method for the development of the DSS, as it provides a structured framework. By first examining the aspects and objectives that the DSS should achieve, the first two phases of problem identification and designing solution objectives lay a solid foundation. The DSS is then designed and developed based on these identified aspects and objectives. This phase translates the theoretical framework into a visual DSS ready to be applied.

Demonstrating the DSS on the operations of KLM Cargo helps identify potential shortcomings and areas for improvement. The evaluation phase then validates the DSS, also assessing its effectiveness. The evaluation also examines the broader application of the DSS for the operations of existing partners of cargo airlines to achieve sustainability goals. This step is crucial for ensuring that the DSS can guide various cargo airlines towards their specific sustainability goals.

The DSS outlines the steps that need to be taken, providing strategies as an output to guide PRM effectively. The step-by-step strategy, which can be created, tailored to the specific segment of the partners based on capabilities and willingness, and to the already implemented sustainability practices, ensures that sustainability goals are systematically addressed. The generalisation of the step-by-step strategy and its broader applicability were highlighted, demonstrating that the DSS can be effectively adapted for use by other cargo airlines and even in broader contexts.

In summary, the development of the DSS through the structured design approach allows for a thorough and effective system. It guides PRM for the operations of existing partners of cargo airlines towards achieving sustainability goals by providing tailored strategies and systematic steps based on variable inputs of sustainability goals and partners. This ensures that the DSS is not only theoretically substantiated but also practically applicable across different contexts within the cargo airlines industry and beyond.

9

Discussion

The discussion chapter of this thesis is structured to provide a clear evaluation of the research. Chapter 9.1 addresses the validity and reliability of the research. Chapter 9.2 delves into the limitations, acknowledging the constraints and potential weaknesses of the study. In Chapter 9.3, the implications of the research are explored, highlighting its significance and impact on both practice and theory. Chapter 9.4 offers practical recommendations, particularly for KLM Cargo, based on the research findings. Finally, Chapter 9.5 outlines possible areas for future research, suggesting directions for further investigation and development in this field.

9.1. Validity and reliability

9.1.1. Validity

Understanding of the scores

Within Chapter 6, the results have been validated. Although best practices were created and executed to create the same understanding of the scores, it should still be asked whether the results of different scorers can be put into one matrix since these results will also be compared with each other. The different scorers are divided based on the areas, since AODs are scoring: an AOD operates within one of the four areas. Significant differences between the areas are shown, which can be validated with the literature. However, it is still uncertain whether this is because of the differences in the area or because of the differences in the understanding of the scorers. This cannot be directly validated and, therefore, remains an assumption while providing the best possible option to create the same understanding.

Correlations of the criteria

The correlation between the capabilities criteria, the willingness criteria, and the capabilities and willingness criteria show a moderate correlation. These correlations can be explained by the literature since willingness and capabilities are related. Also, the capabilities criteria and willingness criteria are logically correlated as well. If a partner scores high on one capability criterion, the possibility that the partner scores high on another capability criterion as well is higher. However, some of the correlations between the criteria show a high correlation, which could mean that those criteria somehow measure the same aspect of a partner. Even though the criteria are chosen carefully to be as independent as possible and are also validated by experts, it can still be the case that criteria do measure the same aspect of a partner. This can overpredict the importance of the highly correlated criteria, which may cause a criterion to weigh more heavily than it should. This can be an even bigger problem when two of those highly correlated criteria are receiving high weights after determining the weights with BWM. This is not the case in the application on KLM Cargo, but this could happen when the DSS gets reapplied.

Scored outstations

None of the 168 outstations as partners of KLM Cargo were segmented in the Type II segment (low capabilities and high willingness). Although this is recurring in the segmentation literature, the absence of outstation in this segment might indicate a potential issue in how the criteria are interpreted or applied

during the scoring. It could possibly suggest that partners perceived as willing may not be accurately reflected in the scoring process.

Of the list of 204 outstations, 168 were scored. 36 of them did not receive a score. Since some of them are not scored for an unclear reason, this could create a distorted picture of the results. The absence of scores for these outstations raises concerns about the completeness and representativeness of the dataset.

Of the scored outstations, only 22 were scored for Asia (because there are fewer partners in this area). Since fewer partners are operating in that area, it could misrepresent this area in comparison with the other three areas, mostly Europe, with 63 scored outstations. This discrepancy in the number of scored outstations across different regions might lead to an unbalanced representation of the data, potentially skewing the results and interpretations towards regions with more data points. Incidentally, it does represent a realistic representation of KLM Cargo's partners.

Also, partners with who KLM Cargo is working are working in areas where cargo is being handled. With some background information from the literature about developing countries within this research, it could be that KLM Cargo is not even operating in these areas. This suggests that the findings may not fully capture the sustainability performance and challenges of partners in (even more) developing regions, where operational contexts and sustainability pressures might differ significantly. The validation based on the general trend of these might, therefore, not be representative.

Checklist

Additionally, the checklist to gain insights into the current sustainability practices was suggested within the focus group. This checklist is very important in combination with the segmentation. The checklist plays a crucial role in ensuring that the development of strategies not only reflects the capabilities and willingness of the partners but also the current practices. However, the steps for creating this checklist have not been validated. Without validation, there is a risk that the checklist may not capture all relevant aspects of the partners' sustainability practices to achieve the specific sustainability goals or that it may not be applied consistently across different contexts. This lack of validation could impact the reliability and accuracy of the step-by-step strategy which is based on the checklist as well.

Step-by-step strategy

Another problem is the step-by-step strategy which is not validated. It is based on the interpretation of the results and the validated specified components of strategies, but the final output has not been validated. Within this unvalidated step-by-step strategy, steps that should be taken are described in a certain order, which is substantially argued for. However, within this strategy and this research, the outstations are seen as equally important. This could mean that within the execution of strategies, a high focus is placed on an outstation that is very small or will not make a huge impact when it actually implements sustainability practices. Also, for a quick win and fast impact, the choice has been made to focus on Type IV outstations first because those are already willing and capable of implementing sustainability practices. However, when companies are under a time restraint (e.g., a specific target year to achieve the sustainability goal), this strategy could be very impractical. Type I partners are focused on later in the process, while those could be the partners which need the most attention before they can also work towards achieving the sustainability goal.

This lack of validation means that while the strategy is theoretically substantiated and well-argued, its practical applicability within the organisation of KLM Cargo remains uncertain. Without validating this step-by-step strategy within KLM Cargo, it is difficult to confirm that the step-by-step strategy will effectively guide PRM and achieve the intended sustainability goals of zero emissions and zero waste. Some conclusions have been made about the broader application of the step-by-step strategy as well, but these results are for that reason not validated as well. It could, therefore, be the case that those conclusions are not generalisable.

9.1.2. Reliability

Scoring by AODs

The reliability of the results and processes in this research is also a critical consideration. One significant factor is the role of the AODs who score the partners. These individuals are likely the same people

who will need to manage the sustainability strategies at a high level. If the AODs themselves are not genuinely willing to enhance sustainability, this could influence the scoring of the partners. Additionally, if they perceive that they are being assessed based on the sustainability performance of the partners in their area, this could also impact their scoring.

It is essential to clarify that the scoring process is intended to provide an overview of the capabilities and willingness of the partners, not to evaluate the AOD's sustainability performance in the area. This clarification can help mitigate potential biases in the scoring process. This issue is particularly relevant since this research deals with existing partners instead of new ones. However, since the PRM is focused on achieving sustainability goals as an organisation in collaboration with partners, the AODs also has a vested interest in achieving the sustainability goals of their own organisation. Nevertheless, intrinsic motivation could still influence the scoring process. The potential for bias is further compounded by the fact that the same individuals who score the partners are also responsible for specifying the components of strategies to be used for each segment.

During the scoring process, some of the partners received the same score on every criterion. This can be the case if a partner actually scores very consistently on all capabilities and willingness criteria. Although, it seems unlikely that this is the case for approximately a quarter of the outstations, which received the same score on all 14 criteria. This indicates some form of bias and probably laziness within the scoring process. An explanation could be that scoring this many partners is too time-consuming. Therefore, it could be that the results of the scoring process are not fully reliable. This can potentially be solved by giving scorers more dedicated time to execute the scoring of the partners.

Another notable point is that the application of the DSS on KLM Cargo did not result in any partners being segmented into Type II (low capabilities and high willingness). Despite this, the AODs have proposed strategies for this segment. The absence of outstations in this segment within KLM Cargo creates a situation where AODs are specifying components of strategies without any example outstations. This raises questions about the reliability of generalising the proposed specified components of strategies for segment Type II.

Checklist

The checklist, as already mentioned, has not been validated, and its reliability is also questionable. The primary concern is that the checklist should be filled in by the partners themselves, which could lead to bias. Outstations (and partners, when generalised) likely understand the importance of appearing sustainable. Consequently, if not many sustainable practices are implemented, the checklist has no mechanism to verify whether the responses are accurate. Verifying the accuracy of the filled checklists is crucial but requires significant time and effort. This verification process is essential to maintain the integrity and reliability of the data used in the DSS.

At a higher level, companies using the DSS must be attentive against greenwashing, particularly when managing partners over which they do not have full control. It is essential to ensure that the claims made by partners are accurate, both in the checklists and in their broader communication. This makes sure the strategies are effective and also helps to prevent the spreading of misleading information and supports the credibility of the sustainability efforts.

9.2. Limitations

PRM of existing partners

The focus of this research has been primarily on the PRM of existing partners. While the study argues that these criteria should be considered when selecting new partners, they are not explicitly integrated into the strategies. It is essential to incorporate these sustainability criteria into the organisation's procurement process when choosing new partners, as they provide a framework for evaluating sustainability. However, these are not the only criteria that should be considered. When selecting new partners, other criteria, such as price, quality, and cargo handling speed, play significant roles. The balance between these 'traditional' criteria and sustainability criteria is crucial but not addressed in this research. This limits the applicability of the DSS to the PRM of existing partners to achieve sustainability goals rather than also providing an approach for partner selection.

Moreover, the research does not address how to weigh and balance these different sets of criteria

(sustainability versus 'traditional' criteria) during the partner selection process. This is a significant limitation, as it leaves practitioners without clear guidance on how to prioritise these factors in their decision-making when selecting partners, also based on the sustainability criteria as provided in this research.

Segmentation

The segmentation approach used in the research presents another limitation. Partners are classified into segments based on whether their scores for capabilities and willingness are above or below a threshold of 3.000. This low or high classification means that a small difference in a partner's score can place them in a completely different segment, potentially changing their classification from 'low' to 'high' capabilities or willingness, or vice versa. This lack of nuance limits the effectiveness of the segmentation, as partners with scores close to the threshold may not be accurately represented.

Based on the sensitivity analysis, 50 outstations are recognised as outstations close to the border and could be sensitive to moving from one segment to another. It has already been stated that these outstations should be handled more carefully. The limitation of the research is that it is unclear what should be done with those outstations. It is quite a large portion of the outstations that are close to the border, so it remains unclear if the components of the strategies can be applied effectively to these outstations. However, since it is known which outstations are doubtful cases regarding their segmentation, focusing on these outstations allows them to be handled with more consideration. On the other hand, 118 outstations are not sensitive enough to change easily from one segment to another, making the components of strategies highly applicable to the corresponding segment.

To address this limitation, a more nuanced segmentation matrix, such as a 3x3 grid including a 'medium' level in addition to 'low' and 'high', could provide a more accurate and informative categorisation of partners. This would help create more tailored and effective strategies for each segment, but it would also make it difficult to make strategies that are clearly different from each other.

Additionally, the research is limited by the lack of clear guidelines on when to use which segmentation technique. The study primarily used a 2x2 based on the model of Kraljic (1983), a widely accepted method in the literature. However, this does not necessarily mean it is the optimal segmentation method for all contexts. For generalisation, the research does not consider whether this segmentation method is the best approach for different types of cargo airlines or other industries.

MCDM with BWM

The MCDM method requires that all partners be scored based on multiple capabilities and willingness criteria. This is a very time-consuming process. Participants in this process might not understand the importance of categorisation, potentially leading to inconsistencies or inaccuracies in the scoring process, which possibly already occurred with the same scores on all criteria, as explained above.

Additionally, even though the BWM is relatively easy to use and provides an Excel solver to calculate the weights, it could still be challenging to implement within an organisation where no one has knowledge of this specific method. Misunderstanding the method could result in incorrect weights that do not accurately represent the relative importance of the criteria, thereby influencing the results.

9.3. Implications

9.3.1. Society

As highlighted in the introduction, society is struggling with significant environmental challenges. The urgent need to decarbonise the aviation industry is critical to these challenges. While it is evident that airlines must become more sustainable, it is also important to address the sustainability of ground operations. The designed DSS offers a tool for cargo airlines to guide PRM for the operations of their existing partners, helping to achieve sustainability goals.

The importance of sustainability is increasingly recognised across various industries, and aviation is no exception. This DSS not only encourages airlines to enhance their own sustainability efforts but also emphasises the role of ground operations in achieving broader environmental goals. By focusing on collaboration with partners, the DSS promotes a comprehensive approach to sustainability that extends beyond the airlines themselves. This approach underscores the importance of working together

with partners to enhance sustainability. Such a collaborative approach ensures that all stakeholders are aligned in their efforts to reduce environmental impacts, fostering a more integrated and effective strategy towards sustainability.

These guidelines will create a structured system for cargo airlines to adhere to. This system offers a clear framework for evaluating and improving the sustainability practices of their partners, ensuring that all parties are contributing to the overarching goal of environmental responsibility. Moreover, by adopting this DSS, cargo airlines can set an example within the industry, demonstrating that sustainable practices are not only necessary but also achievable through collaborative efforts. This can inspire other sectors to adopt similar strategies.

9.3.2. Science

This research addresses notable gaps in the existing literature, particularly in the area of specific sustainability criteria. By developing a list of capabilities and willingness criteria, this study provides a framework for assessing sustainability in general. This contribution offers a detailed set of criteria that can be utilised not only in the aviation industry but also across various sectors where sustainability assessment is essential.

Furthermore, it has been observed that current partner selection processes often do not prioritise sustainability. The criteria developed in this research can be integrated with traditional selection criteria such as price and quality. This integration can enhance the evaluation process, ensuring sustainability becomes a core consideration in partner selection. By doing so, the research encourages a shift in how partners are evaluated, promoting sustainability as a critical factor in decision-making processes.

In addition, the strategies found in the literature based on the 2x2 segmentation model were initially identified as components of strategies rather than clear, explicit strategies. This research has supplemented these initial components of strategies, providing a more detailed overview. The specified components of strategies developed in this study can be applied in a broader context, offering guidance for various industries aiming to implement components of strategies based on segmentation.

Based on (Rezaei & Ortt, 2013b), market segmentation can be divided into three sub-topics:

1. Consumer segmentation
2. Industrial customer segmentation or demand-side business-to-business segmentation
3. Supplier segmentation or supply-side business-to-business segmentation

This research proposes an extension to this framework by introducing a fourth category:

4. Partner segmentation based on existing relationships to achieve sustainability goals

This addition fills an important gap in the literature, providing a structured approach to segment existing partners not just by traditional business metrics but also by their sustainability capabilities and willingness.

The most significant contribution of this research is the development of a generalised DSS. This system was designed in detail to guide PRM for the operations of existing partners of cargo airlines, specifically to achieve sustainability goals. The DSS integrates specific partners and sustainability goals as inputs, employing MCDM and particularly BWM methodology to process these inputs. The result is a step-by-step strategy tailored to enhance the sustainability performance of these partners.

Also, the step-by-step strategy can be used in a broader context. Even though the research focused on generalising the results for cargo airlines in general, it seems that it can be generalised to different actors as well. Organisations that want to achieve certain sustainability goals and are working with many partners can use the segmentation based on the DSS and the generalised strategies, including the step-by-step strategy, which shows which partners to focus on first and how.

This approach not only provides a practical tool for cargo airlines but also sets a theoretical framework as an example for other industries, aiming to incorporate sustainability into their PRM practices.

9.3.3. MSc programme

This research highlights the complicated link between sustainability and the aviation industry, a subject often viewed as contradictory given the environmental impact of air travel. By focusing on a segment of this problem, specifically, the ground operations of cargo airlines, and employing a well-known method within the master's program of CoSEM, namely MCDM with BWM, this thesis serves as a practical example for students. The application of MCDM and BWM to address sustainability in aviation demonstrates to students how theoretical concepts can be applied to real-world problems. By structuring and engineering a system to achieve the broad, social goal of sustainability, this research underscores the potential impact that students can have by engaging with these kinds of complex challenges in a global context.

9.4. Recommendations

9.4.1. KLM Cargo

The recommendations for KLM Cargo are focused on executing the step-by-step strategy. Given that the segmentation of outstations has already been completed by applying the DSS within this research, the initial focus should be developing the checklist as soon as possible. This checklist should be tailored to the sustainability goals of zero emissions and zero waste, outlining all necessary steps for achieving these goals. It is crucial that if a partner meets all items on the checklist, the outstation fully achieves the sustainability objectives. Moreover, it is essential to ensure that the list of all outstations is complete and up-to-date, facilitating accurate scoring of all partners according to their capabilities and willingness.

According to the step-by-step strategy, after creating the checklist, the first focus should be on the Type IV outstations, which have high capabilities and willingness. These outstations are critical for establishing a foundation based on relational development, so they can serve as benchmarks for other outstations. Data should be collected via the checklist to identify any gaps in current sustainable practices, and these gaps should be addressed as soon as possible, leveraging the high capability and willingness of these outstations to make quick progress.

Following the Type IV outstations, the focus should shift to outstations that are not in the Type IV segments but are part of major GHAs. These GHAs generally have more capacity to implement sustainable practices, as indicated by the results. The specified components of strategies should be applied based on the corresponding segment each outstation falls into, using the progress and practices of Type IV outstations as examples, given the uniformity in corporate policies across different outstations within the same GHA. It is recommended to see whether additional GHAs operating at multiple outstations can be addressed besides the three GHAs currently considered.

Next, attention should be paid to Type II and Type III outstations within the same area as the Type IV outstations. The best practices from Type IV outstations can again be effectively applied, now using the similarities of the geographical area. Utilising Type IV outstations as models to guide the implementation of the components of strategies in Type II and Type III outstations will support the process to achieve the sustainability goals.

After every step, it is important to consider whether reassessment to evaluate the strategy's effectiveness is necessary. This reassessment will help understand the impact of the implemented strategies and guide further adjustments. Finally, the focus should be on the Type I outstations, which present the most significant challenges. The successful examples from Type IV outstations should inform the strategies for Type I outstations. Identifying similarities between Type I and Type IV outstations, whether based on geographical area, GHA, or other relevant categories, will facilitate the transfer of successful practices.

It is also advised for KLM Cargo to establish a target year for achieving zero emissions and zero waste for all outstations. The step-by-step strategy is focused on making an impact as soon as possible and taking the 'easiest' and most efficient path to achieve the goals by initially focusing on Type IV partners. However, setting a target year could potentially change this approach. The partners who are the least capable and willing need more time to achieve the sustainability goals. Therefore, it might be necessary to start working with these partners earlier in the process to ensure they meet the targets within the specified timeframe.

An important recommendation, besides the execution of the step-by-step strategy, is to continue to invest in sustainability genuinely. While KLM Cargo aims to promote sustainability, passenger or cargo customers often shoulder the burden. It is recommended that KLM Cargo continues to contribute significantly to sustainability efforts, setting an example for others to follow. Emphasising collaboration with outstations is crucial, rather than imposing changes by dictating to partners what they should do. Fostering a cooperative environment will be more effective. Keep striving to be a frontrunner in sustainability, to be the 'smartest boy in class', will eventually yield significant benefits. This proactive attitude will not only enhance KLM Cargo's sustainability initiatives but also strengthen its pitch to suppliers and customers by demonstrating a genuine commitment to promoting sustainability and encouraging them to do the same by collaborating.

9.4.2. Cargo airlines

For cargo airlines in general, it is highly recommended to implement the DSS designed in this research. Even if it is initially used only to gain insights into the sustainability performance of partners, this could provide valuable information for enhancing overall sustainability efforts. Applying the components of strategies based on these insights can lead to significant improvements in sustainability practices.

Cargo airlines might consider starting with a small sustainability goal to validate the system's effectiveness before tackling more ambitious objectives. This phased approach allows for adjustments and improvements based on initial results, ensuring that the DSS can be effectively scaled up for larger sustainability goals.

Furthermore, since GHAs handle multiple airlines at various outstations, collaboration between airlines is highly recommended. By forming alliances and putting collective pressure on GHAs, cargo airlines can create a united force that encourages GHAs to enhance their sustainability practices more quickly. This collaborative approach not only increases the impact of individual airlines but also fosters a culture of shared responsibility and mutual benefit in the pursuit of sustainability.

9.4.3. Policy

Although providing policy recommendations for research conducted in a global context can be challenging, there are several key areas where policy interventions could still be interesting.

Firstly, greenwashing remains a critical issue when trying to enhance sustainability. Even though this thesis does not focus extensively on greenwashing, it is recommended to establish clear guidelines for what constitutes greenwashing. These guidelines would motivate companies to enhance their sustainability practices rather than misleadingly presenting themselves as environmentally friendly. As sustainability increasingly becomes a marketing tool, ensuring that only genuine efforts are recognised and rewarded (and that greenwashing is penalised) can drive companies to implement sustainability initiatives.

Additionally, the research indicates that partners classified as Type II (low capabilities but high willingness) are most beneficial to subsidise. These partners, while willing to adopt sustainable practices, lack the necessary resources and capabilities to do so effectively. Policies that prioritise subsidies for Type II partners, independent of the context of the executed segmentation, could greatly enhance the overall sustainability performance, as these partners are already motivated to improve but could use financial support to overcome their limitations.

9.5. Future research

Building upon the findings of this research, several areas warrant further exploration to enhance the understanding and application of the DSS in guiding PRM for achieving sustainability goals in cargo airlines and even in a broader context.

Firstly, it would be beneficial to conduct further research to test the best practices developed in this study to ensure the same understanding of scores among multiple scorers. This aspect is crucial for maintaining consistency and reliability in the scoring process across different regions and scorers.

Additionally, investigating the correlations of the capabilities criteria, willingness criteria, and the relationships between capabilities and willingness criteria in the context of sustainability offers a valuable

path for future research. Understanding these correlations more deeply can refine the criteria used and improve the accuracy of the segmentation process.

The step-by-step strategy proposed in this research should also be validated and applied in a broader context. Testing its effectiveness in different organisational and environmental contexts will provide insights into its adaptability and potential for wider application. A result of this application could be the identification of categories for comparing partners, such as by area, which would enhance the strategy's applicability and provide a more nuanced approach to partner comparison and segmentation.

Furthermore, it is essential to evaluate whether the designed DSS is applicable to other cargo airlines or even to other industries outside of cargo aviation. Even though the strategy should be widely adaptable, it should be evaluated to ensure its effectiveness in different contexts. This evaluation could reveal the adaptability of the DSS, making it a valuable tool for various sectors aiming to achieve sustainability goals.

Exploring different categorisation methods for partners is another promising research direction. Identifying which segmentation techniques work best in different contexts can help create more effective and tailored strategies. Developing clear guidelines on when to use specific segmentation methods, as the literature often defaults to the 2x2 matrix without thorough argumentation, will significantly enhance the strategic application of the DSS.

Finally, applying segmentation methods suggested by Rezaei and Fallah Lajimi (2019), which categorises items into non-critical, leverage, bottleneck, and strategic items, could provide new insights. Incorporating segmentation based on the size and impact of the partners, such as critical versus non-critical partners or low-impact versus high-impact partners, could address the current limitation of not considering the size of partners. This approach could enhance the strategic planning and execution of sustainability initiatives by ensuring that partners with the most significant potential impact are prioritised effectively.

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A

Initial literature review

In an earlier stage of the research, a literature review was conducted to identify the knowledge gap. This was done through a systematic process to gather relevant articles. Initially, an extensive collection of preliminary literature was reviewed to gain insights into sustainability within supply chains. Thereafter, Scopus was chosen as the database for the search. The following search string was formulated, with the inclusion of 'ABS' to ensure that only abstracts were considered:

(LANGUAGE(English)) AND ABS((”sustainab”) AND (”value chain” OR ”supply chain” OR ”distribution network” OR ”logistics network” OR ”supply network”) AND (”stakeholder management” OR ”actor management” OR ”partner management”))*

The selected references were chosen during different phases of the screening process. This process included an initial screening, a more comprehensive assessment, and the use of backward snowballing to identify two additional sources. A visual representation of the search process is shown in Figure A.1, providing an overview of the systematic approach, leading to the selection of ten articles.

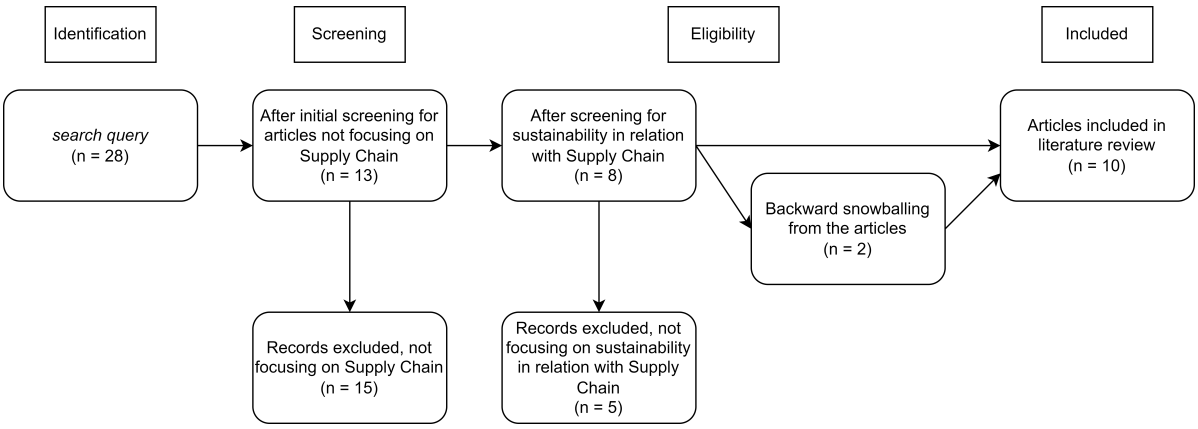

Figure A.1: Schematic overview of the literature selection process

Of these ten articles, the current knowledge of supply chains and their contributions to sustainability in combination with PRM will be explored. Five core concepts were found to reoccur in multiple references. These core concepts were used to identify the initial knowledge gap. The ten references selected via the systematic process are shown in Table A.1, indicating which of the five core concepts are covered in the corresponding article (with an 'X'). The last column provides an indication of how the reference was retrieved.

Table A.1: Overview of the key concepts discussed in the found literature

Reference	Circular economy	Developing countries	Conceptual model	Partner selection	Trade-off	Retrieved via
Akomea-Frimpong et al. (2023)	X	X				Search string on Scopus
Gandolfo and Lupi (2021)	X				X	Search string on Scopus
C. Wu et al. (2020)			X	X		Search string on Scopus
Beske and Seuring (2014)			X	X		Backward snowballing
Seuring et al. (2022)	X		X	X		Search string on Scopus
Siems and Seuring (2021)		X	X			Search string on Scopus
Mc Loughlin et al. (2023)		X	X	X	X	Search string on Scopus
Sajjad et al. (2015)					X	Search string on Scopus
Meckenstock, Barbosa-Póvoa, and Carvalho (2016)		X			X	Backward snowballing
Taylor and Rosca (2023)			X		X	Search string on Scopus

The five different core concepts are:

1. **Circular economy:** a relationship between SSCM and circular economy is given.
2. **Developing countries:** a relationship between PRM and developing countries is given.
3. **Conceptual model:** a conceptual model of PRM is given.
4. **Partner selection:** a relationship between SSCM and partner selection is given.
5. **Trade-off:** a relationship between sustainability and the business model (which represents the trade-off) is given.

It is interesting to see that four of the five concepts from this systematic literature review are reported within the theoretical background (Chapter 2). Circular economy is not reported explicitly, as it seems to be part of the broader concept of sustainability. A sustainability goal could be a circular economy. The other concepts are explicitly reported in the theoretical background, with the conceptual model being more or less transformed into the DSS.

After this initial literature review, additional literature was found to understand and describe the key concepts and to specify the knowledge gap, which resulted in the theoretical background and, therefore, the MRQ as shown in the thesis.

B

Excel solver with the acquired weights of the two experts

The Excel solver by Rezaei (2016b) is used for the calculation of the weights. The Excel solver is easy to use and reproducible in other situations when weights of criteria need to be calculated. This appendix shows an example as given in the solver (Chapter B.1.1) and the definitions of the scale from one to nine (Chapter B.1.2). Then, the solver as filled in by the two experts (Chapter B.2 and B.3) for the capabilities and the willingness criteria have been shown. The weights have also been reported in Chapter 5.6.

B.1. Excel solver

B.1.1. Example

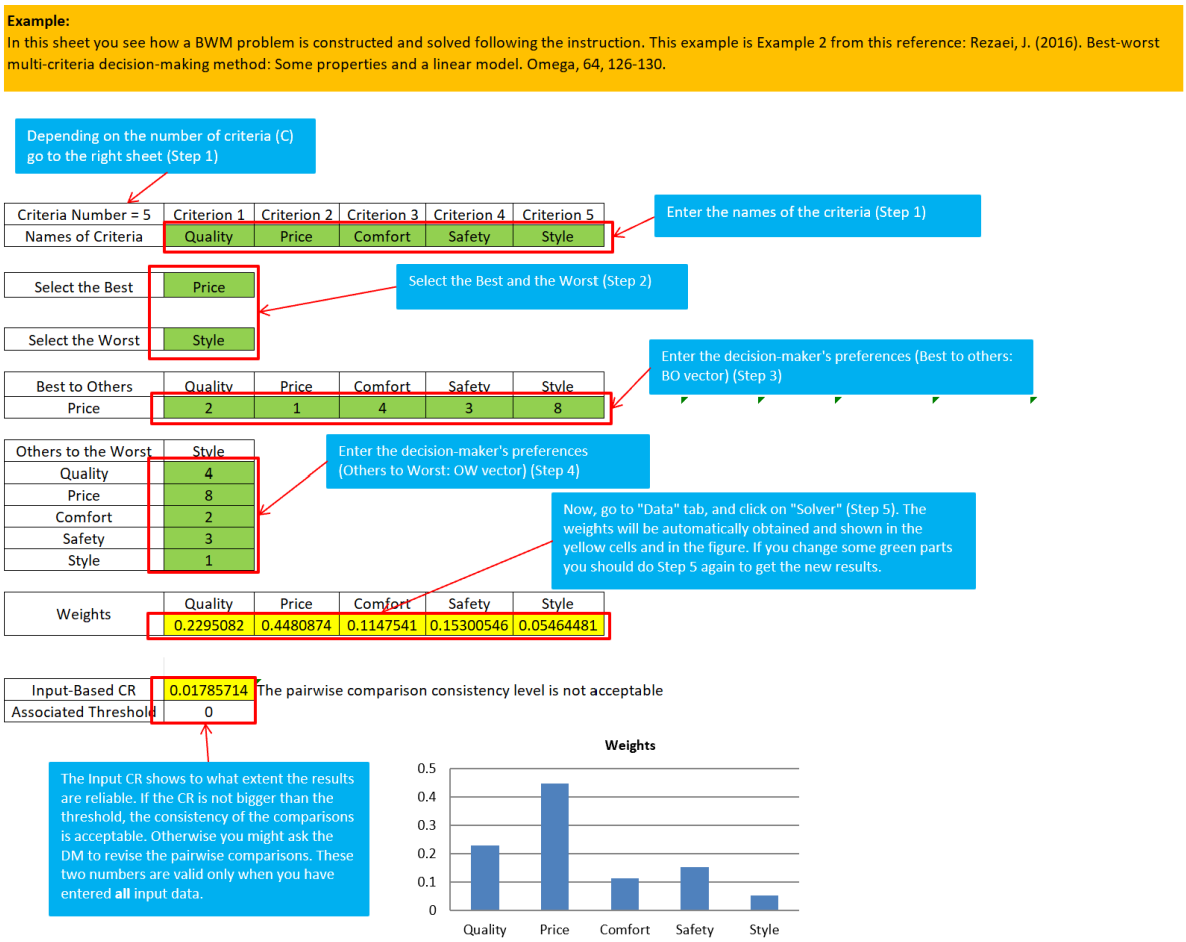

Figure B.1: The Excel solver: an example with explanation

B.1.2. Scale 1 to 9

Within the Excel solver, scores from 1 to 9 can be used for the pairwise comparisons. The meaning of the numbers from 1 to 9 are as follows:

1. **Equal** importance
2. Somewhat between equally and moderately more important than
3. **Moderately** more important than
4. Somewhat between moderately and strongly more important than
5. **Strongly** more important than
6. Somewhat between strongly and very strongly more important than
7. **Very strongly** more important than
8. Somewhat between very strongly and absolutely more important than
9. **Absolutely** more important than

B.2. Expert 1

B.2.1. Trade-off of the capabilities criteria

Criteria Number = 6	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 6
Names of Criteria	Collaborative capability	Financial position	Knowledge management capability	Management and organisation	Measurement capability	Technological capability

Select the Best	Collaborative capability

Select the Worst	Measurement capability

Best to Others	Collaborative capability	Financial position	Knowledge management capability	Management and organisation	Measurement capability	Technological capability
Collaborative	1	1	2	5	6	2

Others to the Worst	Measurement capability
Collaborative	6
Financial position	6
Knowledge	5
Management and	3
Measurement	1
Technological	5

Weights	Collaborative capability	Financial position	Knowledge management capability	Management and organisation	Measurement capability	Technological capability
	0.281767956	0.281767956	0.165745856	0.066298343	0.038674033	0.165745856

Input-Based CR	0.3	The pairwise comparison consistency level is acceptable
Associated Threshold	0.3044	

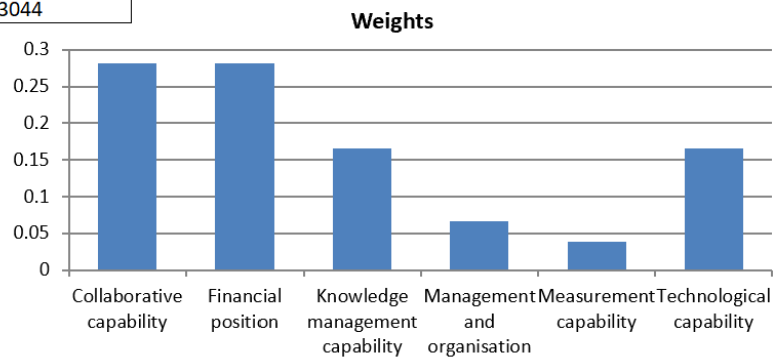

Figure B.2: The Excel solver: an overview of the scores given by expert 1 on the capability criteria

B.2.2. Trade-off of the willingness criteria

Criteria Number = 8	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 6	Criterion 7	Criterion 8
Names of Criteria	Commitment to continuous improvement in process	Economic opportunities	Environmental concerns	Ethical standards	Government grants	Market pressure	Regulatory pressure	Willingness to invest in specific equipment

Select the Best	Environmental concerns

Select the Worst	Regulatory pressure

Best to Others	Commitment to continuous improvement in process	Economic opportunities	Environmental concerns	Ethical standards	Government grants	Market pressure	Regulatory pressure	Willingness to invest in specific equipment
Environmental	2	6	1	3	5	5	7	2

Others to the Worst	Regulatory pressure
Commitment to	7
Economic opportunities	3
Environmental	7
Ethical standards	4
Government grants	2
Market pressure	2
Regulatory pressure	1
Willingness to invest in	7

Weights	Commitment to	Economic	Environmental	Ethical	Government	Market	Regulatory	Willingness
	0.176767677	0.058922559	0.294612795	0.117845	0.07070707	0.07071	0.03367	0.176767677

Input-Based CR	0.261904762	The pairwise comparison consistency level is acceptable
Associated Threshold	0.3251	

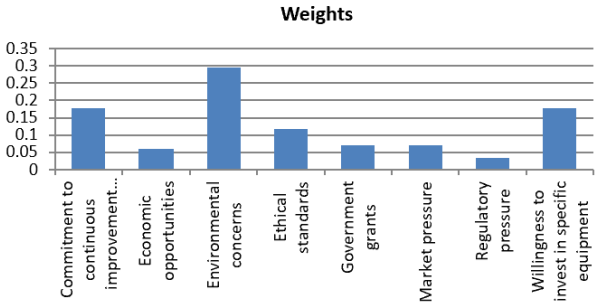

Figure B.3: The Excel solver: an overview of the scores given by expert 1 on the willingness criteria

B.3. Expert 2

B.3.1. Trade-off of the capabilities criteria

Criteria Number = 6	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 6
Names of Criteria	Collaborative capability	Financial position	Knowledge management capability	Management and organisation	Measurement capability	Technological capability

Select the Best	Technological capability

Select the Worst	Measurement capability

Best to Others	Collaborative capability	Financial	Knowledge	Management	Measurement	Technological
Technological	6	3	5	5	8	1

Others to the Worst	Measurement capability
Collaborative	2
Financial position	7
Knowledge	5
Management and	5
Measurement	1
Technological	8

Weights	Collaborative capability	Financial	Knowledge	Management	Measurement	Technological
	0.093696763	0.1873935	0.112436116	0.112436116	0.042589438	0.451448041

Input-Based CR	0.303571429
Associated Threshold	0.3154

The pairwise comparison consistency level is acceptable

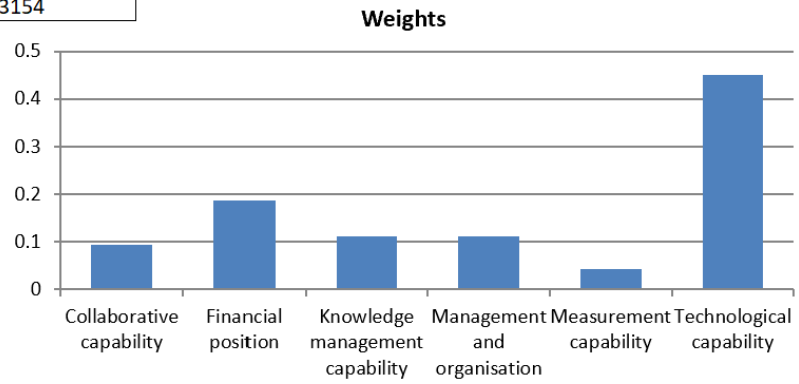

Figure B.4: The Excel solver: an overview of the scores given by expert 2 on the capability criteria

B.3.2. Trade-off of the willingness criteria

Criteria Number = 8	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 6	Criterion 7	Criterion 8
Names of Criteria	Commitment to continuous improvement in process	Economic opportunities	Environmental concerns	Ethical standards	Government grants	Market pressure	Regulatory pressure	Willingness to invest in specific equipment

Select the Best	Commitment to continuous improvement in process
Select the Worst	Market pressure

Best to Others	Commitment to continuous improvement in process	Economic opportunities	Environmental concerns	Ethical standards	Government grants	Market pressure	Regulatory pressure	Willingness to invest in specific equipment
Commitment to	1	5	3	4	3	9	3	5

Others to the Worst	Market pressure
Commitment to	9
Economic	5
Environmental	7
Ethical standards	6
Government grants	7
Market pressure	1
Regulatory pressure	7
Willingness to invest in	5

Weights	Commitment to continuous	Economic	Environmental	Ethical	Government	Market	Regulatory	Willingness
	0.323033708	0.078651685	0.131086142	0.0983146	0.131086142	0.02809	0.1310861	0.078651685

Input-Based CR	0.222222222
Associated Threshold	0.362

The pairwise comparison consistency level is acceptable

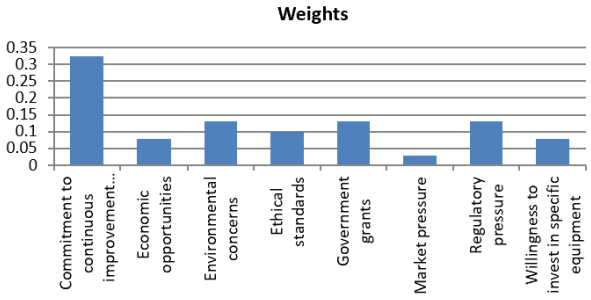

Figure B.5: The Excel solver: an overview of the scores given by expert 2 on the willingness criteria

C

Data management: informed consent

This appendix contains the different informed consent forms signed by the participants.

C.1. Informed consent - interview criteria

Participant information – Interview criteria

You are being invited to participate in a research study titled *Managing partner relationships within global supply chains of cargo airlines to reach sustainability goals*. This study is being done by Tim Verwer from the TU Delft in collaboration with KLM Cargo.

The purpose of this research study is to create a Decision Support System to support cargo airlines to manage their partners efficiently to reach sustainability goals. In this case, the cargo airline is KLM Cargo, the partners are the outstations and the sustainability goals are zero emission and zero waste. The interview will take approximately 60 minutes to participate. The data will be used to gain insight in the criteria which should be used including the weights. We will be asking you questions like:

- What criteria should be taken into account when we want to achieve 'zero emission' and 'zero waste'?
- What is the most important criteria and what is the least important criteria?

Your participation will be audio recorded, with a textual transcript produced afterwards. The gathered data will be utilized for the Decision Support System, the analysis and the validation. You will be provided with a summary of the interview, which we will send to you for review before publication. The summary will be anonymous, besides the company name and your function (as provided in the summary). The summary will be included as supplementary material to the thesis, which will be publicly available.

As with any online activity the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential. We will minimize any risks by storing the information at an institutional storage solution at TU Delft (the Netherlands, governed by GDPR), accessible by the TU Delft research team only. All personal data (the transcript and the audio recording) will be deleted at the latest 2 years after the completion of the project.

Your participation in this study is entirely voluntary and you can withdraw at any time. You are free to omit any questions. The data provided can later also be removed and/or not included into the research if you would like to retract your information, as long as the result has not been published.

Signatures

I have read and understood the study information above, and I consent to participate to the experiment and to the data processing described above.

_____	_____	_____
Name of participant	Signature	Date

Study contact details for further information:

Researcher: Tim Verwer, T.P.Verwer@student.tudelft.nl, student number 4912381

Supervisor: Jafar Rezaei, [redacted]

Figure C.1: Informed consent - interview criteria

C.2. Informed consent - scoring of partners

Participant information – Scoring of partners

You are being invited to participate in a research study titled *Managing partner relationships within global supply chains of cargo airlines to reach sustainability goals*. This study is being done by Tim Verwer from the TU Delft in collaboration with KLM Cargo.

The purpose of this research study is to create a Decision Support System to support cargo airlines to manage their partners efficiently to reach sustainability goals. In this case, the cargo airline is KLM Cargo, the partners are the outstations and the sustainability goals are zero emissions and zero waste. The scoring will take approximately 60 minutes. The data will be used to gain insight in the scores of the handling partners on the criteria. We will be asking you questions like:

- How does outstation X score based on criteria 1?
- How does outstation Y score based on criteria 2?

Your participation will be documented and utilized for the Decision Support System (in an Excel spreadsheet), the analysis and the validation. You will be provided with an overview of the outcomes of the scoring, which we will send to you for review before publication. The scoring will be anonymous, besides the company name and your function (as provided in the summary). The scoring will be included as supplementary material to the thesis, which will be publicly available.

As with any online activity the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential. We will minimize any risks by storing the information at an institutional storage solution at TU Delft (the Netherlands, governed by GDPR), accessible by the TU Delft research team only. All personal data (the transcript and the audio recording) will be deleted at the latest 2 years after the completion of the project.

Your participation in this study is entirely voluntary and you can withdraw at any time. You are free to omit any questions. The data provided can later also be removed and/or not included into the research if you would like to retract your information, as long as the result has not been published.

Signatures

I have read and understood the study information above, and I consent to participate to the experiment and to the data processing described above.

_____	_____	_____
Name of participant	Signature	Date

Study contact details for further information:

Researcher: Tim Verwer, T.P.Verwer@student.tudelft.nl, student number 4912381

Supervisor: Jafar Rezaei, [redacted]

Figure C.2: Informed consent - scoring of partners

C.3. Informed consent - focus group

Participant information – Focus group

You are being invited to participate in a research study titled *Managing partner relationships within global supply chains of cargo airlines to reach sustainability goals*. This study is being done by Tim Verwer from the TU Delft in collaboration with KLM Cargo.

The purpose of this research study is to create a Decision Support System to support cargo airlines to manage their partners efficiently to reach sustainability goals. In this case, the cargo airline is KLM Cargo, the partners are the outstations and the sustainability goals are zero emissions and zero waste. The focus group will take approximately 60 minutes to participate. The data will be used to gain insights in possible strategies to manage partners to achieve these sustainability goals. We will be asking you questions like:

- What are possible strategies for KLM Cargo to achieve zero emissions and zero waste, when looking at the segment of low capabilities and low willingness?
- What could partner X do to achieve zero emissions and zero waste?

Your participation will be audio recorded, with a textual transcript produced afterwards. The gathered data will be utilized for the Decision Support System, the analysis and the validation. You will be provided with a synthesis of the focus group, which we will send to you for review before publication. The synthesis will be anonymous, besides the company name and your function (as provided in the synthesis). The synthesis will be included as supplementary material to the thesis, which will be publicly available.

As with any online activity the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential. We will minimize any risks by storing the information at an institutional storage solution at TU Delft (the Netherlands, governed by GDPR), accessible by the TU Delft research team only. All personal data (the transcript and the audio recording) will be deleted at the latest 2 years after the completion of the project.

Your participation in this study is entirely voluntary and you can withdraw at any time. You are free to omit any questions. The data provided can later also be removed and/or not included into the research if you would like to retract your information, as long as the result has not been published.

Signatures

I have read and understood the study information above, and I consent to participate to the experiment and to the data processing described above.

_____	_____	_____
Name of participant	Signature	Date

Study contact details for further information:

Researcher: Tim Verwer, T.P.Verwer@student.tudelft.nl, student number 4912381

Supervisor: Jafar Rezaei, [redacted]

Figure C.3: Informed consent - focus group

C.4. Informed consent - validation

Participant information – Validation

You are being invited to participate in a research study titled *Managing partner relationships within global supply chains of cargo airlines to reach sustainability goals*. This study is being done by Tim Verwer from the TU Delft in collaboration with KLM Cargo.

The purpose of this research study is to create a Decision Support System to support cargo airlines to manage their partners efficiently to reach sustainability goals. In this case, the cargo airline is KLM Cargo, the partners are the outstations and the sustainability goals are zero emission and zero waste. The interview will take approximately 30 minutes to participate. The data will be used for the validation of the results of the segmentation of the outstations. We will be asking you questions like:

- Is it correct that outstation X belongs to segment IV?
- To which segment does outstation X belong to?

Your participation will be audio recorded, with a textual transcript produced afterwards. The gathered data will be utilized for the Decision Support System, the analysis and the validation. You will be provided with a summary of the interview, which we will send to you for review before publication. The summary will be anonymous, besides the company name and your function (as provided in the summary). The summary will be included as supplementary material to the thesis, which will be publicly available.

As with any online activity the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential. We will minimize any risks by storing the information at an institutional storage solution at TU Delft (the Netherlands, governed by GDPR), accessible by the TU Delft research team only. All personal data (the transcript and the audio recording) will be deleted at the latest 2 years after the completion of the project.

Your participation in this study is entirely voluntary and you can withdraw at any time. You are free to omit any questions. The data provided can later also be removed and/or not included into the research if you would like to retract your information, as long as the result has not been published.

Signatures

I have read and understood the study information above, and I consent to participate to the experiment and to the data processing described above.

Name of participant	Signature	Date

Study contact details for further information:

Researcher: Tim Verwer, T.P.Verwer@student.tudelft.nl, student number 4912381

Supervisor: Jafar Rezaei, [redacted]

Figure C.4: Informed consent - validation

D

Selection of the criteria

Two interviews with experts have been conducted. The interviewees received the list with the capabilities and willingness sustainability criteria, found in the literature (Chapter 2.2.3). They were asked to review the list, confirm the definitions, and suggest any additional insights. Following this, they were asked to select the criteria which are important for the operations of KLM Cargo. This process is presented in Chapter D.1 and D.2. Subsequently, an overview of the scores of the capabilities and willingness criteria is given in Chapter D.3. Some criteria needed to be revisited, which was done in a second round of communication as presented in Chapter D.4. The final selected criteria have been used for the research and are shown in Chapter D.5.

D.1. Interview summary - Expert I

The first interview was conducted on the *22nd of April (11.30-12.00h)* with an *Area Operations Director* of KLM Cargo.

D.1.1. General remarks

None.

D.1.2. Capabilities criteria

Changes to the criteria

The interviewee suggests simplifying the three different collaboration capabilities. The three types of collaboration capabilities (absorptive capability, external capability, and integrative capability) are considered complex and somewhat confusing. Specifically, 'external' collaboration is noted as misleading. To enhance clarity, it is recommended to combine the three capabilities into just one overarching 'collaborative capability'.

Additions to the criteria

None.

Selection of the criteria

- **Collaborative capability**
  Select criterion: yes
  When first looking at the three different collaborative capabilities (absorptive capability, external capability, and integrative capability), then the interviewee argues for taking adaptive capability into account. Combining the three capabilities would make more sense and should then definitely be selected as a sustainability criterion for the use case of KLM Cargo.
- **Financial position**
  Select criterion: yes
  The financial position often goes hand in hand with cost savings. In this, it is seen that key partners are more decisive since they have a higher margin than the small partners.

- **Geographical location capability**
  Select criterion: maybe
  The interviewee gives an example of a country where floods are common. There, sustainability investments are deliberately not made, as they can quickly be lost again.
- **Innovation management capability**
  Select criterion: no
  The interviewee believes that most of the innovations have already been done. The standard list of innovations that can be applied to enhance sustainability are solar panels, reusing materials, LED lighting in the sheds, ensuring good insulation, electrification (e.g. forklifts) and reusing rainwater or wastewater for other purposes.
- **Knowledge management capability**
  Select criterion: yes
  The application of the innovations.
- **Management and organisation**
  Select criterion: yes
  This is seen as an important criteria, as policy and implementation are two different things, policy has to be carried out.
- **Measurement capability**
  Select criterion: maybe
  Knowledge is power; it has to be shown in data.
- **Position in industry**
  Select criterion: no
  The position in the industry is used to differentiate yourself, but this is not the main selection criteria to enhance sustainability. It is not a qualifier.
- **Technological capability**
  Select criterion: maybe
  Doubt, since when a partner has the money (the financial position), you can most of the time buy the technology as well.

D.1.3. Willingness criteria

Changes to the criteria
None.

Additions to the criteria
None.

Selection of the criteria

- **Attitude**
  Select criterion: no
  99 of the 100 partners do have a sustainability program, therefore it looks like everyone has the right attitude, so it is hard to differentiate on this criteria.
- **Commitment to continuous improvement in process**
  Select criterion: yes
  Include criteria.
- **Dependency**
  Select criterion: yes
  It is important to take this one into account since when a partner makes a decision, they are still dependent on one another.
- **Economic opportunities**
  Select criterion: yes
  Definitely.

- **Environmental concerns (public concerns/public pressure)**
  Select criterion: yes
  Definitely.
- **Ethical standards**
  Select criterion: yes
  Definitely.
- **Flexible contract terms and conditions**
  Select criterion: maybe
  The interviewee says that the company is currently looking at a sustainability side letter within the contracts. Since this is currently not the case and the terms and conditions are minimally focused on sustainability, no differentiation can be made with this criteria.
- **Government grants**
  Select criterion: yes
  Definitely.
- **Honest and frequent communications**
  Select criterion: no
  The communication with the partners is predominantly considered as honest and frequent, so no big differentiation can be made on this criteria.
- **Long-term relationship**
  Select criterion: no
  The starting point are long-term relationships, hence there is not going to be much difference between the different partners based on this criteria.
- **Market pressure**
  Select criterion: yes
  Definitely, it is interesting to see what is going on worldwide.
- **Mutual respect and honesty**
  Select criterion: no
  It is not interesting to include this criterion.
- **Regulatory pressure (legal pressure)**
  Select criterion: yes
  Include criteria.
- **Relationship closeness**
  Select criterion: no
  Just like long-term relationships, this one is not necessary.
- **Willingness to co-design and participate in new sustainability practices**
  Select criterion: no
  Hard to differentiate.
- **Willingness to invest in specific equipment**
  Select criterion: yes
  Differentiation is possible for this one.
- **Willingness to share information, ideas, and technology**
  Select criterion: no
  Also no differentiation.

D.2. Interview summary - Expert II

The second interview was conducted on the *24th of April (09.30-10.00h)* with a *Procurement Unit Manager* of KLM Cargo.

D.2.1. General remarks

The criteria are considered as clear. The interviewee agrees with the method; this is how it should be, and this is the method which should be used to address the problem.

The interviewee wonders whether the influenceability of the criteria should not be considered. After being explained that this is done when the strategies are determined according to the different segments, the interviewee agrees that this comes later in the process, so the influenceability of the criteria can be ignored for now, as it is only about classifying the partners in the matrix.

D.2.2. Capabilities criteria

Changes to the criteria

The second interviewee also suggested combining the three different collaboration capabilities. The enhance clarity, it is recommended to combine the three capabilities into just one overarching 'collaborative capability'.

The interviewee indicates that it is possible to combine knowledge management capability with management and organisation. One is the knowledge of the management, the other is the willingness to accept. The more knowledge comes to that management, the easier it is for the management to go along with it.

Additions to the criteria

None.

Selection of the criteria

- **Collaborative capability**
  Select criterion: yes
  Include criteria.
- **Financial position**
  Select criterion: yes
  Include criteria.
- **Geographical location capability**
  Select criterion: no
  In Africa, solar is a much more important issue than, for example, in Nordic countries. Incidentally, this is not considered a big topic, so the criterion does not have to be included.
- **Innovation management capability**
  Select criterion: yes
  Include criteria.
- **Knowledge management capability**
  Select criterion: yes
  Include criteria.
- **Management and organisation**
  Select criterion: yes
  Include criteria.
- **Measurement capability**
  Select criterion: yes
  Include criteria, knowledge is power.
- **Position in industry**
  Select criterion: no
  It is not necessary to include this criterion.
- **Technological capability**
  Select criterion: yes
  Include criteria.

D.2.3. Willingness criteria

Changes to the criteria

The explanation of dependency could be more clear.

Long-term relationship and relationship closeness are similar, The interviewee indicates that these could be taken together.

Additions to the criteria
None.

Selection of the criteria
- **Attitude**
  Select criterion: yes
  This depends on a lot, what is the attitude of the partners.
- **Commitment to continuous improvement in process**
  Select criterion: yes
  Include criteria. This can be influenced because it is contactable.
- **Dependency**
  Select criterion: no
  This is not an important criterion.
- **Economic opportunities**
  Select criterion: yes
  Include criteria, important.
- **Environmental concerns (public concerns/public pressure)**
  Select criterion: yes
  Interesting criterion, include it. Also based on geographical location.
- **Ethical standards**
  Select criterion: maybe
  Doubt.
- **Flexible contract terms and conditions**
  Select criterion: no
  Not much differentiation is possible for this criteria.
- **Government grants**
  Select criterion: yes
  Very important criteria.
- **Honest and frequent communications**
  Select criterion: maybe
  Slightly in-between.
- **Long-term relationship**
  Select criterion: no
  The relationships are meant to be long-term, so the interviewee states that they already know this is all right.
- **Market pressure**
  Select criterion: maybe
  Doubt.
- **Mutual respect and honesty**
  Select criterion: maybe
  Doubt.
- **Regulatory pressure (legal pressure)**
  Select criterion: yes
  Include criteria.
- **Relationship closeness**
  Select criterion: no
  Quite the same as long-term relationship, according to the interviewee.

- **Willingness to co-design and participate in new sustainability practices**
  Select criterion: yes
  Soft criteria, but include it.
- **Willingness to invest in specific equipment**
  Select criterion: maybe
  Doubt.
- **Willingness to share information, ideas, and technology**
  Select criterion: yes
  Include criteria.

D.3. First selection of the criteria

Based on the results, the choice was made to consider a criterion if both experts said ”yes” or if one expert said ”yes” and the other was doubtful (”maybe”). Table D.1 and D.2 illustrate this process, with a ’0’ indicating a ”no”, ’0.5’ indicating a ”maybe”, and a ’1’ indicating a ”yes”. Criteria with a score higher than 1 were considered relevant for the operations of KLM Cargo.

Table D.1: Scores of the capabilities criteria

Criteria	Expert I	Expert II	Total	>1
Collaborative capability	1	1	2	Yes
Financial position	1	1	2	Yes
Geographical location capability	0.5	0	0.5	No
Innovation management capability	**0**	**1**	**1**	**No**
Knowledge management capability	1	1	2	Yes
Management and organisation	1	1	2	Yes
Measurement capability	0.5	1	1.5	Yes
Position in industry	0	0	0	No
Technological capability	0.5	1	1.5	Yes

Table D.2: Scores of the willingness criteria

Criteria	Expert I	Expert II	Total	>1
Attitude	**0**	**1**	**1**	**No**
Commitment to continuous improvement in process	1	1	2	Yes
Dependency	**1**	**0**	**1**	**No**
Economic opportunities	1	1	2	Yes
Environmental concerns	1	1	2	Yes
Ethical standards	1	0.5	1.5	Yes
Flexible contract terms and conditions	0.5	0	0.5	No
Government grants	1	1	2	Yes
Honest and frequent communications	0	0.5	0.5	No
Long-term relationship	0	0	0	No
Market pressure	1	0.5	1.5	Yes
Mutual respect and honesty	0	0.5	0.5	No
Regulatory pressure	1	1	2	Yes
Relationship closeness	0	0	0	No
Willingness to co-design and participate in new sustainability practices	**0**	**1**	**1**	**No**
Willingness to invest in specific equipment	1	0.5	1.5	Yes
Willingness to share information, ideas, and technology	**0**	**1**	**1**	**No**

D.4. Checking questionable criteria

Because three collaborative capabilities were taken together, the total number of 28 criteria is now 26. Of these 26 criteria, 5 were important to consider again (bold and blue in Table D.1 and D.2). These are the criteria where one expert said ”yes” and the other one said ”no”. To ensure these criteria should not

be taken into account, a second round of communication with the experts was held. These five criteria, 'innovation management capability', 'attitude', 'dependency', 'willingness to co-design and participate in new sustainability practices', and 'willingness to share information, ideas, and technology', were presented to them with the rationale of the other expert, asking if they still agree with their own answer or if they wanted to change their opinion. The summaries of this second round of communication are shown in Chapter D.4.1 and D.4.2.

D.4.1. Expert I

General remarks
None.

Capabilities criteria

- **Innovation management capability**
  Select criterion: no - Expert II: yes
  Another criterion with respect to finance was already incorporated.

Willingness criteria

- **Attitude**
  Select criterion: no - Expert II: yes
  All partners will be positive about this because they are compelled by airlines and public opinion.
- **Dependency**
  Select criterion: yes - Expert II: no
  It is more related to the availability of materials in certain countries. Additionally, it depends on whether there is a push from the government.
- **Willingness to co-design and participate in new sustainability practices**
  Select criterion: no - Expert II: yes
  Theoretically, yes, but in practice, it is very difficult, and everyone ends up doing their own thing. It takes a lot of time, and the return on investment is minimal.
- **Willingness to share information, ideas and technology**
  Select criterion: no - Expert II: yes
  No, because every handler already shares.

D.4.2. Expert II

General remarks
The choices were made in one meeting, so they are somewhat dependent on that moment. Mainly focus on the opinion of the criteria which are like-minded.

The expert also states that operations has a deeper understanding of this. As far as the expert is concerned, the opinions of Expert I can be decisive. Procurement (the area of Expert II), is more advisory/challenging than determining in this matter.

Capabilities criteria

- **Innovation management capability**
  Select criterion: yes - Expert I: no
  The capacity of Swissport, Menzies and WFS is often much greater than most. Therefore, the assumption is that large suppliers are the best in this regard by definition. As a result, some smaller (growing) parties might be left out if this criterion is not considered.

Willingness criteria

- **Attitude**
  Select criterion: yes - Expert I: no
  Attitude is very important because it indicates how easily the partners can be influenced.
- **Dependency**
  Select criterion: no - Expert I: yes
  The expert actually agrees with Expert I after reconsidering.

- **Willingness to co-design and participate in new sustainability practices**
  Select criterion: yes - Expert I: no
  Somewhat related to attitude. Include one of these two (or combine them).
- **Willingness to share information, ideas and technology**
  Select criterion: yes - Expert I: no
  Include a combination of the three: attitude/willingness, if it is not already included.

D.5. Final selection of the criteria

Based on the second round of communication with the experts, the choice was made not to change the first selection of the criteria. This decision was made because a smaller number of criteria makes the scoring process more clear and efficient. Apart from the fact that it can be seen as logical to include 'dependency', Expert I's additional explanation was not convincing enough, as the explanation to include this criterion anyway has already been clearly covered by other criteria. Besides that, the rationale of Expert I for not taking the criteria into account was convincing, and the second expert stated that the opinions of the first expert should be decisive, as that expert is more closely related to the operation. Table 5.1 shows the selected criteria which are considered important for the operations of KLM Cargo.

E

Scoring of the outstations

This Appendix contains the scores of the 168 outstations on the capabilities and the willingness criteria. The outstations are scored by the AODs of each area. Table E.1 shows the scores for Asia, E.2 for Africa, Table E.3 for America, and Table E.4 for Europe.

Table E.1: Scoring of the outstations in Asia

Area	Outstation	C_1^C	C_2^C	C_3^C	C_4^C	C_5^C	C_6^C	C_1^W	C_2^W	C_3^W	C_4^W	C_5^W	C_6^W	C_7^W	C_8^W
Asia	1	5	4	4	4	3	4	4	4	4	4	2	4	2	4
	2	5	4	4	4	3	4	4	4	4	4	2	4	2	4
	3	5	3	4	4	3	4	4	4	4	4	2	4	3	4
	4	5	3	4	4	3	4	4	4	4	4	2	4	3	4
	5	5	4	5	5	4	5	5	4	5	5	2	3	2	5
	6	4	4	5	5	4	5	5	4	5	5	2	3	2	5
	7	4	4	5	5	4	5	5	4	5	5	2	3	2	5
	8	**5**	**5**	**4**	**4**	**3**	**3**	**5**	**3**	**3**	**3**	**1**	**2**	**2**	**4**
	9	2	5	3	3	3	2	2	2	2	3	1	1	1	3
	10	4	4	4	4	4	4	4	4	5	4	1	1	1	4
	11	5	4	4	4	4	4	5	5	4	4	1	1	1	4
	12	5	4	4	4	4	4	5	5	4	4	1	1	1	4
	13	4	4	4	4	4	3	4	4	3	3	1	1	1	3
	14	4	4	4	4	4	3	4	4	3	3	1	1	1	3
	15	2	4	2	2	1	1	2	4	3	3	1	1	1	2
	16	5	5	4	4	3	3	5	3	3	3	1	2	2	4
	17	4	4	4	4	4	3	4	4	3	3	2	2	1	4
	18	4	5	3	3	3	4	3	2	2	3	1	1	1	3
	19	5	4	3	3	2	1	4	1	1	3	1	1	1	3
	20	5	4	3	3	2	1	4	1	1	3	1	1	1	3
	21	4	3	3	3	2	2	4	1	1	3	1	1	1	3
	22	5	4	3	3	2	1	4	1	1	3	1	1	1	3

Table E.2: Scoring of the outstations in Africa

Area	Outstation	C_1^C	C_2^C	C_3^C	C_4^C	C_5^C	C_6^C	C_1^W	C_2^W	C_3^W	C_4^W	C_5^W	C_6^W	C_7^W	C_8^W
Africa	23	4	4	5	4	2	3	4	3	2	3	1	2	4	4
	24	3	3	3	3	2	2	3	2	2	3	1	1	1	2
	25	4	4	5	4	2	3	4	3	3	4	1	2	4	4
	26	4	4	5	4	2	3	4	3	2	3	1	2	4	4
	27	2	1	2	2	2	2	2	2	2	2	2	2	2	2
	28	3	3	3	3	2	2	3	2	2	3	1	1	1	2
	29	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	30	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	31	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	32	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	33	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	34	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	35	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	36	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	37	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	38	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	39	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	40	5	5	5	5	5	5	5	3	3	3	3	3	3	4
	41	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	42	2	2	2	2	2	2	2	2	2	2	2	2	2	2
	43	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	44	4	2	4	4	2	3	4	3	3	3	1	2	2	2
	45	4	4	5	4	2	3	4	3	3	4	1	2	4	4
	46	4	4	5	4	2	3	4	3	3	4	1	2	4	4
	47	3	3	4	4	2	3	4	2	2	3	1	1	1	2
	48	**4**	**4**	**5**	**4**	**2**	**3**	**4**	**3**	**3**	**4**	**1**	**2**	**4**	**4**
	49	4	4	5	4	2	3	4	3	3	4	1	2	4	4
	50	4	4	5	4	2	3	4	3	3	4	1	2	4	4
	51	4	4	5	4	2	3	4	3	3	4	1	2	4	4
	52	2	1	1	1	1	1	1	1	1	1	1	1	1	1
	53	4	1	3	3	2	3	4	2	1	3	1	1	1	2
	54	2	2	4	4	4	3	2	2	3	2	3	3	3	2
	55	4	4	4	4	4	4	4	3	2	3	3	2	3	2
	56	4	4	4	4	4	4	4	2	2	2	1	2	2	1

Table E.3: Scoring of the outstations in America

Area	Outstation	C_1^C	C_2^C	C_3^C	C_4^C	C_5^C	C_6^C	C_1^W	C_2^W	C_3^W	C_4^W	C_5^W	C_6^W	C_7^W	C_8^W
	57	3	2	3	3	3	4	4	3	4	3	1	2	2	2
	58	3	3	3	3	3	3	4	3	3	4	1	3	3	3
	59	3	3	3	3	2	3	2	3	3	2	2	2	3	2
	60	4	3	4	4	3	3	3	3	3	3	2	2	3	2
	61	3	3	3	3	3	2	3	3	3	3	1	2	3	2
	62	4	3	4	4	3	2	3	2	3	3	2	2	3	1
	63	4	2	4	3	3	3	4	3	4	4	3	2	4	3
	64	4	3	3	3	3	3	3	3	3	4	3	2	2	3
	65	4	2	4	3	3	3	4	3	4	4	3	2	4	3
	66	4	2	3	3	3	3	3	3	3	4	3	2	2	3
	67	4	2	4	3	3	3	4	3	4	4	3	2	4	3
	68	4	3	4	3	4	3	3	4	5	4	3	2	2	3
	69	4	3	3	3	3	2	3	3	3	4	3	2	2	3
	70	4	2	4	3	3	3	4	3	4	4	3	2	4	3
	71	3	1	3	3	3	2	3	2	3	4	2	2	2	2
	72	4	3	3	3	3	3	3	3	3	4	3	1	2	3
	73	4	2	4	3	3	3	4	3	4	4	3	2	4	3
	74	2	1	2	2	2	1	2	2	2	3	3	1	2	2
	75	4	2	4	3	3	3	4	3	4	4	3	2	4	3
	76	4	2	4	3	3	3	4	3	4	4	3	2	4	3
	77	4	3	4	3	3	4	4	3	4	4	4	3	3	3
	78	5	3	3	5	3	5	3	4	2	3	3	1	1	3
	79	4	3	4	3	3	4	4	3	4	4	4	3	3	3
	80	3	3	3	3	3	3	3	3	3	3	3	3	3	3
America	81	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	82	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	83	2	1	1	1	1	1	1	1	1	1	1	1	1	1
	84	2	2	1	1	1	1	1	1	1	1	1	1	1	1
	85	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	86	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	87	4	3	4	4	4	4	4	4	4	5	3	3	3	3
	88	4	4	5	5	4	4	4	5	4	5	4	4	4	4
	89	4	3	4	4	4	4	4	4	4	5	3	3	3	3
	90	**4**	**3**	**3**	**4**	**2**	**3**	**4**	**2**	**3**	**4**	**1**	**1**	**2**	**3**
	91	4	3	3	4	2	3	4	2	3	4	1	1	2	3
	92	4	3	3	4	2	3	4	2	3	4	1	1	2	3
	93	4	3	3	4	2	3	4	2	3	4	1	1	2	3
	94	4	3	3	3	2	3	4	3	3	4	2	1	3	3
	95	3	3	3	3	2	2	3	2	3	3	1	4	2	3
	96	4	3	3	4	2	3	4	3	3	4	1	1	2	3
	97	4	3	3	4	2	3	4	3	3	4	1	1	2	3
	98	4	2	3	4	2	3	4	2	3	4	2	1	2	2
	99	4	4	4	4	4	4	5	4	5	5	5	4	3	5
	100	4	4	4	4	4	4	5	4	5	5	5	4	3	5
	101	5	5	5	5	5	5	5	4	4	5	3	4	2	3
	102	4	4	4	4	4	4	5	4	5	5	5	4	4	5
	103	4	4	4	4	4	4	5	4	5	5	5	4	4	5
	104	4	4	4	4	4	3	4	4	3	4	3	3	2	3
	105	4	5	4	4	5	3	4	5	5	5	5	3	4	4

Table E.4: Scoring of the outstations in Europe

Area	Outstation	C_1^C	C_2^C	C_3^C	C_4^C	C_5^C	C_6^C	C_1^W	C_2^W	C_3^W	C_4^W	C_5^W	C_6^W	C_7^W	C_8^W
	106	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	107	4	3	3	3	2	3	3	3	2	3	3	3	3	3
	108	4	4	4	4	2	4	4	3	3	3	3	3	3	4
	109	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	110	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	111	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	112	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	113	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	114	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	115	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	116	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	117	4	3	3	4	2	3	3	3	2	3	3	2	3	3
	118	4	2	3	3	2	2	3	3	2	3	3	2	3	3
	119	4	4	4	3	3	3	4	3	4	3	4	3	4	3
	120	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	121	3	3	3	3	4	3	4	3	3	3	4	3	4	4
	122	4	4	4	4	3	4	4	4	4	4	4	4	4	4
	123	4	4	4	4	4	4	3	4	4	4	4	4	4	4
	124	4	4	4	4	3	4	4	3	4	4	4	3	4	4
	125	3	4	4	4	3	4	4	4	3	4	4	4	3	4
	126	4	4	4	4	3	3	3	4	4	4	4	3	4	4
	127	3	4	3	4	3	4	4	4	4	4	3	4	4	4
	128	4	3	4	4	3	4	4	4	3	4	4	4	4	4
	129	**4**	**4**	**4**	**4**	**2**	**4**	**4**	**3**	**3**	**3**	**3**	**3**	**3**	**4**
	130	4	3	4	4	2	4	4	3	3	4	3	4	3	4
	131	4	3	3	3	2	3	3	3	2	3	3	3	3	3
	132	4	4	4	4	2	4	4	3	3	3	3	3	3	4
	133	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	134	4	4	3	4	4	4	4	3	4	4	3	4	4	4
	135	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	136	4	4	4	3	4	4	3	3	4	3	4	3	4	3
Europe	137	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	138	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	139	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	140	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	141	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	142	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	143	4	3	3	4	2	3	3	3	2	3	3	2	3	3
	144	4	3	3	4	2	3	3	3	2	3	3	2	3	3
	145	3	4	4	3	3	3	3	3	3	4	3	4	3	4
	146	4	2	3	3	2	2	3	3	2	3	3	2	3	3
	147	4	4	4	3	3	3	4	3	4	3	4	3	4	3
	148	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	149	3	3	3	3	4	3	4	3	3	3	4	3	4	4
	150	4	3	4	3	4	3	4	4	4	3	3	3	4	3
	151	4	4	4	4	4	4	4	4	4	3	4	3	4	3
	152	4	4	4	4	4	4	4	4	4	4	4	4	3	3
	153	4	3	4	3	4	3	4	3	4	3	4	3	4	3
	154	3	4	3	4	4	3	4	3	4	3	4	3	4	3
	155	3	4	3	4	4	4	3	3	4	4	3	4	3	3
	156	4	4	4	4	4	4	4	4	4	4	4	4	4	3
	157	4	3	3	3	4	3	4	4	3	4	3	4	3	4
	158	3	3	3	4	3	4	4	4	3	3	4	3	4	3
	159	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	160	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	161	4	4	3	4	3	3	3	4	4	3	4	4	3	3
	162	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	163	4	4	4	4	2	4	4	3	3	3	3	4	3	4
	164	3	3	3	4	4	3	4	3	4	4	3	3	4	3
	165	4	3	3	3	4	4	3	3	4	3	3	4	4	3
	166	3	3	3	4	4	3	3	4	4	3	3	3	4	3
	167	4	4	4	3	2	4	4	3	3	3	3	4	3	4
	168	3	3	3	4	3	4	3	4	3	4	4	4	3	3

F

Statistical significance of the correlations

The t-scores are presented for all correlations with a sample size of $n = 168$ in Table F.1, F.2, and F.3.

Table F.1: t-scores of the correlations of the capabilities criteria

	C_1^C	C_2^C	C_3^C	C_4^C	C_5^C	C_6^C
C_1^C	-	8.833	10.839	9.842	5.786	8.449
C_2^C		-	11.452	11.883	8.742	9.996
C_3^C			-	12.769	8.297	10.983
C_4^C				-	8.706	14.396
C_5^C					-	12.663
C_6^C						-

Table F.2: t-scores of the correlations of the willingness criteria

	C_1^W	C_2^W	C_3^W	C_4^W	C_5^W	C_6^W	C_7^W	C_8^W
C_1^W	-	8.644	9.971	11.366	3.741	5.433	5.464	13.289
C_2^W		-	16.069	11.660	10.332	11.957	7.770	12.885
C_3^W			-	14.982	10.859	11.702	10.056	10.570
C_4^W				-	6.447	7.572	6.888	12.098
C_5^W					-	16.348	12.834	7.042
C_6^W						-	12.353	11.039
C_7^W							-	8.809
C_8^W								-

Table F.3: t-scores of the correlations between the capabilities and the willingness criteria

	C_1^W	C_2^W	C_3^W	C_4^W	C_5^W	C_6^W	C_7^W	C_8^W
C_1^C	12.783	7.331	6.374	8.146	2.647	3.551	3.226	9.358
C_2^C	10.056	9.512	7.142	6.468	4.548	7.244	5.128	13.924
C_3^C	13.757	9.836	10.141	9.913	4.536	7.145	8.614	12.972
C_4^C	11.970	11.518	8.251	9.884	4.451	7.026	5.506	11.720
C_5^C	8.407	15.002	16.091	8.915	11.146	10.739	7.414	8.265
C_6^C	11.131	14.475	13.219	10.355	9.267	12.844	7.043	12.518

Then the p-values are presented, with the highest p-value highlighted in bold and blue in Table F.4, F.5, and F.6. All correlations are highly significant, as all p-values are lower than the significance level ($a = 0.01$).

Table F.4: p-values of the correlations of the capabilities criteria

	C_1^C	C_2^C	C_3^C	C_4^C	C_5^C	C_6^C
C_1^C	-	1.40E-15	4.88E-21	2.72E-18	**3.51E-08**	1.42E-14
C_2^C		-	9.50E-23	5.89E-24	2.44E-15	1.04E-18
C_3^C			-	1.89E-26	3.51E-14	1.94E-21
C_4^C				-	3.03E-15	5.15E-31
C_5^C					-	3.77E-26
C_6^C						-

Table F.5: p-values of the correlations of the willingness criteria

	C_1^W	C_2^W	C_3^W	C_4^W	C_5^W	C_6^W	C_7^W	C_8^W
C_1^W	-	4.40E-15	1.21E-18	1.65E-22	**2.52E-04**	1.95E-07	1.68E-07	6.51E-28
C_2^W		-	1.19E-35	2.49E-23	1.23E-19	3.64E-24	7.75E-13	8.96E-27
C_3^W			-	1.20E-32	4.28E-21	1.89E-23	7.10E-19	2.72E-20
C_4^W				-	1.19E-09	2.43E-12	1.11E-10	1.46E-24
C_5^W					-	2.06E-36	1.24E-26	4.80E-11
C_6^W						-	2.81E-25	1.36E-21
C_7^W							-	1.62E-15
C_8^W								-

Table F.6: p-values of the correlations between the capabilities and the willingness criteria

	C_1^W	C_2^W	C_3^W	C_4^W	C_5^W	C_6^W	C_7^W	C_8^W
C_1^C	1.73E-26	9.53E-12	1.75E-09	8.62E-14	**8.90E-03**	4.99E-04	1.51E-03	5.56E-17
C_2^C	7.06E-19	2.15E-17	2.74E-11	1.07E-09	1.04E-05	1.56E-11	8.07E-07	1.08E-29
C_3^C	3.16E-29	2.82E-18	4.13E-19	1.74E-18	1.10E-05	2.70E-11	5.28E-15	5.08E-27
C_4^C	3.34E-24	6.21E-23	4.62E-14	2.09E-18	1.57E-05	5.24E-11	1.37E-07	1.68E-23
C_5^C	1.83E-14	1.05E-32	1.04E-35	8.51E-16	6.82E-22	9.26E-21	5.96E-12	4.26E-14
C_6^C	7.50E-22	3.10E-31	1.03E-27	1.07E-19	9.76E-17	1.16E-26	4.75E-11	9.67E-26

G

Validation of the scoring of the outstations

To ensure the accuracy of the scoring process, an expert interview was conducted to validate the results. Given that various criteria were first selected, multiple individuals scored the outstations, and weights were determined, it is crucial to verify that an expert's perception of an outstation aligns with the scoring results. This validation process helps confirm that the methodology and scoring accurately reflect the real-world conditions and expert evaluations of the outstations.

G.1. Interview summary - Expert I

The interview to validate the results of the scoring of the outstation was conducted on the *17th of July (08.30-09.00h)* with an *Area Operations Director* of KLM Cargo. The same expert has been interviewed before for the selection of the criteria and for the allocation of the weights. The interviewee is working in one of the four areas but has sufficient knowledge about the other three areas as well to validate the segmentation.

G.1.1. Check of segmented stations

The first part of the validation process entailed checking a random outstation for each segment. Since no outstations were segmented in the Type II segment, this segment was logically left out of the validation. For the process, outstations were randomly selected. However, outstations located near the borders of the matrix (i.e., close to a score of 3 on capabilities and/or willingness) were deliberately avoided. This approach aimed to ensure that the chosen outstations were convincingly segmented into their respective segments without ambiguity.

The method led to the validation of 12 outstations, with three outstations for each area. During the validation, the interviewee was asked to confirm whether it is correct that an outstation belongs to its designated segment. The interviewee is provided with the name of the outstation, incidentally only the number of the outstations is mentioned in the summary.

Asia

- **Type I: outstation #15**
  Correctly segmented: yes
- **Type III: outstation #18**
  Correctly segmented: yes
  With the current handling agent, it is correct, and since the information is based on the current situation, the segmentation is correct. The handling agent is about the change, which could, logically, change the segment to which outstation 18 belongs.
- **Type IV: outstation #5**
  Correctly segmented: yes

Africa

- **Type I: outstation #32**
  Correctly segmented: yes
- **Type III: outstation #56**
  Correctly segmented: unknown
  The interviewee does not have knowledge about outstation 56. Therefore, another Type III outstation was randomly selected.
- **Type III: outstation #26**
  Correctly segmented: yes
- **Type IV: outstation #40**
  Correctly segmented: yes
  The handling is done by KLM Cargo.

America

- **Type I: outstation #84**
  Correctly segmented: yes
  This is a new airport, everything is currently starting up there, only freight is going to that airport, so this is correct.
- **Type III: outstation #78**
  Correctly segmented: yes
- **Type IV: outstation #88**
  Correctly segmented: yes
  The outstation has got the money and the willingness over there, so this is correct.

Europe

- **Type I: outstation #146**
  Correctly segmented: yes
  First, the interviewee remarks that this is an interesting result since the handling agent is understood to be Swissport or Menzies. The interviewee is informed that this is not correct and the name of the handling agent is provided. The interviewee indicates that, in that case, the segmentation is actually correct.
- **Type III: outstation #144**
  Correctly segmented: yes
- **Type IV: outstation #156**
  Correctly segmented: yes
  This country is progressive and the handling agent is good, so this segmentation is correct.

G.1.2. Manual segmentation of outstations

The second part of the validation process involved another method to further ensure the accuracy of the segmentation. Instead of merely naming an outstation and asking whether its segmentation was correct, this additional validation step required the interviewee to evaluate three outstations. The interviewee was asked to identify which segment they believed each outstation should belong to. This approach provided an extra layer of validation by cross-verifying the interviewee's understanding of the segmentation process.

- **Type IV: outstation #6**
  Manual segmentation: Type III or Type IV
  The interviewee responds with high capabilities and low willingness, which is equivalent to segment Type III. The interviewee continues with the explanation that this handling agent is monopolistic. There is enough money, but they are not so easily influenced. At the same time, it could be high capabilities and high willingness, according to the interviewee, because of the environmental pressure by the government of this country.

- **Type I: outstation #21**
  Manual segmentation: Type I
  Low capabilities and low willingness.
- **Type III: outstation #13**
  Manual segmentation: Type III
  High capabilities and low willingness.

After the manual segmentation of the three outstations, the interviewee is provided with the segments of those outstations based on the results. The interviewee agrees with the results and indicates that the segmentation of outstation 6 is also correct, despite the doubt between Type III and Type IV during the manual segmentation.

G.2. Overview of the validation

The validation process consisted of two parts. In the first part, an outstation was named along with the segment it belonged to according to the method used, and the interviewee was asked to confirm if this segmentation was correct. In the second part, an outstation was named, and the interviewee was asked to indicate the segment it should belong to.

For the first part, 13 outstations were evaluated. One outstation could not be validated due to insufficient knowledge about this specific outstation, but the remaining 12 were correctly segmented according to the expert. This included one outstation from each segment across all four areas (Asia, Africa, America, and Europe), except for the Type II segment, as no outstations were segmented under this segment.

For the second part, three outstations from the three segments (again, excluding Type II) were evaluated. Two outstations were fully correct, while the third was also correct, but the expert initially provided two possible segments (Type III or Type IV). After revealing the segmentation according to the method used, the expert agreed with the assigned segment.

Therefore, the validation is successful. A second interviewee is not needed for further validation, and the results can be interpreted as accurately representing the real-world situation.


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