COMPLETE E-FREIGHT IMPLEMENTATION IN THE AIR CARGO INDUSTRY

A Multi-Case Study at AirFrance-KLM Martinair Cargo

COMPLETE E-FREIGHT IMPLEMENTATION IN THE AIR CARGO INDUSTRY: A MULTI-CASE STUDY AT AIRFRANCE-KLM CARGO

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By
Moreen Wiegman
Student number: 4568362

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Graduation committee

Chairperson	: Dr. Jan Anne Annema,	TU Delft, Transport & Logistics
First Supervisor	: Dr. Jan Anne Annema,	TU Delft, Transport & Logistics
Second Supervisor	: Dr. Mark de Bruijne,	TU Delft, Organisation & Governance
External supervisor	: Simon Spoor,	AirFrance-KLM Martinair Cargo

PREFACE

This thesis is my final research performed to complete the Master of Science degree in Complex System Engineering and Management (CoSEM) of the faculty of Technology, Policy and Management at the Delft University of Technology (TU Delft). During the execution of this thesis, I have applied the knowledge and skills gained from my two-year MSc program to a complex socio-technical problem in a real-life setting. Through my strong problem-solving abilities and dedication, I have achieved a result that I am proud of. However, I acknowledge that this accomplishment would not have been possible without the support and guidance of my family, friends, and supervisors. Therefore, I would like to express my gratitude to all those who have assisted me in the writing process.

First and foremost, I would like to express my heartfelt appreciativeness to all my supervisors for their unwavering support, guidance, and advice throughout my thesis journey. Their contributions have been invaluable and instrumental in shaping this work. I am immensely grateful to Simon for providing me with the opportunity to execute my thesis and to explore my research interests freely. His trust, support, encouragement, and constructive feedback have been crucial in developing my ideas and ensuring that my research stays on track. I also appreciate the structural meetings that we had, which helped me to stay organized and focused. I am equally grateful to Jan Anne Annema for providing me with unlimited assistance whenever I needed it. His reassurance and belief in my capabilities have given me the confidence to push myself further. I am particularly thankful for his realistic approach and straight-to-the-point feedback, which helped me to stay on top of my game. Finally, I would like to extend my gratitude to Mark de Bruijne for his critical view and thorough feedback on my work. His enthusiasm and scientific understanding on my research have been a source of inspiration for me. His constructive feedback has enabled me to improve my work continuously and strive for excellence. Overall, I am fortunate to have had such wonderful supervisors who have not only provided me with academic guidance but have also been supportive and understanding throughout this process.

As I type these concluding words of the preface, I am filled with deep gratitude for the unwavering support of my family, friends and boyfriend. They have been my pillars of strength throughout this journey. Their unwavering encouragement and belief in my abilities have fueled my determination to overcome the challenges encountered while crafting this thesis. They have been instrumental in shaping my mindset, enabling me to navigate barriers, seize opportunities, and embrace incremental and adaptive solutions that ultimately led me to produce a thesis that I am proud of.

ABSTRACT

Due to growing Global Trade and an amplified desire for fast transportation, the demand for air cargo shipments increases. These shipments consist of high-value goods that account for a significant amount of capital, causing customers to have strict demands. This combination of growth and demanding customer needs puts a lot of pressure on stakeholders of the air cargo supply chain in finding sufficient capacity as well as ensuring safe, reliable, and efficient operations. In order to do so, a lot of documentation is required between several stakeholders. However, in the current process, there are a lot of inefficiencies and errors in the documentation due to the use of digital and paper-based documentation in parallel. Mistakes in entering critical information can result in incomplete or incorrect goods descriptions, posing safety and compliance risks. The consequences of such errors include unsafe situations, lawsuits, significant fines, and financial losses. The manual handling and updating of documents are also time-consuming, causing inefficiencies that are especially problematic for time-sensitive air cargo. The question arises as, to why complete and successful e-Freight implementation i.e. having a complete paperless documentation process, is not yet reached within the air cargo supply chain.

Despite the recognized inefficiencies and the urge to eliminate paper documents in the current documentation process, no literature was found that focused on the documentation process of the air cargo supply chain. Consequently, there is an absence of an overview of existing barriers to the implementation of e-Freight in the air cargo supply chain. Also, there exists a scarcity of empirical studies within the air cargo supply chain. To close these gaps, the research aims to obtain an understanding of potential barriers to e-Freight implementation in the air cargo supply chain that are discussed in existing literature, categorize and classify these indicated potential barriers, gain insights on the current state of e-Freight implementation in the air cargo supply chain, identify what barriers, opportunities and potential solutions to complete e-Freight implementation are present at AirFrance-KLM Martinair Cargo (AFKLMP Cargo) according to practitioners and experts in the field, and eventually analyze the empirical findings from this thesis in relation to the insights gained from the literature exploration. Hence, the main goal of this research is to obtain the existing barriers to complete e-Freight implementation within AFKLMP Cargo by executing an empirical study. Given the context dependency and access to empirical data, this research will be performed at the organization AFKLMP Cargo. The following main research question has therefore been formulated:

''Which barriers, opportunities, and solutions can be identified to support the complete implementation of e-Freight at Air France-KLM Martinair Cargo?''

To address the research question, a theoretical conceptual barrier overview was developed by conducting a comprehensive review of a diverse range of literature due to the absence of literature within this specific research domain. The reviewed literature, therefore, included various types of barriers to change or innovation, sustainability innovation, digitalization, and paperless documentation. While some of the literature explicitly discussed adoption or implementation barriers, others focused on organizational or supply chain-related barriers. An in-depth single case study was conducted to attain empirical evidence and to obtain an understanding of the state-of-the-art, existing barriers, and potential solutions for complete e-

Freight adoption and implementation within an airline. The case study included multiple embedded units of analysis i.e. sub-cases on the e-Freight implementation status at different outstations within AFKLMP Cargo, ranging from Amsterdam to Singapore, to Los Angeles, to Lagos, to Lima, to arrive at a comprehensive overview of all implementation barriers present within the entire organization of AFKLMP Cargo.

To gain a comprehensive understanding of the innovation adoption and implementation barriers present within AFKLMP Cargo, e-Freight experts, middle managers, and employees from the operational core were consulted within this organization. Semi-structured interviews were conducted to gather information on the current state of the respective stations and to identify challenges recognized by e-Freight implementation experts and practitioners. Informal conversations with experts yielded additional sector-specific and organization-specific insights. Direct observations also supplemented the empirical evidence and were crucial to gain an accurate depiction of the exact documentation process and specifications on paper documents used.

To analyze the semi-structured interview transcripts, a bottom-up coding method was employed using the template analysis method, which is a semi-grounded theory approach. The established theoretical conceptual overview was used as a lens to look at the empirical outcomes, and a new empirical overview of barriers was constructed by replicating, combining, and creating final categories. From the semi-structured interviews, in total 21 barriers within the 7 main categories of organizational, social & cultural, economic & financial, technical/technological, market, regulatory, and standardization were identified. Subsequently, the direct observations and informal expert insights aided in the construction. In the table below, the identified barriers are listed.

Internal/ External	Barrier Main Category	Barrier Sub-Category	Direct Observations	Expert insights
Internal	Organizational Barriers	Insufficient communication channels	X	
		Deficient e-Freight project design	X	X
		Performance measurement gap	X	X
		Unsupportive organizational structure		X
		Lack of training, education and guidance	X	
	Social & Cultural Barriers	Lack of commitment from top management	X	X
		Organizational inertia	X	
		Cultural rigidity	X	
		Lack of qualified personnel		X
	Economic & Financial Barriers	Lack of budget allocation		X
Internal & External	Technical / Technological Barriers	Lack of technological integration	X	X
		Misaligned technology solutions		X
		Lack of infrastructure facilities	X	X
External	Market Barriers	Incorrect customer input	X	
		Conservative industry and attitudes	X	X
		Customer resistance to change		X
		Lack of competitiveness		X
		No collaboration with external partners		X
	Regulatory Barriers	Restricting regulations		X
		Missing or inadequate regulations		X
Trend	Standardization Barriers	Lack of standards	X	X

The findings indicate numerous barriers exist within and beyond the control of AFKLMP Cargo. While some being more pronounced than others, a complex coherence of interrelationships and interdependencies is recognized. The lack of industry standards regarding air cargo documentation even complexifies this coherence, leading to country specific restrictions and processes that counteract the complete implementation of e-Freight. This in turn, emphasizes opportunities regarding the acceptance of digital documents by local authorities, which provides a breakthrough for certain outstations while it opens up new possibilities and paves the way for complete e-Freight implementation. Moreover, the introduction of standards or internationally restricting regulations such as the Import Control System 2 (ICS2), is seen as a crucial step and opportunity towards standardized and unified digital documentation across the globe.

Another important challenge identified is the gap between the organization and the market as seen in the Figure. This gap refers to the lack of a shared understanding between the organization and customers regarding the (digital) document standards and versions. While the customers do not prioritize e-Freight and AFKLMP Cargo does not communicate effectively, no progress is being made. This gap is reinforced by the overall conservative attitude of the industry. The lack of effective communication can be attributed to several

Main categories semi-structured interviews

reasons, the origin being the lack of commitment from the top toward developing e-Freight. Within such an internationally decentralized multi-unit organization where strategic decisions are made by the top, their commitment is even more important. This is the core of the lack of structural action on e-Freight throughout the entire organization. The Acceptance Outstations Program (AOP) serves as a successful example of standardized implementation across outstations and presents a valuable opportunity for top management to allocate resources and establish an appropriate e-Freight project.

Due to the identification of a complex coherence of barriers, no silver bullet exists. Therefore, an adaptive and collaborative implementation approach is recommended by focusing on internal practices to solve external challenges. Starting with pilots and focusing on outstations with favorable external conditions is suggested to later expand when having success. Focus should be given to construct an engaging story and intrinsically motivate both within and outside the organization to get people moving. The win-win for all should be emphasized to arrive at collaborative actions. With the stakeholder interdependencies this collaboration is crucial to arrive at complete e-Freight implementation. Engaging in dialogue with customs and government officials to reconsider their stance on restrictive regulations is also recommended. To achieve success, it is important to take small steps and follow a structured and iterative process.

The scientific contribution of this research lies in its ability to generate substantial new knowledge and bridge knowledge gaps. Firstly, the study provides a theoretical overview

categorizing barriers to paperless documentation implementation, offering guidance for future research or practitioners in identifying barriers within the context of paperless documentation and the air cargo industry. Secondly, the study addresses the scarcity of empirical studies in the air cargo supply chain by providing an elaborate understanding of barriers, opportunities, and solutions on the implementation of e-Freight within AFKLMP Cargo's real-world setting. This contributes to knowledge on the air cargo documentation process and the state-of-the-art of e-Freight. Lastly, the study goes beyond surface-level and identifies additional theoretical explanations, such as the interplay between standardization implementation and decentralized organizations with bureaucratic elements. This generates new knowledge on the complexities of implementing standardization in such contexts, and provides a better understanding on underlying reasons for the lack of e-Freight implementation at AFKLMP Cargo. The findings serve as a foundation for future research to delve deeper into these theoretical explanations and explore their applicability in other organizational settings. Overall, this research advances the field by providing insights into e-Freight implementation and offering valuable contributions to academia, industry professionals and practitioners seeking to enhance the adoption of e-Freight initiatives.

The research findings indicate that while some aspects of the e-Freight implementation are applicable to the entire air cargo industry, others may require further testing. External characteristics such as industry practices and regulations are likely to be applicable industry-wide, while findings related to airlines show greater transferability due to shared stakeholder dependencies and organizational networks. However, the exact applicability of the findings should be assessed by comparing the context of each organization. Future research could therefore execute a comparative analysis with an organization in the air cargo supply chain to make more valid statements on the transferability.

This thesis identifies limitations and provides recommendations primarily stemming from the research methods employed. The recommendations address the need for future academic research to test, compare, or expand upon the results. Furthermore, recommendations are also provided for the specific case studied.

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LIST OF ABBREVIATIONS

Abbreviation	Full meaning
ACN:	Air Cargo Netherlands
AF:	Air France
AFKL:	Air France - KLM
AFKLMP:	AirFrance-KLM Martinair Cargo
AWB:	Air WayBill
BKD:	Confirmation Booking
BPI:	Business Process Improvements
CoSEM:	Complex System Engineering and Management
CSO:	Customer Service Organisation
DGD:	Dangerous Goods Declaration
EAP:	e-AWB shipment with accompanying documents or pouch
EAW:	e-AWB shipment without accompanying documents and without pouch
e-AWB:	Electronic Air WayBill, i.e. FWB
EDI:	Electronic Data Interchange
FF:	Freight Forwarder
FWB:	Freight WayBill – Electronic copy of MAWB, i.e. e-AWB
GHA:	Ground Handling Agent
IATA:	International Air Transport Association
KL:	IATA Airline Code for KLM
KLM:	Koninklijke Luchtvaart Maatschappij
KPI:	Key Performance Indicator
LAX:	IATA Airport Code for Los Angeles
LIM:	IATA Airport Code for Lima
LOS:	IATA Airport Code for Lagos
MAWB:	Master Air WayBill
MP:	IATA Airline Code for MartinAir
OPS:	Operations
SHC:	Special Handling Code
SIN:	IATA Airport Code for Singapore
SPL:	IATA Airport Code for Schiphol Airport
YYL:	IATA Airport Code for Toronto

DEFINITIONS

Name	Definition
AWB:	An Air Waybill (AWB) is a paper document issued by or on behalf of the shipper, serving as evidence of the contract between the shipper and airline(s) for the transportation of cargo along the routes operated by the airline(s)
Cargo:	Goods or commodities i.e. Freight
Carrier:	Airline
Consignment:	A collection of one or more pieces of goods that are received by an airline from a shipper at a single time and location, documented on a single air waybill or shipment record, and delivered to a single consignee at a designated destination address.
e-AWB:	A paperless document of the AWB i.e. FWB
e-Freight:	The complete paperless documentation of shipments
Freight:	Goods or commodities i.e. Cargo
Freight Forwarder:	A company or agent that organizes and facilitates the transportation of goods on behalf of shippers towards airlines.
FWB:	A paperless document of the AWB i.e. e-AWB
Goods:	Tangible items or products
Handling Agent:	A company or organization responsible for providing services and support on the ground for cargo operations at stations
Hub:	The central airports where all transportation routes converge and goods are transferred or distributed to different destinations.
Outstation:	All connected airports of AirFrance-KLM Martinair Cargo, except for the hubs
Product:	A tangible item within the shipments
Shipment:	The freight attached with its information
Shipper:	The party of entity that sends or delivers goods for transportation in the air cargo supply chain
Station:	Airport

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1. PROBLEM INTRODUCTION

1.1 CONTEXT

In recent years, demand for air cargo shipments made a major spurt due to growing Global Trade and an increased desire for fast transportation (Diefenbach, Erlemann, Lunin, Grosse, Schocke & Glock, 2021). Air cargo already accounted for more than 35% of total trade in 2006 and has since then grown at a yearly rate of approximately 4% (Chopra, 2021). This pattern was even exceeded in the last years, with cargo demand up to 9.4% in October 2021 compared to pre-COVID levels in October 2019 (IATA, 2021). While air cargo mainly consists of high-value goods that account for significant capital throughout transportation (Boeing, 2018), customers have strict demands. They request shipments to have short transportation times, while at the same time being reliable, safe, and secure. The combination of the growing number of shipments and the demanding needs of customers puts much pressure on the air cargo supply chain actors to find sufficient capacity and ensure safe, reliable, and efficient operations (Diefenbach et al., 2021).

Compliant, safe, and secure transportation requires much documentation and communication on the shipments between several stakeholders such as the shippers, the Freight Forwarders (FFs), the Ground Handling Agents (GHA), the customs authorities, the airlines, and the consignees. As indicated by IATA, a single shipment could generate a flow of up to 30 documents (2018). Hence, it is of great importance that all these stakeholders collaborate, to ensure that the documents contain correct information and comply with the imperatives of air cargo goods. In Figure 1, the multi-stakeholder network of the air cargo documentation process is presented. Appendix A shows a more precise indication of all document handovers.

Figure 1: Shipment journey with documentation (ECS Group, 2021)

However, in the current process, there are a lot of inefficiencies and errors due to the existence of 'traditional' paper-based documents and the simultaneous use of digital and paper-based documentation (Diefenbach et al, 2021). The manual work that comes with the handling of

traditional papers takes a long time and is prone to human errors (Ballen Prada & Prada, 2022; Civelek & Özalp, 2018; Diefenbach et al., 2021). Mistakes in entering critical information, such as incomplete or inaccurate descriptions, details, or dimensions of goods, can result in a variety of problems. Safety and compliance are the primary areas of concern as such errors could lead to unsafe situations, lawsuits, and significant fines. For the dimensions in specific, financial losses could be the result. Moreover, the manual handling and updating of documents can be a time-consuming process, which creates inefficiencies that are particularly undesirable for the time-sensitive goods transported by air.

Already in 2006, Nomura, Hutchins and Holder acknowledged that pressures existed to ''eliminate or reduce the use of 'oldfashioned' paper in air operations'' (2006). A couple of years later, in 2014, Pieters indicates that IATA even initiated a specific e-Freight project to achieve paperless air transport, with its end goal being the year 2015 (2014). Moreover, numerous players in the supply chain have included paperless transportation in their pillars, initiating various projects and efforts to implement paperless documentation, which can be found in Appendix C. All of these developments illustrate that digitizing cargo-related documents has been considered a paramount solution to the indicated shortcomings for already many years. The complete banning of hardcopies in the process and the adoption of only digital freight documents i.e. e-Freight is acknowledged as a crucial step toward an end-to-end digitally integrated supply chain collaboration resolving current issues (IATA, 2018).

However, the widespread and complete adoption and implementation of e-Freight has not been in practice up to the present, resulting in the simultaneous use of digital and paper (Diefenbach et al., 2021). This practice reinforces existing issues and inefficiencies, while it creates a fragmented and complex documentation flow (Civelek et al., 2017). Information may be input and recorded on multiple platforms, leading to inconsistencies and errors in data, and increasing the likelihood of critical information being missed, overlooked, or mis-entered. As a result, there is a lack of clarity and consistency in the process of handling digital and paper-based documents leading to incomplete, incorrect, or out-of-date documents (Diefenbach et al., 2021).

1.2 RESEARCH PROBLEM

Despite the inefficiencies that exist in the current documentation process in combination with the developed projects and initiatives, the recognized urge to eliminate paper documents for already many years, the advent of the internet and the development and spreading of electronic information systems (Panos, Kapnissis & Leligou, 2020), the implementation is quite slow in the air cargo industry compared to document digitization in the airline industry overall (Agrawal, Narain & Ullah, 2020) and complete implementation of e-Freight stays out (Ziakas, 2018). There is still a missing connection on how to make the transformation from using paper-based documents towards implementing complete paperless documentation work in practice (Sehlin, Truedsson & Cronemyr, 2019).

Therefore, the question arises what are the reasons for this lack of complete implementation? A possible reason could be the high level of complexity of e-Freight and its environment that makes complete implementation challenging, keeping the adoption rate low (Gausdal, Czachorowski & Solesvik, 2018). The socio-technical system of air cargo documentation is internationally dependent, involves multiple stakeholders, and includes a huge number of document types with their own requirements. This complexity makes complete implementation

challenging and requires cooperation among all parties in the supply chain as no individual actor has the ability and power to change the entire process. However, the cooperation among the different parties in the supply chain is currently at an insufficient level (Jović et al., 2022). Furthermore, the internally decentralized multi-unit structure of airlines also contributes to the difficulty of implementing such a standardization. The multi-unit structure adds another layer of complexity to the coordination and alignment of processes and practices across different units within the airline organization. This decentralized structure can hinder the uniform implementation of e-Freight standards and practices, requiring additional efforts to ensure consistency and integration.

Regardless of speculations regarding the reasons for the incomplete implementation of e-Freight in the air cargo supply chain, specific reasons for this failure have not yet been captured or summarized (see section 1.3). Thus, it is crucial to identify possible reasons for the failure of realizing complete paperless documentation to eventually determine suitable solutions to completely adopt and implement e-Freight in the air cargo supply chain. This can be achieved by identifying the barriers that impede the adoption and implementation of paperless documentation within the air cargo supply chain.

1.3 KNOWLEDGE GAP IDENTIFICATION

In the aviation industry, research is mainly focused on passenger transport as the core revenue of airlines comes from passenger flights (Wittmer, Bieger & Muller, 2013). As Nobert and Roy (1998) stated, airlines neglected research on the air cargo industry for a very long time and hence less research has been performed on cargo transport until today. Specifically on the air cargo supply chain, only a limited amount of research is found (Sieke, 2010; Vancroonenburg et al., 2014; Feng, Li and Shen, 2015; Zhang et al., 2017; Bierwirth & Schocke; 2017; Diefenbach, 2021; Kern, 2021). This literature mainly analyzed and considered theory without encompassing real data and falls short of meeting the practical requirements that are faced in real-world problems. Hence, most real-world problems remain unsatisfactorily solved in the air cargo supply chain. This is mainly due to the complexity of the processes and the many interconnected systems and players (Feng et al, 2015). However, one paper performed a practical case study on the GHAs process chain and considered real data. Shortcomings and countermeasures were indicated with an emphasis on digitalization (Diefenbach et al., 2021), but just for one stakeholder (GHA), and thus one part of the process was considered. Therefore, the first knowledge gap that can be identified is the scarcity of empirical studies within the air cargo supply chain.

Within existing literature on the air cargo industry and supply chain, some papers indicate the existence of shortcomings, inefficiencies, and uncertainties in the current data documentation and communication process, as already largely mentioned in section 1.1. This is due to the fact that; documentation still relies on paper (Bierwirth & Schocke, 2017; Berland, 2018; IATA, 2018; Diefenbach et al, 2021; Kern, 2021), paper and digital are used in parallel (Diefenbach et al., 2021) and there is a low digitalization grade (Bierwirth & Schocke, 2017; Freightos, 2019; Kern, 2021). In accumulation with the scarce amount of research on the air cargo supply chain (Hofmann & Osterwalder, 2017; Vural et al., 2020) and no research found precisely focusing on the documentation process in the air cargo supply chain, the relevance of executing a study on the reasons why this data documentation process contains inefficiencies and is still (partly) paper-based, is emphasized

Several studies indicated barriers to adopting paperless documentation in the transport and logistics sector and supply chain, such as barriers to paperless documentation in the maritime sector (Ziakas, 2018; Panos, Kapnissis & Leligou, 2020) or barriers to the implementation of international paperless trade (Laryea, 2005; Civelek et al., 2017; Bueno Rezende de Castro & Kornher, 2023), or transport and export documents (Ballen Prada & Prada, 2022; Roman, Pietrzak & Stolarczyk, 2022). However, only two papers indicated some hurdles to implementing paperless documentation in the air cargo supply chain specifically (Bierwirth & Schocke; 2017; Diefenbach, et al., 2021). No research yet provided an overview nor constructed a categorization or classification on the barriers to complete e-Freight implementation in the air cargo supply chain. Therefore, the last indicated main knowledge gap is the absence of an overview of existing barriers to the complete implementation of e-Freight in the air cargo supply chain. In addition, no solutions for indicated problems were suggested yet nor strategies that could overcome these barriers were constructed to realize the complete implementation of e-Freight.

1.4 RESEARCH SCOPE

As noted in the preceding section, the complete implementation of e-Freight in the air cargo supply chain lacks. Existing research neither gives an elaborate indication of the documentation process and its state-of-the-art nor explains why this lack of complete implementation persists or what measures can be taken to address it. Furthermore, there is a dearth of empirical studies within the air cargo domain. To bridge these gaps in knowledge, an empirical study investigating this issue is warranted. Executing a case study at an airline may be specifically relevant, while they play a crucial role within the documentation process and are often at the forefront of implementing new technologies and processes within the air cargo supply chain. It will allow for a deep understanding of the specific organizational context and the complex interactions among various stakeholders involved in the documentation process of the air cargo supply chain. Insights into the unique barriers and opportunities that exist within the airline's operations can be gained and shed light on the factors that may be hindering the complete implementation of e-Freight within the entire air cargo supply chain.

Therefore, the use case of this research is scoped to the context of one specific airline; Air France-KLM Martinair (AFKLMP) Cargo. This choice is made while a graduation internship is offered. Moreover, access to empirical data and the possibility to contact both employees and experts are provided. In Figure 2, a simplified visualization of the air cargo documentation process is displayed, along with the focus on the airline within this case, indicating their central role along with their interactions. The scope of this study is centered on the airline, covering not only its internal practices but also its external interactions with the industry and other external parties.

Figure 2: Simplified visualization of air cargo supply chain documentation process (IATA, 2018)

The international network in which AFKLMP Cargo operates is a Hub-and-Spoke network. To gain a comprehensive understanding of all barriers faced by the organization in implementing e-Freight, this study focuses on one hub airport (AMS) and several outstations located across different continents, big in size, and varying digital performances. This choice of different locations is made as AFKLMP Cargo transports all over the world and the processes and people in different areas represent and influence the organization's performance. In this way, a comprehensive overview of the potential barriers to complete paperless documentation implementation is indicated. Furthermore, as a lot of documents are handled within the air cargo supply chain, this research is bounded to the export cargo documentation process with a main focus on the most important transport document representing the contract of carriage: the AWB, thus e-AWB (i.e. FWB).

1.5 RESEARCH OBJECTIVES AND RESEARCH QUESTION

Considering the three indicated knowledge gaps and the identified scope of this thesis, the main objectives of this research are:
- Obtain an understanding of potential barriers to e-Freight implementation that are discussed in the existing literature
- Categorize and classify these indicated potential barriers to e-Freight implementation in the air cargo supply chain
- Gain insights on the current state of e-Freight implementation in the air cargo supply chain
- Identify what barriers, opportunities, and potential solutions to e-Freight implementation are present within the air cargo supply chain

In consideration of the three identified knowledge gaps and the main research objectives, the following main research question (MRQ) is formulated:
  ''Which barriers, opportunities, and solutions can be identified to support the complete implementation of e-Freight at Air France-KLM Martinair Cargo?''

To support answering the main research question, the following sub-research questions will be addressed:
1. *What is the state-of-the-art of e-Freight within the air cargo supply chain?*
2. *What are the potential barriers to e-Freight implementation in the air cargo supply chain and how can they be categorized?*
3. *What are the existing barriers to complete e-Freight implementation in the air cargo supply chain according employees, experts and observations from AFKLMP Cargo?*
4. *What are opportunities or potential solutions according to employees and experts from AFKLMP Cargo to mitigate or even overcome the barriers to support complete e-Freight implementation?*

1.6 RESEARCH APPROACH/METHODOLOGIES

To answer the formulated research questions and fill the first identified knowledge gap of the scarcity of empirical results within the air cargo supply chain, a case study approach is executed. First, a literature exploration is conducted to indicate potential barriers. To eventually arrive at the empirical results, interviews are conducted as the main research method.

The first sub-question will be answered by analyzing documents of AFKLMP Cargo, observing the processes, and asking respondents. The second sub-question will be answered by performing a thorough literature review and exploration of the barriers by considering four research topics, using the barrier approach. The literature search was done with specific attention to the identification of barriers and serves as a theoretical lens for the specific innovation at stake. Following, by using an inductive approach, the final conceptual theoretical overview can be constructed on the potential key barriers to e-Freight implementation in the air cargo industry. Finally, interviews with several employees and experts from AFKLMP Cargo will be conducted to answer the third and fourth sub-question. Practical insights will be provided into the applicability of the constructed conceptual overview by comparing it to empirical outcomes derived from the interviews. Direct observations and expert insights will aid in the construction of the empirical overview.

1.7 RELEVANCE

1.7.1 SCIENTIFIC RELEVANCE

The scientific relevance is already largely explained under section 1.3. To summarize, despite the significance of digitalization as a trend powerfully influencing the transport and logistics industry and supply chain in scientific papers, the literature tends to stay behind the practice in the air cargo supply chain (Hofmann & Osterwalder, 2017). Although a large number of studies focus on digitalization and its impact on transport efficiency, studies focusing specifically on the digitalization of the air cargo supply chain have been relatively scarce (Vural et al., 2020). However, while some papers do indicate inefficiencies, shortcomings, or barriers and propose countermeasures or suggest means of improvement (Bierwirth & Schocke, 2017; Diefenbach et al., 2021), no papers provide an overview of these barriers or address opportunities, solutions, or even potential strategies to overcome these barriers. Therefore, the main knowledge gap is the absence of an overview of existing contextual implementation barriers to realizing the complete implementation of e-Freight.

1.7.2 SOCIETAL RELEVANCE

Generally, it is of societal relevance to analyze the implementation of e-Freight as it is on the interface of the private and public domains. It eliminates tons of paper documents and enables new innovative services and solutions, serving public sustainability goals and at the same time increasing the value of air cargo to the whole business (IATA, 2018).

On the one hand, e-Freight implementation serves public sustainability goals as it leads to a huge amount of paper saved (Civelek & Özalp, 2018; Ziakas, 2018). It contributes to environmental sustainability by mitigating deforestation and reducing carbon footprint. From an ecologically conscious perspective, this minimized environmental impact is not to be undermined at all (Ziakas, 2018).

On the other hand, complete e-Freight implementation diminishes the current issues present and improves safety, efficiency and leads to cost savings (Ballen Prada & Prada, 2022; Carlan et al., 2016; Civelek et al., 2017; Civelek & Özalp, 2018; Nikolaeva et al., 2020). E-Freight could save costs related to printing, mailing, and storing paper documents (Bierwirth & Schocke, 2017; Civelek et al., 2017), attributable to both the elimination of papers and the

automation of the process (Nikolaeva et al., 2020). Due to the before mentioned substantial volume of documentation present in the air cargo supply chain, this change to paperless can yield a significant impact on costs.

Regarding efficiency, paperless documentation leads to time savings in operational tasks such as entering and processing shipment information and allows for better planning due to the transmission of data prior to the arrival of the goods (Bierwith & Schocke, 2017). Therefore, it improves efficiency by reducing the time and effort required to handle documentation. The enhanced simplicity and predictability (Nikolaeva et al., 2020) of the documentation process will mitigate the likelihood of errors (Civelek & Özalp, 2018) and causes speeding up the cargo while information can flow faster (Carlan et al., 2016). This results in a more convenient business process, fulfilling the imperatives of air cargo transportation, and increasing customer and employee satisfaction. In addition, by enabling the quick and easy exchange of information between actors present in the supply chain, safety can be enhanced. As Ziakas stated: ''a far higher level of security than will ever be possible with paper'' (2018).

Eventually, the insight into the barriers to e-Freight implementation could be used as a starting point to construct overcoming solutions and strategies, eventually realize complete implementation and reap all the above mentioned benefits of paperless documentation. Above all, in this way the air cargo industry can contribute to a more sustainable, efficient and safe global trade ecosystem.

1.7.3 RELEVANCE TO STUDY PROGRAMME

Furthermore, this can be considered a typical CoSEM issue as it is a complex issue in an interconnected world. The air cargo supply chain is part of the broader field of transportation, and as de Haan and de Heer (2015) mention, transportation issues have a significant impact on society since they affect many countries, people and organizations. As a result, these issues can be classified as global and complex. Due to the high level of complexity, not a single solution is available. Because air cargo specifically transports high-value goods at competitive prices with short delivery times to consumers worldwide, the challenges faced in air cargo operations translate to global and complex issues. Also, it is of multidisciplinary ground as it considers optimizing the supply chain (engineering) while it has to deal with several laws and regulations (social). All in all, the air cargo supply chain can be considered a complex, large-scale, interconnected, socio-technical system (Tsakalidis, Gkoumas & Pekar, 2020).

1.8 RESEARCH OUTLINE

The research outline is visualized in Figure 3, and consists of three main phases:
1. The conceptualization
2. The data collection
3. The data analysis and results

Chapter 1 commences with a context description, an identification of the research problem, along with existing knowledge gaps, and constructs research objectives and research questions. Also, the approach, scope, and relevance are being discussed.

Conceptualization

In Chapter 2, the conceptualization starts with an introduction to the selected research approach and presents the sub-questions and corresponding research methods employed. In Chapter 3, the barriers are explored by means of a literature review on four different search topics, followed by a more inductive approach combining literature with common sense on the air cargo supply chain to finally construct a conceptual theoretical overview of the potential barriers to complete e-Freight implementation in the air cargo supply chain. This overview will be used as a lens to look at the empirical findings. When looking at the direction of the arrows in Figure 3, the information flows from the conceptual overview straight into the data collection.

Data collection

By using the conceptual theoretical overview of the barriers as a lens, interviews are designed and conducted. An explanation of the construction of the interview questions, along with the selection of interviewees and the way of conducting them can be found in Chapter 2. Moreover, direct observations and informal expert conversations supplement the empirical findings.

Data analysis and results

In this phase, the empirical data is analyzed, and the interview transcripts in specifically are coded, leading to the main results. These insights are supplemented and validated by direct observations and expert insights. Two types of main results are found.
- Findings on the actual state-of-the-art of e-Freight implementation at AFKLMP Cargo
- Findings on the barriers experienced within AFKLMP Cargo to complete e-Freight implementation

Finally, the research is analyzed along with its implications in the discussion, followed by its conclusions and recommendations.
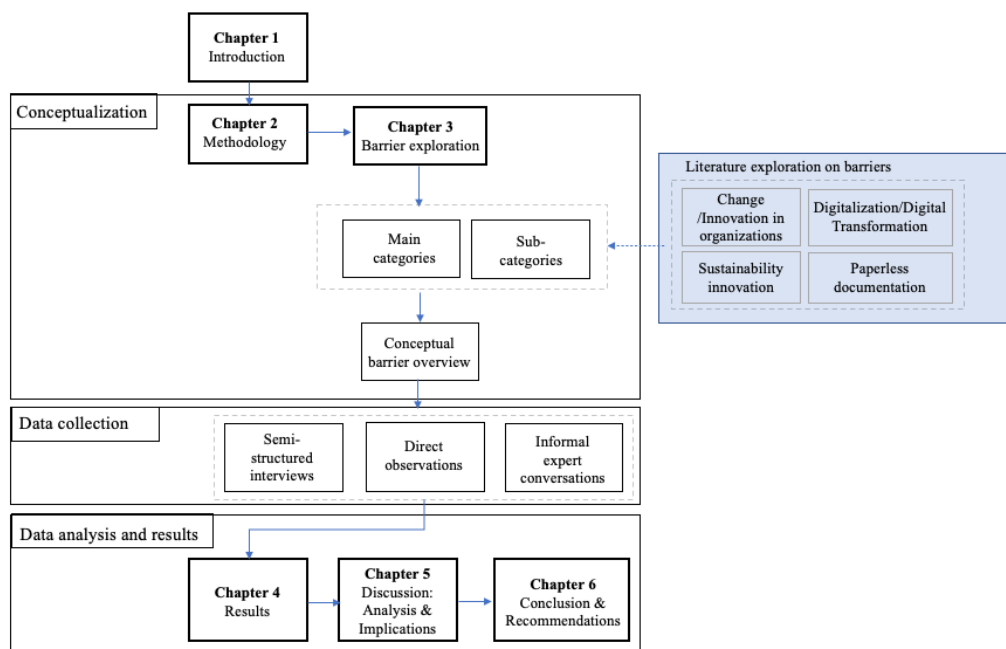
Figure 3: Thesis outline

1. METHODOLOGY

This chapter discusses the selected research approach and all methods used to perform this research. The main methodologies used are literature reviews (desk research), document analysis (desk research), direct observations (field research), semi-structured interviews (empirical data gathering), and informal expert conversations (empirical data gathering). For each of these indicated methodologies, the corresponding sub-questions are indicated.

2.1 RESEARCH APPROACH

This is a research of qualitative nature and will follow an exploratory and interpretive approach, while there is a lack of theory and real-time data within this research domain. The overall objective is to further understand why paperless documentation is not completely adopted and implemented in the air cargo supply chain. This research will attempt to discover new interesting insights by delving deeper into the research topic (Swedberg, 2020).

2.1.1 IN-DEPTH SINGLE CASE STUDY

A suitable approach to tackle this research question is an in-depth single case study with multiple embedded units of analysis i.e. sub-cases (Ketokivi & Choi, 2014). The case study research approach is particularly useful to apply when there is a need for an in-depth, multi-faceted understanding of a complex issue in its real-world setting (Crowe et al., 2011). Departing from the complex structure of the cargo supply chain that involves multiple geographical locations, documents, and actors with different interests and perspectives, a case study is ideal to extend the knowledge of such a complex phenomenon as it allows ''to focus on a 'case' and retain a holistic and real-world perspective'' (Ying, 2014). As indicated, this real-world perspective and gathering of practical real data will fit the first indicated knowledge gap, which can be found in Section 1.3. Furthermore, the barrier approach is used as a sub-approach when gathering data and focuses specifically on indicating barriers when exploring information. This approach is used to indicate the reasons for the lack of implementation of paperless documentation at the organization of AFKLMP Cargo and is chosen to identify the reasons for failure. This approach is further explained in Section 3.X.

2.1.2 MULTIPLE EMBEDDED UNITS OF ANALYSIS (MULTI-CASE)

In order to generate a broader appreciation of a particular issue (Crowe et al., 2011), namely the implementation of paperless cargo-related documentation covering the entire organization AFKLMP Cargo, a single in-depth case study (AFKLMP Cargo organization) consisting of multiple embedded units of analysis will be executed. This involves studying multiple stations simultaneously, not focusing on one single station or geographical context (Crowe et al., 2011). This is especially relevant within this use case, while the network in which AFKLMP Cargo operates is a so-called Hub-and-Spoke network. A Hub-and-Spoke network is a type of transportation network in which a central hub (i.e. airport) serves as a connecting point for several smaller spoke airports. In the context of AFKLMP Cargo, the hub airports serve as a main cargo transfer point, where cargo from multiple origins is consolidated and then sorted for onward transportation to its final destination. Therefore, to gain a comprehensive understanding of the barriers faced by the entire organization in implementing e-Freight, both

hubs and spokes need to be included in the research, while the hubs are central connection points that are dependent on these spoke airports. Further explanation on the Hub-and-Spoke network is given in Appendix A.

2.1.2.1 CASE SELECTION

To select these sub-cases, the diverse case-selection strategy i.e. diverse-case method will be used to achieve a maximum variance along all relevant dimensions of implementation (Gerring, 2006). As Gerring mentions, this method aims to involve a selection of a set of cases that represent the full range of possible values that exist (2007). In this thesis, a set of cases is selected that aims to represent the full range of possible barriers that exist within AFKLMP Cargo for the complete implementation of e-Freight. The initial decision was made to select a single hub and multiple outstations for the study, while a hub is the central connection point, and the performance of the hub is dependent on the spokes (i.e. outstations). The hub AMS was selected due to the opportunity to do an internship and the ease of obtaining empirical insights. For the outstations, the selection was based on the relevant dimensions of the degree of digitalization and thus digital performance, geographical location, and size.

While all outstations within AFKLMP Cargo are located in various areas, continents, and countries, it is important to select a set of cases differing in geographical location to capture the full range of possible implementation obstructions. Factors such as regulations and cultural differences could differ across different geographical locations. As the hub is located in the EU, the selection of the other subcases includes the areas: the USA, South America, Asia, and Africa. Regarding the digital performance, the outstations have been selected from within the above-mentioned areas based on their e-AWB performance, while this is the only available and reliable data regarding e-Freight performance among all stations that is captured within AFKLMP Cargo systems/dashboards. For the e-AWB performance, data from the #GoPaperless dashboard is analyzed and stations are selected based on: 1) the percentage of e-AWB contracted customers, 2) the percentage of e-AWBs handled. It must be noted that the following assumptions are made in order to indicate the digital performance 1) that e-AWB contracted customers actually provide e-AWBs, and 2) that AWBs, defined as e-AWBs by the Special Handing Codes (ECC/ECP) are actually handled as e-AWB. Furthermore, three categories have been identified and subsequently, stations have been selected within these categories. These categories (CATs) are the following:
1. A station that is (almost) 100% e-AWB (CAT 1)
2. Stations that are in progress where paper and digital are used in parallel (50/50) (CAT 2)
3. A station where all documentation is completely paper-based (CAT 3)

This specific diverse selection of outstations allows to investigate a representative range of stations; good performing, regular-performing, and bad-performing stations regarding the implementation of paperless documentation. By investigating these diverse cases, an all-encompassing overview of the adoption and implementation barriers, opportunities, and potential solutions will be created that will be applicable to the entire organization AFKLMP Cargo and allows for a more complete indication of existing barriers within. Subsequently, the focus was directed toward selecting outstations with larger sizes. Such outstations generally

have more complex operations, which have a greater impact on the overall performance of the organization, making them more influential in the adoption of e-Freight. Multiple stations from the identified areas were compared based on the amount of AWBs handled in the same period of time, and the station with the correct digital performance of within the appointed CAT and most AWBs handled was chosen. The following stations were included in Table 1 and a visualization can be found in Appendix A.

	Origin station	Area	AWBs	e-AWBs	e-AWB %	non-eAWBs	CAT
Hub	Amsterdam Schiphol Airport (AMS/SPL)	Europe	12523	11953	95.4%	570	HUB
Outstation	Singapore (SIN)	Asia	1293	11283	99.2%	10	CAT 1
	Los Angeles (LAX)	USA	1750	1173	67%	577	CAT 2
	Lima (LIM)	South America	663	328	49.5%	335	CAT 2
	Lagos (LOS)	Africa	172	0	0%	172	CAT 3

Table 1: Selected stations with their selection criteria

The advantage of a multi-case approach is that it allows comparisons to be made across several cases and replication (Crowe et al., 2011). As Ying (2014) recommends screening the cases thoroughly to guarantee particular relevance to the issues of concern as well as the use of replication logic, carefully selecting multiple sub-cases will provide a stronger substantiation of the generated overview on found barriers, opportunities and proposed solutions for generalization to the whole organization or even to other organizations. The indication of the level of replication according to these cases will examine whether the framework will be applicable to the whole organization. In addition, acquiring an understanding of the organization and country characteristics that impact the degree of perceived barriers can improve our comprehension of the innovative process at the organizational level (Hölzl & Janger, 2012). This information can then inform the development of more effective innovation policies, strategies, or action points for AFKLMP Cargo.

However, in the research at hand, practical limitations in attaining an in-depth understanding of several cases could arise. The volume of data together with the time constraints, could impact the depth of analysis that is achievable (Crowe et al., 2011). Attention should be given to avoid the urge of acquiring as much data as possible to gain a complete overview. Sufficient time must be set aside to analyze and interpret data that often has a high level of complexity.

2.3 RESEARCH METHODS

In this section, all research methods used will be discussed based on both data gathering methods and data analysis methods. The main data-gathering methodologies used are literature review (desk research), document analysis (desk research), semi-structured interviews (empirical data gathering), direct observations (field research), and informal expert conversations (empirical data gathering). The case study relies on multiple sources of evidence, with data converging in a triangulation fashion (Yin, 1984). The data analysis method that will be performed is the template analysis method in combination with the content analysis by means of the software tool ATLAS.ti.

2.3.1 DATA GATHERING METHODS

The main data-gathering methods that are being used in this thesis are; a literature review, document analysis, semi-structured interviews, direct observations, and informal expert conversations. The choice of these methods and the way in which they are used, approached, and executed will be explained. Also, advantages and potential downsides are being discussed.

2.3.1.1 LITERATURE REVIEW

To answer several sub-questions (SQs) stated in this research, the literature review method was used. In this sub-chapter, the contribution of the literature review is outlined and the way in which the literature review was conducted is explained. Next to the SQs stated in this research, additional SQs were formulated in advance of the research to arrive at the present knowledge gaps. Therefore, two literature reviews were executed within this study and answer the following SQs:

Knowledge gap SQs:
1. *What scientific literature already exist on the air cargo supply chain?*
2. *What scientific literature already exist on the digitalization of data documentation and communication within the air cargo industry?*
3. *What scientific literature already exist on barriers, opportunities, and strategies for paperless documentation?*

2. *What are the potential barriers to e-Freight implementation in the air cargo supply chain and how can they be categorized?*
   a. *What are the barriers to the implementation of change or innovations (in organizations) according to theory?*
   b. *What are the barriers to the implementation of sustainable innovations (in organizations) according to theory?*
   c. *What are the barriers to digitalization or digital transformation in the transport or logistics supply chain?*
   d. *What are the barriers to paperless documentation in the transport or logistics supply chain?*

As distinguished by the color of the questions, it is indicated that two separate literature reviews were done. The first aim is to identify knowledge gaps within existing literature and define the direction and scope of this research. The relevance of executing this study on the air cargo supply chain with emphasis on the digitalization of the documentation process, and finally identifying barriers was indicated.

The second is to arrive at the potential barriers present within the literature and employs the barrier approach as a method to search within the literature. This entails that the researcher explores and analyses literature to identify factors, challenges or limitations that act as barriers to change or innovative activities. By examining the literature through the lens of barriers, insights are gained into the potential reasons of a lack of adoption or implementation. With this

approach, this second review aims to identify potential and state-of-the-art barriers to achieving complete paperless documentation/e-Freight in the air cargo supply chain. Since the literature on barriers to implementing e-Freight in the air cargo supply chain is limited, literature on other potential barriers was included in this literature exploration. Additional literature was explored on barriers that exist when implementing change, innovation, sustainable innovation, or document digitalization. Also, literature was searched on barriers to implementing e-Freight i.e. paperless documentation in the entire logistics supply chain. Finally, this review and exploration aims to construct an initial conceptual theoretical overview of all potential barriers to e-Freight implementation and will be used as a (theoretical) lens to look at/test the empirical data results that are derived from the interviews.

Literature review approach

As indicated, two separate literature reviews were executed. The first one is to identify the knowledge gaps that are present within the existing scientific literature, and the second one is to understand what could be potential barriers to e-Freight implementation. For both literature reviews, the essential data will be acquired through conducting a literature review not only on academic literature but also on grey literature. The grey literature was needed in this research because too little scientific research is available on the barriers to implementing e-Freight in the air cargo supply chain. By reviewing and exploring both academic and grey literature, existing sources from a wide range of fields will be gathered (Nakano & Muniz, 2018). This entails the gathering of data that is already produced and captured by others. The data will be obtained through academic and grey, open, and protected sources.

Regarding the academic literature, peer-reviewed sources will be collected from databases such as Google Scholar, SCOPUS, and Science Direct by conducting a systematic literature review (SLR). A structured strategy was executed, using the electronic sourcing databases with the manuscript language restricted to English. This research used keywords and search terms in combination with Boolean operators to define search strings. These search strings led to the identification of studies, which needed to be scoped down. This process of scoping down is called the process of screening. Article titles and abstracts were selected with a focus on certain keywords. Next, in the eligibility phase literature was evaluated in more detail by ''forward-'' and ''backward snowballing''. Through this technique of the identification of references from the already selected literature, new relevant literature was obtained (Jalali & Wohlin, 2012). The most outdated source that is used is from 1984 and the most recent one is from 2023 To give an idea of the above-described selection process, the selection process that was used to arrive at the knowledge gaps along with its defined search string is displayed in Figure 4. Similar processes were executed to answer SQs 2abcd. The main research topics and their corresponding search terms to answer the SQs 2abcd i.e. the second literature review, are displayed in Table 2. As just mentioned, the literature is explored by using the barrier approach as a lens to search within literature and indicate reasons for the failure of adoption and implementation of change or innovative activities. A specific focus is given to barriers within the indicated papers.
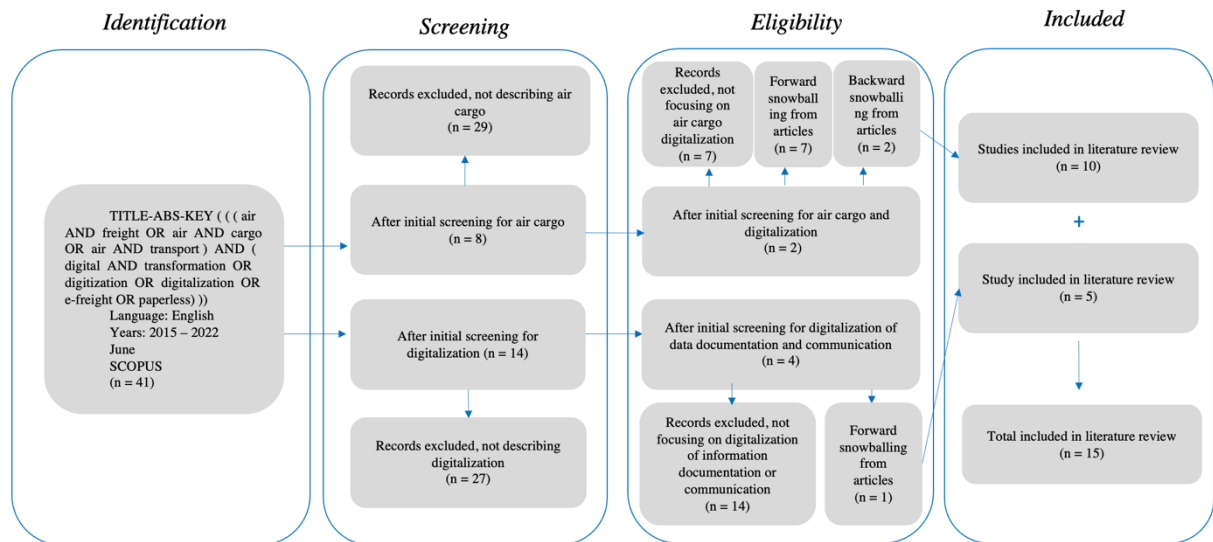
Figure 4 – Literature selection strategy of first search string

Research Topics	Search terms
Barriers to change/innovation	''barrier'', ''change'', ''innovation'', ''organization'', ''firms'', ''barrier and change or innovation'', ''barrier and change or innovation and organization or firm'',
Barriers to sustainable innovation	''barrier'', ''sustainability'', ''sustainable'', ''innovation'', ''supply chain'', ''barrier and sustainability or sustainable'', ''barrier and sustainability or sustainable and innovation or supply chain''
Barriers to digitalization/digitization/digital transformation (DT) in entire transport and logistics supply chain:	''digitalization'', ''digital transformation'', ''digitization'', ''supply chain'', ''freight'', ''cargo'', ''transport'', ''digitalization or digital transformation or digitization and supply chain or freight or cargo or transport''
Digitalization of documentation/paperless documentation	''paperless'', ''paperless trade'', ''document'', ''documentation'', ''electronic'', ''digital'', ''paperless or paperless trade or digital or electronic and document or documentation''

Table 2 – Research topics and search terms

The grey literature will be searched on the internet or within the company to find governmental reports on regulation, policy documents, IATA papers, company-specific documents such as company memos and annual reports, websites, or newspapers. The grey literature was needed in this research because too little scientific research is available on the barriers to the implementation of e-Freight in the air cargo supply chain.

By making use of this already captured data as input for the research, a lot of time and effort can be saved. However, a limitation of solely executing a literature review is that the researcher is confined to existing sources, which may be incomplete (Hox & Boeije, 2004). However, in the following phase of this research, interviews will be conducted, direct observations and expert insights will supplement the observed data, resolving this limitation.

From this explored literature, both a theoretical barrier overview and a conceptual model are constructed. The conceptual theoretical barrier overview indicates what barriers could potentially exist, while the conceptual model visualizes where the barriers take place and how

this is coupled to the categorization. The construction of this overview is explained in Chapter 3.2.

2.3.1.2 DOCUMENT ANALYSIS

Document analysis provides insights on the state-of-the-art of e-Freight in the air cargo supply chain within the organization of AFKLMP Cargo. Multiple documents from within the organization are analyzed to gain a deeper understanding of the document handling processes, documentation types, digital possibilities of the documentation types, and already initiated e-AWB projects. In Appendix B an overview is given of the existing document types.

Content analysis was performed to systematically examine the content of all documents to identify the state of e-AWB within AFKLMP Cargo.

2.3.1.3 SEMI-STRUCTURED INTERVIEWS

The semi-structured interviews method will answer the following SQs:
1. *What is the state-of-the-art of e-Freight within the air cargo supply chain?*
3. *What are the existing barriers to complete e-Freight implementation in the air cargo supply chain according to employees, experts and observations from AFKLMP Cargo?*
4. *What are opportunities or potential solutions according to employees and experts from AFKLMP Cargo to mitigate or even overcome the barriers to support complete e-Freight implementation?*

Semi-structured interviews will be conducted for five different cases with carefully selected respondents that are important for the implementation of e-Freight, ranging from e-Freight experts to middle managers to employees from the operational core of the selected cases. These respondents will be interviewed about their specific role, the current situation at their specific station, past and present barriers they experience, what they think are potential opportunities to take a step in the direction of e-Freight implementation, and their view on potential solutions to overcome the indicated barriers. This will ensure the obtainment of in-depth information on the experience and expertise of the people working in the field of the respective cases (Evans & Lewis, 2017). Semi-structured interviews are therefore suitable to gain expert's and practitioners' opinions and insights on a subject at hand (Gill, Stewart, Treasure & Chadwick, 2008), highlight joint emerging ideas (Creswell & Poth, 2016) as well as detect issues that are not previously covered in the literature (Campbell, Moy, Feibelmann, Weissman & Blumenthal, 2004). The empirical data obtained through the interviews and thus the opinions and experience of AFKLMP Cargo experts, managers, and staff will be used to test the findings from the literature review on potential barriers to e-Freight implementation in the air cargo industry. The semi-structured interviews will provide parts of the empirical findings for the comparative analysis between the empirical results and the theory (Siems & Seuring, 2021).

The semi-structured outline was chosen for the interviews since it contains standardized questions to start the discussion, and continues with unstructured interactions that allow for in-depth information sharing on the subject (Saunders, Lewis & Thornhill, 2016). All interviews are executed in an open and flexible manner to allow for a broad perspective of answers, but a specific focus will be maintained by using an interview guide. This allows to both address pre-

determined questions and verify empirical expectations, and identify additional context-dependent real-world issues by asking follow-up questions.

The approach has downsides due to the time required to set appointments with participants, create an interview procedure, and execute the transcription and coding of open questions (Folkestad, 2008). The presumably gleaned insights, however, outweigh this limitation.

Interview population
The semi-structured interview respondents were carefully selected to assist the investigator in the case studies and collect a range of opinions and experiences (Longhurst, 2003). They are selected based on their knowledge and experience in the air cargo documentation process, particularly on their critical roles in implementing e-Freight within AFKLMP Cargo. By including the e-Freight experts, middle managers, and operational core, it is possible to gain a better understanding of the practical challenges that may arise during the implementation of e-Freight. They can provide valuable insights into the day-to-day operations of the organization and identify barriers that hinder the complete implementation of e-Freight. As already mentioned, respondents range from internal e-Freight experts to middle managers to staff from the operational core of the organization AFKLMP Cargo. These function categories were derived from the book of Mintzberg (1979), who emphasizes the role of these functions in the implementation of change in organizations. Since this research is mainly exploratory and holistic, it is essential to gather data and involve all mentioned respondents in order to get a complete picture of the existing barriers to implementing e-Freight.

E-Freight experts
Including e-Freight experts as respondents is important because they have specialized knowledge and experience in the field. They have a deep understanding of technical, operational, regulatory, financial, social, and organizational aspects of e-Freight, which makes them a paramount input on the barriers that could obstruct complete implementation. They can mainly provide valuable input on the technical feasibility and could indicate potential technological barriers that could impact the complete implementation. Also, they can provide insights into the regulatory environment. They have a rather overarching view of all barriers that could obstruct the complete implementation of e-Freight.

Middle managers
It is important to interview middle managers because they play a crucial role in the complete implementation of e-Freight. They are responsible for translating the strategy of top-level managers into realistic action plans for the operational core to execute. By doing so, they bridge the gap between strategic decisions and their execution, ensuring that plans are feasible, practical, and aligned with organizational goals. They have a unique perspective on the implementation process and are thus able to identify important barriers to implementation. They can provide valuable insights on the specific barriers that are present during the implementation phase, while they oversee the day-to-day operations and are close to the actual implementation. At the same time, they have insights into the strategic goals and see whether gaps exist between the strategies and implementation practices. Due to this unique perspective of having insights into both the strategies from top management and the day-to-day operations, middle managers are able to come up with feasible solutions for failing project implementation.

Operational core

The operational core, in turn, is responsible for executing the plans. The main departments included as respondents from this operational core to implement e-Freight are the operational (OPS) department and the customer service (CSO) department. The OPS department executes the process and physically handles the papers, while the CSO department communicates with the customers who provide the document input.

OPS:

It is important to interview practitioners and operational staff that are directly involved in the process at the operational level because they have direct, hands-on insight into the implementation process. They are responsible for executing the actions associated with e-Freight implementation and often have a detailed understanding on the specific challenges and opportunities regarding the executive tasks. On the operational level, valuable insights can be derived into the practical barriers, while problems are really felt in their day-to-day tasks. Their views are important to understand the implementation process from a bottom-up perspective.

CSO:

Interviewing customer service is important because they are frontline staff who interact directly with customers and are therefore in the best position to understand the challenges that will be faced by customers when implementing e-Freight.

International respondents

Subsequently, respondents from these function groups were selected within the different included cases/stations in order to provide insights on the implementation throughout different geographical locations. This approach includes the influence of cultural and environmental factors on the implementation process.

This selection of stations leads to a wide variety of international people with different languages, cultures, norms, and values. This could result in both advantages and disadvantages. An advantage is that it fulfills the aim of this thesis to study the most diverse cases and comes as close as possible to represent the full range of possible barriers. However, a disadvantage could be the presence of a language barrier. This could lead to multiple forms of miscommunication or reduced productivity. Interviewees may encounter difficulties expressing themselves in English, which can result in challenges in conveying their intended meaning. In addition, they may struggle to comprehend questions accurately due to a limited understanding of the language. Finally, there is a possibility that the speaker's dialect may impede the investigator's comprehension of the intended message. This needs to be taken into account when selecting the respondents and while conducting the interviews. Therefore, research is done in advance to try to select people that have developed English skills. People from the following cities and continents were interviewed:

- Amsterdam (Europe)
- Singapore (Asia)
- Los Angeles (USA)
- Lima (South America)
- Lagos (Africa)

Selected respondents

For each included station, respondents are interviewed from AFKLMP Cargo with the following varying job positions:

- Area Operating Director (AOD) – Middle management
- Market Manager (MT) – Middle management
- Operations Manager & Staff (OPS) – Operational core (high level)
- Customer Service Manager & Staff (CSO) – Operational core (high level)

In addition, while all respondents are from one organization (AFKLMP Cargo), two additional external respondents were included to check the answers, and partly validate the perceptions of the AFKLMP Cargo respondents on the external environment. However, these interviews were not coded and were solely used to check and partly validate the empirical outcomes from within the organization. The following

- Ground Handling Agent (GHA)
- Customer (FF)

Overall, respondents are selected within the local practice with a total of 19 participants. All important functions and management levels for the implementation are included. The respondents are listed in Table 3, along with their interview ID, job function, and link to the according management level.

Interview ID	Function	Management level	Station
[1]	Area Operations Director (AOD)	Middle Manager	LAX
[2]	Operations Manager (OPS)	Operational core (high)	LAX
[3]	Operations Manager (OPS)	Operational core (high)	LAX
[4]	Market Manager (MT)	Middle Manager	LAX
[5]	Operations Manager (OPS)	Operational core (high)	LIM
[6]	Market Manager (MT)	Middle Manager	LIM
[7]	Market Manager (MT)	Middle Manager	LIM
[8]	Customer Service Manager (CSO)	Operational core (high)	LIM
[9]	Area Operations Director (AOD)	Middle Manager	SIN
[10]	Market Manager (MT)	Middle Manager	SIN
[11]	Customer Service Manager (CSO)	Operational core (high)	SIN
[12]	Operations Manager (OPS)	Operational core (high)	SIN
[13]	Operations Manager (OPS)	Operational core (high)	LOS
[14]	Customer Service Manager (CSO)	Operational core (high)	LOS
[15]	Former Digital Operations (OPS) responsible	E-Freight expert	SPL
[16]	Former Program Manager Paperless	E-Freight expert	SPL
[17]	Digital Operations (OPS) Manager	E-Freight expert	SPL
[18]	Freight Forwarder (customer)	External	LAX
[19]	Ground Handling Agent	Operational core (external)	LAX

Table 3: Respondents with their functions, management levels, and station origins

Interview scheduling

To schedule these interviews, the connections established during the previous internship at AFKLMP Cargo at the AMS hub will be utilized. The interviewees are all from AFKLMP

Cargo, but they are not located at one station or location. As a result, most of the interviews will be arranged and conducted online since they are scattered worldwide. However, given the time and resources available for this graduation internship, it is feasible to conduct a site visit to one of the cases or stations. As a result, a visit to Singapore Airport will be arranged, where all of the respondents listed previously will be interviewed in person. To supplement the empirical data collected through direct observation of the process, a tour of the warehouse will also be conducted. Additionally, every effort will be made to arrange face-to-face interviews with respondents from the other stations. Appendix D, an overview can be found on the interview scheduling process.

Interview Preparation

One of the most significant and critical aspects of preparing semi-structured interviews is the construction of effective interview research questions (Turner, 2010). When constructing these questions, several main requirements need to be taken into consideration: '' (1) the questions must have an open end, (2) there must be neutrality in the questions, (3) only one question should be asked at the time, (4) the wording should be clear in the questions, (5) and lastly, "why"-question should be asked only when strictly necessary'' (McNamara, 2019). A tailor-made interview guide with interview questions was created for all separate job positions with special attention to these requirements when constructing and conducting these interviews. The constructed research questions will be used at the start of the conversation, and follow-up questions may be asked after by executing verbal or non-verbal probing techniques (Kallio et al., 2016). Verbal probing, as suggested by Whiting (2008), can be utilized by reflecting on the interviewee's viewpoint or expressing interest in their expertise. Nonverbal probing, on the other hand, involves maintaining silence and allowing the interviewee to vocalize their thoughts (Whiting, 2008). In obtaining unbiased opinions from the interviewees, both verbal and nonverbal probes were employed. The interview questions are provided in Appendix D, and a Data Management Plan (DMP) was also established to govern data storage and management throughout the project, as well as to outline what happens to the data after the project.

2.3.1.4 DIRECT OBSERVATIONS

Direct observations will supplement the following SQs:
1. *What is the state-of-the-art of e-Freight within the air cargo supply chain?*
2. *What are the potential barriers to e-Freight implementation in the air cargo supply chain and how can they be categorized?*
3. *What are the existing barriers to complete e-Freight implementation in the air cargo supply chain according employees, experts and observations from AFKLMP Cargo?*
4. *What are opportunities or potential solutions according to employees and experts from AFKLMP Cargo to mitigate or even overcome the barriers to support complete e-Freight implementation?*

Long-term direct observations internship

As a result of a preceding internship completed at the SPL hub of AFKLMP Cargo and the ensuing graduation internship, a certain amount of knowledge on the specific research topic had already been acquired, with additional insights gathered through direct observations during the thesis execution.

Live site visits

In addition to the already gained knowledge on the specific research topic, live site visits were executed at two stations: Amsterdam Schiphol Airport (AMS/SPL) and Singapore (SIN).

As previously mentioned, conducting interviews with the operational core is of utmost importance, much like doing physical live visits. This will lead to gaining a true understanding of the operational documentation processes and related issues. This is essential for providing an accurate depiction of the process steps and paper documents used, as theory and interviews may not always align with the actual situation. Seeing the process firsthand is crucial in obtaining a realistic overview, and is necessary for accurately identifying the root of the problem and developing customized and practical solutions. Moreover, the researcher recognized the significance of this approach through personal experience.

The analysis encompassed visits to and evaluation of two distinct locations to avoid narrow-mindedness concerning a single situation or process. During the site visit to AMS, the researcher met with the "Shift Leader" and "Unit Manager" of the documentation department, and a comprehensive understanding of the current documentation process was obtained through a tour of the department. In Appendix E, some observations of this on-site visit can be found in a logbook. During the site visit to SIN, the researcher met with all respective respondents from SIN to execute the semi-structured interviews in real life. Also, the OPS Manager provided a tour through the warehouse where the documentation process was shown and explained. Similarly, in Appendix E, observations of this visit can be found in a logbook.

2.3.1.5   INFORMAL EXPERT CONVERSATIONS

Informal expert conversations will supplement the following SQs:

1. *What is the state-of-the-art of e-Freight within the air cargo supply chain?*
2. *What are the existing barriers to complete e-Freight implementation in the air cargo supply chain according employees, experts and observations from AFKLMP Cargo?*
3. *What are opportunities or potential solutions according to employees and experts from AFKLMP Cargo to mitigate or even overcome the barriers to support complete e-Freight implementation?*

Initially, conducting exploratory informal conversations with AFKLMP Cargo e-Freight experts will facilitate the acquisition of knowledge and foster a deeper comprehension of e-Freight specifications and implementation. This information will be employed to effectively define the scope of the project, establish the AFKLMP Cargo company case, and appropriately select diverse sub-cases for subsequent analysis. Furthermore, the discussions will yield more sector-specific (airfreight) and organization-specific (AFKLMP Cargo) insights regarding the barriers, opportunities, and potential solutions for accomplishing e-Freight implementation.

The e-Freight experts from AFKLMP Cargo who will provide the necessary information hold the position of "Digital Operations (OPS) responsible" within the organization.

2.3.2. DATA ANALYSIS METHOD

2.3.2.1 QUALITATIVE DATA ANALYSIS

While qualitative research is not executed according to set steps, a combination of different analysis methods is used. There are multiple different methods, templates and theories which can be combined and applied. Therefore, the process presents a combination of the way Ravasi (2022) explained how to analyze case studies with the use of retroduction to interpret the empirical findings in the discussion. A combination of looking at empirical data with a theoretical lens, and theorizing again from the empirical findings was executed.

2.3.2.2 SEMI-STRUCTURED INTERVIEW TRANSCRIPTS

The data analysis method will be performed to gain insights on the following topics, mainly derived from the interviews:
- Findings on the actual state of the art of e-Freight implementation at AFKLMP Cargo
- Findings on the barriers experienced within AFKLMP Cargo
- Findings on the interviewees' perceived opportunities to implement e-Freight
- Findings on potential solutions interviewees proposed to overcome the indicated barriers

The conducted interviews are transcribed and coding is performed to allow analysis on the text. To this end, the ATLAS.ti software tool is utilized for coding and further examination of the interviews. To arrive at an overview of all empirical barriers mentioned as well as indicating their occurrence and thus relevance, a qualitative data analysis is performed. A systematic combining technique (Dubois & Gadde, 2022) is used to analyze the semi-structured interview transcripts. The bottom-up template analysis method was employed to arrive at the construction of main and sub-barriers together with content analysis to indicate their significance.

When coding the empirical results of the semi-structured interviews, the conceptual theoretical model was used as a lens to identify barrier categories. It became clear that with the top-down method of coding the interviews, it was difficult to directly couple the answers of respondents to the identified categories mentioned in the literature. The answers of respondents were differently interpretable, there was overlap, and some answers were not clearly exclusive. Therefore, a semi-grounded theory approach, known as the template analysis method, was employed for the coding process, using a bottom-up method with open codes. The conceptual theoretical overview was used to guide the coding of the data, and open coding was conducted with reference to the concepts of the overview. The open codes were then classified into categories using the conceptual theoretical overview as a basis and lens, the 2nd order codes. This classification involved re-categorizing some codes under already identified categories, assigning open codes to already identified categories, merging codes to create new categories, and adding some categories. Following, the 2nd order codes were categorized within the main categories as 3rd order codes, again using the conceptual overview as a lens. Finally, the 4th order codes

- 1st order codes: descriptive open coding
- 2nd order codes: categorized with the conceptual theoretical model as a lens
- 3rd order: main categorization
- 4th order: main category (Internal/External)
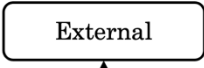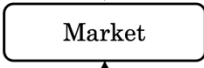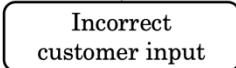
Total	Order	Coding example		
4	4th order codes	Axial	External	
7	3rd order codes	Axial	Market	
21	2nd order codes	Axial	Incorrect customer input	
197	1st order open codes	Descriptive	Incorrect AWB information	Inconsistency in data exchange

Figure 5: Coding scheme

Subsequently, content analysis was performed to analyze the frequency of codes and categories identified through the bottom-up coding method. This analysis determines the number of occurrences of these codes and categories mentioned by the respondents (Johannesson & Perjons, 2014). The results of this analysis will be used to make statements about the prevalence of barriers identified by the respondents.

The aim of constructing an overview of these barriers is to provide a theoretical and evidence-based tool for AFKLMP Cargo, and specifically Digital OPS responsible, to indicate the root cause of the failure of complete e-Freight implementation and use it as a base to indicate solutions or construct tailor-made strategies. The indicated opportunities or potential solutions or strategies can also be used as a starting point to actually construct strategies.

3. BARRIER EXPLORATION

This chapter aims to construct an overview of potential barriers to e-Freight adoption and implementation. In Chapter 3.1 the barrier approach of specifically searching for hindering factors in literature is explained, along with the barrier identification and research topics reviewed in the literature. Following in Chapter 3.2, the main categories of potential barriers are indicated through a literature review. Eventually, a final conceptual theoretical overview of the included main- and sub-barrier categories will be identified through a more inductive approach and additional help of direct observations and expert insights.

3.1 LITERATURE REVIEW: BARRIER APPROACH

Despite multiple attempts to implement e-Freight through various projects and initiatives as indicated in Appendix A, these efforts have thus far proved unsuccessful. Consequently, it is crucial to initially identify the underlying causes of these failures, when aiming to overcome and arrive at successful implementation eventually. To find out what are potential reasons for the lack of complete adoption and implementation of a change, the barrier approach was used as a search focus when exploring the literature. The "barrier approach" as a search method (e.g., Hadjimanolis, 2003; Piatier, 1984) aims to search for factors that impede or hamper innovative activities (Sandberg & Aarikka-Stenroos, 2014; Hölzl & Janger, 2012). This approach was used as a lens to explore and analyze the literature and emphasizes the focus on searching for barriers in literature in specific.

The barrier approach is especially useful because it enables the identification of specific bottlenecks among the numerous factors that potentially affect the adoption and implementation of the specific innovative activity (Hölzl & Janger, 2012). The barriers can be used as a starting point to finally arrive at tailored solutions or construct strategies to overcome them. Furthermore, barriers can be seen as beneficial as they eliminate unrealistic innovation projects and aid in the allocation of resources (Hölzl & Janger, 2012). This provides an opportunity to refine and adjust project plans to increase the chances of successful implementation. Importantly, barriers are not solely roadblocks to progress, but they can also present or unlock the identification of opportunities. By identifying barriers, organizations can leverage them as catalysts for change or innovative activities.

Consequently, identifying barriers is crucial for recognizing the unmet imperatives of innovative activity at both the organizational and ecosystem levels. By focusing on barriers, organizations can pinpoint specific areas that require attention and develop targeted solutions or strategies to overcome them. This proactive approach enables organizations to transform barriers into opportunities and drive successful implementation. Therefore, it is paramount to thoroughly search for barriers and construct a comprehensive overview of potential obstacles. This process lays the foundation for identifying opportunities and crafting suitable solutions or strategies to overcome the identified barriers. By taking this approach, organizations can effectively navigate the challenges associated with innovation and maximize their chances of success.

Next, the specific terms utilized in this thesis to identify the barriers were set out. In addition, while there is a lack of literature on barriers to e-Freight implementation in the air cargo industry, all research topics included in the literature search were illuminated.

3.1.1 BARRIER IDENTIFICATION

The identification of barriers that could be applicable to e-Freight implementation in the air cargo supply chain is based on a comprehensive analysis of relevant literature. The sources were evaluated in terms of explicitly stating ''barriers'', in combination with a variety of terms that were utilized in articles to refer to barriers. The following terms were regarded as signifying barriers:

- Hindrances (Ziakas, 2018)
- Challenges (Ziakas, 2018; Vogelsang et al., 2021)
- Shortcomings (Diefenbach et al., 2021)
- Obstacles (Hölzl & Janger, 2012; Sehlin, Truedsson & Cronemyr, 2019; Durão, Ferreira, Pereira & Moreira, 2019; Diefenbach et al., 2021)
- Bottlenecks (Hölzl & Janger, 2012; Diefenbach et al., 2021)
- Factors that affect the innovation process of organizations (Hölzl & Janger, 2012)
- Failures (Hölzl & Janger, 2012)
- Issues (Hölzl & Janger, 2012)
- Sources of errors (Diefenbach et al., 2021)
- Dysfunctional factors (Tijan, Jović, Aksentijević & Pucihar, 2021)

Researchers of articles analyzed in this study stated that barriers inhibit, hinder, complicate, deter, delay, or change (Mirow et al., 2007; Hölzl & Janger, 2012), prevent, impede or hamper (Sandberg and Aarikka-Stenroos, 2014; Hölzl & Janger, 2012; D'Este et al., 2012) innovative ideas and innovation projects and lead organizations to fail to implement changes or innovations.

3.1.2 RESEARCH TOPICS ANALYZED

The initial search focused on barriers specifically related to e-Freight adoption and implementation in the air cargo supply chain, but a lack of literature on this specific topic led to a broader search on barriers to implementing change, innovation, and sustainability innovation. The literature search also included the implementation of digitalization, digital transformation, and paperless documentation in the entire transport and logistics supply chain. Several search terms were combined to arrive at useful studies and a lot of forward and backward snowballing was applied. This was especially helpful when a literature review indicating barriers was found. Below, the connection of e-Freight implementation to all four additional search topics is explained along with the main search terms used. An overview of all search terms used can be found in section 2.3.

1. Barriers to change/innovation:

First of all, e-Freight is considered a change in the air cargo supply chain, because it implies the change from the traditional way of documenting freight and shipping transactions through the use of paper documents towards a new electronic documentation process where the need for paper is eliminated. Secondly, e-Freight is considered innovative as it represents technological advancement. The use allows for faster and more efficient processing of the cargo and offers greater visibility and tracking of the freight movements. E-Freight not only replaces traditional paper-based documentation but also introduces new technologies and processes that require changes in the way businesses operate. Specifically, it is considered a disruptive innovation, while it fundamentally changes the process. Therefore, an additional search is done

on barriers to change and innovation with emphasis on organizations. The following search terms were combined: ''barrier'', ''change'', ''innovation'', ''organization'', ''firm''.

2. Barriers to sustainable innovation:

E-Freight is perceived as a sustainable innovation for several reasons. It reduces the amount of paper used in the air cargo industry while it transforms documentation from traditional paper documents to electronic documents, minimizing environmental impacts (Jović et al., 2022). In addition, e-Freight allows real-time tracking of information, which enables more efficient planning, reducing the need for inefficient and redundant transportation, and minimizing transportation-related emissions. This search was done with an emphasis on supply chains and on the adoption of sustainable innovation. The search terms that were included to arrive at the necessary articles: ''barrier'', ''sustainability'', ''sustainable'', ''innovation'', ''supply chain''

3. Barriers to digitalization/digitization/digital transformation (DT) in the entire transport and logistics supply chain:

E-Freight is a form of digital transformation, digitalization, or digitization because it aims to transform traditional paper documents into digital documents by using digital technologies. Digitization is the conversion of analog information into a digital format (Autio, 2017), just as e-Freight converts paper-based shipment documents into digital ones. Digitalization is the use of technology to streamline business processes like e-Freight uses digital documentation to automate freight transactions and improve efficiency. Digital Transformation (DT) is the use of technology to fundamentally transform business models and industry structures. E-Freight aims to do this by disrupting paper documents and structures while introducing new technologies and processes. While air cargo is just a part of the transport and logistics supply chain, a search on these three terms is done in the entire transport and logistics supply chain. The search terms that were used include: ''digitalization'', ''digital transformation'', ''digitization'', ''supply chain'', ''freight'', ''cargo'', ''transport''

4. Digitization of documentation/paperless documentation:

While e-Freight includes the digitization of cargo documentation and aims to arrive at paperless documentation, not only the air cargo documentation is included, but also documentation of other cargo sectors is investigated, such as the maritime sector. Search terms that were used, include: ''paperless'', ''paperless trade'', ''document'', ''documentation'', ''electronic'', ''digital''.

From these four literature searches, studies followed from which barriers were identified. In Appendix F all included studies can be found for each search topic.

3.2 LITERATURE REVIEW: BARRIER CATEGORIZATION

While no categorization or classification exists on the barriers to e-Freight implementation in the air cargo industry, nor any list or overview of these barriers, the included studies' categorizations and classifications were examined and utilized to create an overview. Within these included studies, some returning main categories were recognized. An analytical approach was utilized as the starting point to list, categorize and classify the main barriers found.

The commonly used two-part division between internal and external barriers to innovation was indicated, followed by other main categories such as technological, economic, organizational, and others.

3.2.1. INTERNAL AND EXTERNAL BARRIERS

When searching in literature for barriers to the successful implementation of change or (sustainable) innovation in an organization, both internal and external barriers were primarily used as main categories (Piatier, 1984; Hadjimanolis, 2003; Hölzl, W., & Janger, 2012; Madrid-Guijarro, Garcia & Van Auken, 2009; Reynolds & Hristov, 2009; Sandberg and Aarikka-Stenroos, 2014; Stornelli, Ozcan & Simms, 2021). Eleven studies in total included this commonly used division. Eight studies focusing on innovation, or innovation adoption, and three studies focusing on the adoption of sustainability innovation in specific, used this main categorization. In Appendix F, all studies using internal and external barriers are displayed, along with their main focus.

Both barrier categories can affect the success of proposed change or innovation in an organization. The division between internal and external barriers facilitates the identification of barriers that an organization has the ability to impact, as well as barriers that are either partially or fully beyond the control of an organization. The question therefore for the organization regarding external barriers is: ''is it possible?'', and for internal barriers: ''are we doing it?''. Below, an indication will be given on the origin of the barriers within these two categories, examples will be provided and the relevance of using this two-part division will be emphasized.

3.2.1.1 INTERNAL BARRIERS

According to Sandberg and Aarikka-Stenroos (2014), internal barriers are generated and originate within the organization and are closely linked to its management and organizational structure. Such barriers that lie within this category are lack of resources, a lack of support from upper management, or a lack of understanding or expertise about a particular technology or process. These are barriers that lie within the control of the organization and can be addressed and solved subsequently. By identifying and addressing internal barriers, an organization can ensure that it has the resources and support it needs to implement the change successfully. The presence of these barriers does not necessarily mean that implementation of innovation within an organization is impossible. Rather, internal barriers can be viewed as organizational screening mechanisms that differentiate between viable and non-viable innovation initiatives (Hölzl, W., & Janger, 2012). Some even argue that the internal barrier 'resistance to change' may lead to an improvement of the innovation performance of organizations as it could eliminate the non-viable parts of the innovation (Sandberg & Aarikka-Stenroos, 2014). Therefore, next to the terms indicated earlier this chapter to detect barriers, the internal barriers

are also identified by ''factors that affect the innovation process within organizations deterring, delaying or changing innovative ideas and projects'' (Hölzl & Janger, 2012).

3.2.1.2 EXTERNAL BARRIERS

External barriers stem from the external environment, originating from outside of the organization (Sandberg & Aarikka-Stenroos, 2014). They refer to obstacles or challenges that originate outside of an organization, such as competition, regulatory requirements, or economic conditions. They arise during the interaction between the organization and its external environment; other organizations or actors within the ecosystem. This encompasses elements such as the actions of competitors, customers, partners, and government entities (Hölzl & Janger, 2012; Madrid-Guijarro et al., 2009; Sandberg & Aarikka-Stenroos, 2014). These barriers can limit an organization's ability to implement changes or new initiatives effectively, and they are beyond the control of the organization. By identifying and understanding external barriers, an organization can anticipate and plan for potential challenges, and make adjustments to their internal change initiative as necessary.

Considering both internal and external barriers can help an organization to identify and really understand the underlying causes of the failure of an attempted change or innovation implementation. This two-faceted approach leads to a comprehensive overview of all possible barriers that prevent the complete implementation and provides a clear division between barriers within and beyond the organization's control. It's important to note that an organization may be able to address internal barriers more easily than external barriers, as internal barriers are often under its control while external barriers may restrict the implementation of certain changes or innovations, or require coordination and cooperation with other stakeholders outside the organization. This division can thus aid the organization in its focus on certain barriers to either design solutions or strategies for the barriers within its control, or address the external barriers and try to solve it with the external environment.

Interrelation:
Furthermore, complex interrelationships and interdependencies exist between internal and external barriers (Greenland et al., 2018). Internal barriers can affect an organization's ability to respond to external barriers, and external barriers can exacerbate internal barriers. For example, an internal barrier such as a lack of resources can make it difficult for an organization to respond to an external barrier such as increased competition. Similarly, an external barrier such as a change in regulation can exacerbate an internal barrier such as a lack of understanding of the new regulation. Also, internal and external barriers can interact in complex ways. To take the same example of the external barrier of change in regulation may require an organization to change its internal processes, which can lead to the internal barrier of resistance to change.

Lastly, they could be interdependent and it could be difficult to identify what is the main barrier, causing the other barriers. For example no standardization; is the root barrier internal or external? In this sense, it is important for an organization to consider both internal and external barriers in a holistic way as they can interact, interrelate, could be interdependent, and have complex interrelationships. The division of these two categories can help the organization identify and address the root causes of the obstacles and develop a comprehensive strategy for overcoming them.

3.2.2 MAIN CATEGORIES

Next to the internal and external barriers, other main categories were derived from the included studies. The most common category types derived from the analyzed literature include technical/technological, economic and financial, market, organizational, regulatory and institutional, and social/cultural barriers. In Appendix F, all main categories mentioned in the included studies are displayed and classified accordingly based on the number of times mentioned.

Most studies divide their main barriers and list them into four to seven categories. Therefore, the amount of main categories that will be included in this thesis lies within this range. Since several studies use similar terms or synonyms for the same type of category, some categories were combined. The final terminology of the main category types included in this thesis is set out below, along with the terms it was combined with. The chosen terms of the main barriers were defined based on the number of times mentioned and combined with similar terms that were less frequently mentioned. The classification of the final six main categories of barriers included in this thesis was determined based on the number of times the barriers were mentioned in the included studies. In Table 4, the classification of the main categories can be seen along with their terms, and the terms where it was combined with.

Main categories	Combined	Used by authors	#
Technical/Technological		(Gupta, Kusi-Sarpong & Rezaei, 2020) (Gupta & Barua, 2018) (Greenland et al., 2018) (Vogelsang et al., 2021) (Hölzl & Janger, 2012) (Panos, Kapnissis & Leligou, 2020) (Tijan, Jović, Aksentijević & Pucihar, 2021) (Stornelli, Ozcan & Simms, 2021) (de Jesus & Mendonca, 2018) (Kern, 2021) (Jović, Tijan, Vidmar & Pucihar, 2022) (Bueno Rezende de Castro & Kornher, 2023) (Moktadir, Ali, Rajesh & Paul, 2018)	13
Regulatory and Institutional	- Legislation/political (Greenland et al., 2018) - Legal (Panos, Kapnissis & Leligou, 2020) (Laryea, 2005) - Government (Hadjimanolis, 2003) - Political (Stewart, Bey & Boks, 2016)	(Gupta, Kusi-Sarpong & Rezaei, 2020) (Long, Blok & Coninx, 2016) (Greenland et al., 2018) (Panos, Kapnissis & Leligou, 2020) (Stornelli, Ozcan & Simms, 2021) (de Jesus & Mendonca, 2018) (D'Este et al., 2012) (Hadjimanolis, 2003) (Laryea, 2005) (Stewart, Bey & Boks, 2016)	10
Economic and financial		(Gupta, Kusi-Sarpong & Rezaei, 2020) (Gupta & Barua, 2018) (Long, Blok & Coninx, 2016) (Greenland et al., 2018) (Hölzl & Janger, 2012) (Reynolds & Hristov, 2009) (Stornelli, Ozcan & Simms, 2021) (de Jesus & Mendonca, 2018) (D'Este et al., 2012) (Moktadir, Ali, Rajesh & Paul, 2018)	9
Organizational	- Management (Kern, 2021) - Managerial/organizational (Gupta & Barua, 2018) - Skill (Hölzl & Janger, 2012) - Knowledge/support (Moktadir, Ali, Rajesh & Paul, 2018)	(Gupta, Kusi-Sarpong & Rezaei, 2020) (Long, Blok & Coninx, 2016) (Vogelsang et al., 2021) (Tijan, Jović, Aksentijević & Pucihar, 2021) (Stornelli, Ozcan & Simms, 2021) (Kern, 2021) (Jović, Tijan, Vidmar & Pucihar, 2022) (Gupta & Barua, 2018) (Hölzl & Janger, 2012) (Moktadir, Ali, Rajesh & Paul, 2018)	9
Market	- External partnership/stakeholder (Gupta & Barua, 2018) - Society (Moktadir, Ali, Rajesh & Paul, 2018)	(Gupta, Kusi-Sarpong & Rezaei, 2020) (Long, Blok & Coninx, 2016) (Reynolds & Hristov, 2009) (Hadjimanolis, 2003) (Hölzl & Janger, 2012) (de Jesus & Mendonca, 2018) (D'Este et al., 2012) (Gupta & Barua, 2018) (Moktadir, Ali, Rajesh & Paul, 2018)	9
Social & Cultural	- Behavioural/psychological (Long, Blok & Coninx, 2016) - Individual (Vogelsang et al., 2021) - Personnel-related (Stornelli, Ozcan & Simms, 2021)	(Gupta, Kusi-Sarpong & Rezaei, 2020) (Greenland et al., 2018) (de Jesus & Mendonca, 2018) (Bueno Rezende de Castro & Kornher, 2023) (Stewart, Bey & Boks, 2016) (Vogelsang et al., 2021) (Long, Blok & Coninx, 2016) (Stornelli, Ozcan & Simms, 2021)	8

Table 4: Classification of main categories included in this thesis

The included main categories are explained along with their relevance to e-Freight implementation.

Technical or Technological Barriers (TB)

Technological or technical barriers can pose significant obstacles in the context of e-Freight implementation, while technical adjustments are required to realize a paperless process. These barriers can arise from the technological infrastructure required for the design, development and implementation of products, processes or systems related to e-Freight realization. They encompass a range of complexities, including process and system complexities, that impact the interplay and integration of technical resources (Vogelsang et al., 2021). Think about problems related to system interoperability, data exchange and technology adoption. These barriers mainly impact operations and counteract integration and interoperability (Stornelli, Ozcan & Simms, 2021).

Regulatory and Institutional Barriers (RIB)

Regulatory and institutional barriers are challenges that arise due to rules, regulations, policies and procedures established by regulatory bodies or institutions. Such barriers refer to the hindrances that emerge from legal and regulatory structures and may include the lack of, inadequate or restricting rules, regulations, laws or institutions (standards), which mainly originate from the external environment. Think about barriers such as the lack of standardization and harmonization of regulations. Restricting regulations in their turn can impact the whole adoption process (Stornelli, Ozcan & Simms, 2021). In addition, compliance with national (local), international, and industry-specific regulations may pose challenges that vary between different continents and countries. Therefore, overcoming regulatory and institutional barriers is critical for complete e-Freight implementation.

Economic and Financial Barriers (EFB)

Economic and financial barriers are obstacles that organizations encounter due to the cost implications and the inability to secure funding. It could be due to limited access to capital or a shortage of funds. The challenges can include expenses related to technology adoption, such as the cost of acquiring or developing the necessary hardware and software, training employees on the new system, or restructuring existing processes to align with the new system. The severity of these economic and financial barriers may hinder an organization's ability to achieve the benefits of e-Freight, affecting the success of the implementation effort.

Organizational Barriers (OB)

Organizational barriers are defined as obstacles that result from internal factors within an organization that prevent the efficient functioning of the organization. These barriers are reflective of challenges that arise due to internal structures and management. They can include issues related to leadership, adoption, management, and internal communication innovation (Reynolds & Hristov, 2009). For instance, the lack of resources and a missing vision are typical indicators of the existence of barriers on the organizational level (Vogelsang et al., 2021). The barriers may also relate to the communication and execution of change within organizations (Stornelli, Ozcan & Simms, 2021). They originate from the interplay of the organization as a whole and management practices and are not influenced by single staff members or external factors (Vogelsang et al., 2021). Organizational barriers are important to consider when examining the lack of implementation of e-Freight because they can hinder or prevent the adoption of new required processes within an organization, thereby impacting the overall success of the implementation.

Social Barriers (SCB)

Social and cultural barriers are obstacles related to the attitudes, beliefs and behaviors that prevent individuals from changing to achieve a desired outcome or goal. It includes behavioral aspects and psychological challenges. It can include challenges related to social acceptance, trust, societal and cultural norms, and attitudes and perceptions. As defined by Vogelsang et al. (2021) they can include perceptions, assumptions and feelings of the individual. Employee resistance could be a common example of such a barrier, which can be caused by threats to established competencies, issues related to skills development, a skills gap and fear of job losses, as pointed out by Stornelli, Ozcan, and Simms (2021). These kind of factors can influence the acceptance and adoption of e-Freight.

Market Barriers (MB)

Market barriers refer to the impediments that emerge as a consequence of external market elements. These can include shortcomings related to industry structure and attitudes, as well as other external market interactions such as customers and competitors (Reynolds & Hristov, 2009). The airline industry is heavily reliant on external partners, including their customers (Freight Forwarders) and ground handling agents (GHAs), to facilitate and ensure the smooth operation of their business. As such, the relationship and interaction with these external partners are crucial to the success of e-Freight implementation.

It is important to note that these barriers are not mutually exclusive and an organization may face multiple barriers at the same time. Next to facing multiple barriers at the same time, these barriers are often interrelated or interdependent, which makes the identification complex. It can occur that the presence of a certain barrier is perceived, while actually another barrier is present.

Below, a visualization of the literature exploration with its included topics, leading to the barrier categories is indicated.
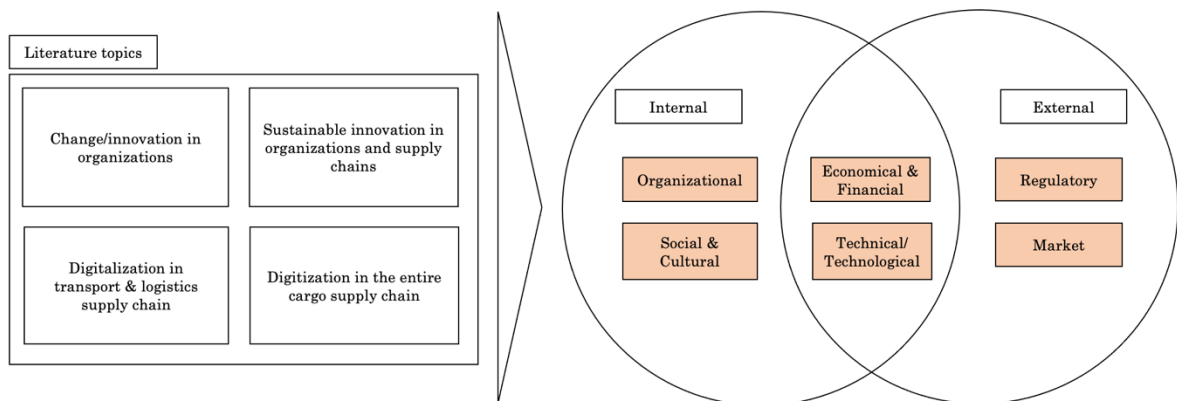
Figure 6: Visualized barrier categorization

Within the orange indicated main categories, some more specific sub-categories were also found in literature. These are combined in a conceptual theoretical barrier overview.

The previous section provided an indication of the categorization and classification of the main categories included in this thesis along with an explanation and their potential relevance towards e-Freight implementation. Not only the differentiation between internal and external barriers is highlighted, but it also offers a more nuanced categorization and classification of the main categories.

Given the substantial variability in barrier categorization and classification of all analyzed studies, it was determined to employ a more inductive approach to the final conceptual barrier categorization. This method was deemed to provide a more comprehensive understanding of the diversity of barriers discussed in the relevant research. The main barrier categorizations were used as a starting point to construct a more comprehensive conceptual overview, also including the sub-categories listed in Appendix G.

Although barriers appear to be largely subjective and contingent on the context, the initial main and sub-categories were derived through a literature exploration of broader research fields. Therefore, the construction of the conceptual theoretical overview on potential barriers to e-Freight implementation within the air cargo supply chain is made based on the literature combined with experience/common sense on the air cargo supply chain derived from an internship at AFKLMP Cargo. While the literature review does not include particular barriers towards change implementation in the air cargo supply chain due to the lack of literature present, a more inductive approach was used to construct the conceptual theoretical model including the inclusion of the sub-categories. Table 5 displays the conceptual theoretical barrier overview. In Appendix G, this table can be found along with the sources in which all sub-categories were referenced.

Internal/External	Barrier Main Category	Barrier Sub Category
Internal	Organizational Barriers (Structure)	Project vision, strategy and implementation deficiency
		Performance measurement gap
		Unsupportive organizational structure
		Lack of communication
		Lack of training, education or guidance
		Lack of functional cooperation (organizational silos)
		Inadequate or lack of resources
		Lack of employee empowerment
	Organizational Barriers (Social and Cultural)	Organizational inertia
		Lack of knowledge or information
		Lack of commitment from top management
		Lack of qualified personnel
		Employees resistance to change
Internal & External	Technical or Technological Barriers	Lack of technological integration
		Misaligned technology solutions
		Lack of infrastructure facilities
	Standardization Barriers	Lack of standardization
External	Market & Network Barriers	Lack of customer performance
		Conservative industry and attitudes
		Customer resistance to change
		Lack of industry specific guidelines/standards
		Lack of competitiveness
		No collaboration with external partners
	Regulatory Barriers	Restricting regulations
		Missing or inadequate regulations
		Lack of government support

Table 5: The conceptual theoretical barrier overview

This resulted in the final set of barriers being categorized into six main categories, both identified for separate internal, separate external, and combined purposes. Within these main categories, 12 sub-barriers for the internal, 9 sub-barriers for the external barriers, and 9 sub-barriers for the combined barriers are identified. This final conceptual theoretical overview of barriers serves as a lens to finally look at the empirical outcomes. Within the internal barriers, the Organizational Barriers, and the Social and Cultural Barriers are categorized. Within the external barriers, the Regulatory and Institutional Barriers and the Market Barriers are categorized. And within the combined barriers, the Technical Barriers and the Economic and Financial Barriers are categorized. The sub-categories have been arranged in order within their main category, from top to bottom, based on the frequency of their mention in the literature. Below, a concise explanation is provided of all included sub-categories.

Organizational
- **Unsupportive organizational structure**: Unclear hierarchical authority and arrangements of an organization: lack of a framework or structure designed by managers to divide and coordinate activities, responsibilities, and practices. There is a lack of communication.
- **Lack of functional cooperation (organizational silos)**: Lack of common values, cooperation, collaboration, and integration among business units or interdepartmental
- **Lack of employee empowerment:** The absence of staff involvement and empowerment at lower levels. The knowledge and input of lower-level employees are often not considered in research and development processes, and they may not be given opportunities to participate in decision-making.
- **Lack of training, education or guidance:** No internal employee training and education on the new process or technology.
- **Project vision and strategy deficiency:** Lack of project vision, strategy, and direction. Organizations may struggle to formulate a clear project approach, prioritize goals, and translate them into functional units. The lack of clear mission and vision statements and the difficulty in creating a business case. It also includes executive reticence with lack of implementation, a lack of project-based teams, and difficulties in integrating new processes.
- **Performance measurement gap:** Lack, inconsistent or inadequate performance measurement tools. There is an absence of defined performance evaluation matrices and hence the failure of incentivizing.
- **Inadequate or lack of resources: The organization** does not assess or invest in required resources.

Social and Cultural
- **Lack of commitment from top management**: The resistance or lack of commitment, motivation, support or awareness from the top-level management to change the existing practices and implement the proposed change or innovation. The top management is concerned mostly related to core business and lacks commitment to back activities related to sustainability innovation. Lack of innovation leadership and risk taking.
- **Resistance to change:** This refers to behavioral/psychological barriers that include the lack of acceptance, motivation, or positive attitudes towards the change among managers and employees. This encompasses their assumptions, perceptions, opinions, and reactions. Such barriers may arise from fear of job loss, threats to established

competencies, fear of transparency (e.g., data abuse or loss of data control), and high personal risk aversion.

- **Lack of qualified personnel:** Lack of skills, competencies and expertise regarding the new technical process.
- **Lack of knowledge or information:** Lack or asymmetry of knowledge and information on sustainable issues or practices, technologies or new processes.
- **Lack of awareness:** Lack of awareness or understanding about benefits of the proposed change or innovation.

Economical

- **Lack of budget:** Lack of budget, financial resources or support from the organization
- **Difficult access to financial resources:** includes barriers towards investment justification, not getting access to financial resources.
- **High initial investment / cost**: high initial investment/implementation costs
- **Investment aversion**: Organization is hesitant to invest due to concerns on the return of investment. There is uncertainty on returns and results.

Technical

- **Lack of infrastructure facilities**: Lack of or inappropriate infrastructure facilities like latest equipment, information technology, or limited internet and network availability, access, and speed.
- **Lack of technological integration:** Lack of industry and infrastructure standards; of electronic documents. And lack of system interoperability due to decentralization. No integrating IT systems.
- **Data security risk:** Organizations are hesitant to exchange information with external parties in a digital manner due to risks for data security or data quality such as hacker attacks.
- **IT implementation gap:** lack of technology implementation and adoption
- **Misaligned technology solution:** Inappropriate and immature technology solutions for the projects' purpose. Technological solutions that do not match the needs.

Regulatory

- **Lack of government support:** Lack of support and guidelines from the government. There are no rules and regulations to motivate or incentivize organizations in implementing specific practices.
- **Missing or inadequate regulations:** Lack of regulations, standardization of regulations, and harmonization processes have led to an absence of international legal framework, resulting in uncertainty and differing requirements between countries. This includes an absence of trade and administrative procedures at border crossings and an insufficient trade community.
- **Restricting regulations:** National restricting regulations or legislations from customs or authorities.

Market

- **Customer resistance:** Low level of motivation, acceptance, understanding, and knowledge of customers on the change or innovative activity.
- **Lack of customer performance:** Poor and unclear customer performance on the required or desired input to sufficiently handle the documentation by the concerned organization. This entails submitting paper hardcopies or incorrect digital document versions, or the quality of the digital document version.
- **Lack of competitiveness:** No competitors or rivalry toward implementing the new process.
- **No collaboration with external partners:** Lack of collaboration and knowledge sharing among actors in the industry. Organizations become isolated from each other, failing to collaborate and not networking with each other.
- **Lack of industry-specific guidelines:** the lack of or no industry-specific guidelines or standards.
- **Conservative industry:** Conservative, old-fashioned, non-pioneering industry with resistance to change of all actors.

When considering all barriers incorporated in the conceptual theoretical overview, the importance of the constructed barrier categories is indicated by counting the amount of sources that mentioned the barriers. Figure 7 depicts the distribution of these main categories within the explored literature. All categories are almost evenly distributed, but the Technical/Technological barrier category was cited most frequently.

Figure 7: Radar chart importance literature main categories

Identifying barriers is crucial for understanding the reasons behind unsuccessful e-Freight implementation. Barriers serve as a starting point for developing tailored solutions and strategies, while also laying a foundation for identifying opportunities. Thoroughly searching for barriers enables organizations to navigate challenges effectively and maximize the potential for success.

The reviewed literature included various types of barriers to change or innovation, sustainability innovation, digitalization, and paperless documentation. While some of the literature explicitly discussed adoption or implementation barriers, others focused on organizational or supply chain-related barriers. By categorizing and classifying all found barriers from the literature exploration with an inductive approach, a conceptual theoretical overview is constructed on the potential barriers to complete e-Freight implementation within the air cargo supply chain from an airline point of view. In Table 5, the conceptual theoretical overview can be found along with all identified barriers.

The following visualization displays the barrier categories and its interaction, influence and dependencies on/with the complete implementation of e-Freight and thus a change or innovative activity.
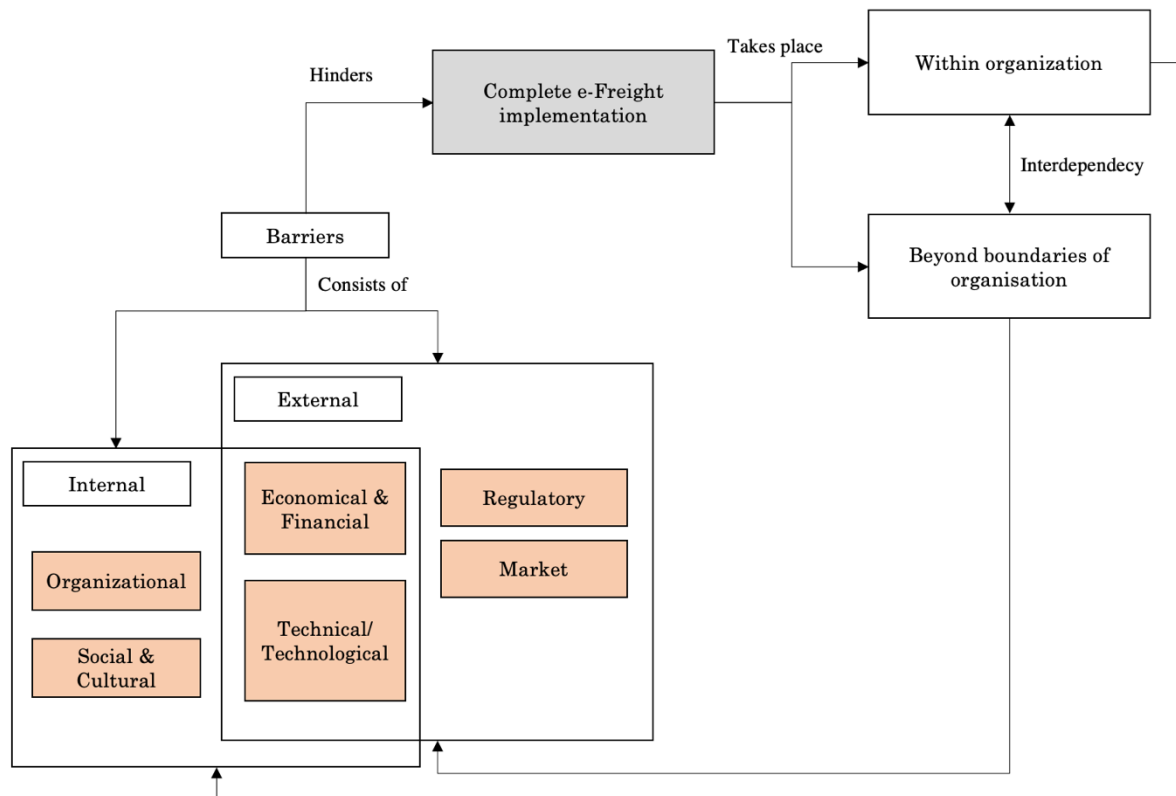
Figure 8: Conceptual model

4. RESULTS

In this chapter, the findings of the case study are presented. First, the state-of-the-art on the presence of papers in the process of AFKLMP Cargo is outlined. Following, an overview of the main barriers to the implementation of paperless documentation is constructed. This overview is constructed based on the empirical data input, ranging from semi-structured interviews, to direct observations from both on-site visits and a long-term internship to informal expert conversations.

4.1 STATE-OF-THE-ART CARGO DOCUMENTATION AFKLMP CARGO

This subsection highlights the current state-of-the-art on e-AWB and e-Freight performance at AFKLMP Cargo. It specifies the processes where paper hardcopies of various documents are still present, either required or not required but still present.

4.1.1 E-AWB

The presence of the AWB hardcopy could be due to several internal and external processes.

First, the internal process at some outstations or some internal teams or departments still uses paper copies of the AWB to update the documents or execute checks. Paper copies are part of their way of working and are incorporated into their process. This does not necessarily mean that the hardcopies are required and the process is not possible without the physical papers, but the employees are rather used to the paper hardcopies in the process. This could be the operational export team or other teams or departments that need to update or check the documents. The operational export team needs to see the details of the AWB to check whether the booked information and the actual information match. When electronic devices are not present, they need to check the details on a paper hardcopy. Moreover, they may need to update the AWB according to the actual information and make these necessary adjustments on the paper copies with a pen before scanning and sharing the adjusted documents with the customers. Regarding other internal teams or departments, ''the RIC team'' [3] at LAX station, still asks for the paper hardcopies of the AWB to check the documents. As a respondent mentions ''it is just incorporated in the process of the RIC team, they need to put the PDF in the system and we provide the hardcopies with the correct information to them to prevent confusion'' [2]. This leads to the fact that paper copies of the AWB are still present in some internal processes within the organization. Within the respondents, there exists confusion about whether the documents are required on paper or just incorporated into the process. There is clearly no/not enough knowledge of the process and they execute the process as a routine. This can be seen from the following statements from different respondents:
- ''RIC team requires the papers'' [2]
- ''RIC team does not require the papers, but we want to prevent confusion'' [3]
- ''It is just incorporated in the process of the RIC team; they put the PDF in the system'' [4]

Second, paper hardcopies of the AWB are present due to the input from customers (FFs) and some external parties require the paper hardcopies of the AWB for their checks. Think about the GHA, customs, local authorities, security agencies, and governments. In some countries, the external parties require the AWB hardcopy, but it is not always clear whether it is required

and there is a hard restriction, or whether it is just a routine or preference of the external parties. This could be for example for the TSA security authority in LAX, the government in LOS, or the customs in LIM.

Again, for the external process can be seen that there is not enough knowledge of the process and its requirements regarding the presence of paper hard copies. From the following statements from several respondents from the LAX station, can be concluded that there is no knowledge or clarity on whether the paper hardcopies are required or it is just embedded in the process:
- ''AWB needs to be attached to the TSA'' [2]
- ''That is what our operation team understands. So, it will be interesting to hear if that is really the case and a rule or do we think it is a rule?'' [4]
- ''Ja, dat zeggen ze, maar volgens mij is dat niet zo. In alle beetje moderne landen mag je gewoon een elektronische kopie hebben, als je dat maar goed organiseert'' [1]

4.1.2 E-FREIGHT

The analysis reveals what supporting documents are still present in a paper, either required, perceived to be required, or just still incorporated in the process. For special cargo, some supporting documents are required in the process. Most of these documents are still required to be paper-based. There often does not exist a digital version of the document, which can be due to a lack of development of document standards or restricting rules or regulations from the relevant country to use a digital version. They need to put stamps for example, or are only able to check and stamp the documents when there is a hardcopy. Examples of these supporting documents, mentioned by the respondents: Health certificates, Human remains certificates, phytosanitary certificates, Carnes, Live animal checklists, Heavy cargo, and Dangerous Goods Declaration.

While there is a process between external actors, the airline provides an option to book a pouch, where the relevant external parties (shipper-consignee) have the choice to ship hard copies of documents (i.e. invoices, checklists etc). The airline just ships the pouch but does not use or check the documents that are in the pouch. It is a process between external parties and they do not want to interfere in the process of the external parties.

Airlines are dependent on several external parties whether they could be 100% paperless or not. This is due to the process of external parties that passes the airline (shipper-consignee), the input from their customers, and checks that need to be done. In Table 6, the external parties are indicated along with the reasons for the potential need for or presence of paper hard copies.

External party	Reason
Customer (Freight Forwarder)	Document submission
GHA (Ground Handling Agent)	Document handling/updating
Consignee	Pouch
Customs	Checks and stamps
Local authority/government	Checks and stamps
Security agency (TSA)	Checks and stamps

Table 6: External parties and the presence of paper hardcopies

4.1.3 DATA VS. REALITY

There will be indicated whether the assumed e-AWB and e-Freight status or performance of the investigated stations rhymes with the actual physical situation. Due to the only source of data being the dashboard displaying the 'e-AWB contract', 'e-AWB' handled documents (ECC/ECP), and 'Paperless' status (EAW/EAP), this was used as input to indicate the digital performance of the included outstations. While the 'e-AWB contract' status is the only tab and status from the dashboard that is displaying correct data and is actively used at the moment, the perceived digital maturity of a station was based on this parameter. Based on this data and perception, assumptions were made on the digital performance of a station. There was assumed that when customers were shown as e-AWB contracted, they submitted solely e-AWBs of correct quality.

The results point out that for some stations the assumptions made, do match with the actual situation, but for some stations, it does not match the assumed situation. For the majority of the stations, the assumed digital maturity is conform the actual physical situation regarding the documents used. For example, while checking the operational processes during the on-site visit in the warehouse in SIN and AMS, it was confirmed that no paper hard copies of the AWB were present in the process. However, for two other stations, it turns out that the actual situation does not match the assumed digital performance. This insight applies to LAX station and YYZ station. All percentages that are displayed are parts of the total amount of customers or documents handled.

LAX data dashboard (2022):

- e-AWB contracted customers: 64.0%
- e-AWB handled: 79.3% (dashboard) > **~ 0%** (reality)

However, from the interviews comes forward that the customers are e-AWB contracted, but they do not solely provide e-AWBs or FWBs. They all still attach paper copies of the AWBs on their shipments due to several reasons that may be internal or external. This leads to the situation where some provide solely paper copies of the AWB, some provide both a paper copy and an e-AWB, and some (very scarcely) provide only the e-AWB. As a respondent from the LAX station mentions ''To be honest, I would say last year, I didn't hear even once someone asking questions that the customer arrived saying that it's a e-AWB. I haven't heard that, not even once. There is no distinction, even if the customer is signed e-AWB. Everything is being handled as a regular hard copy.''[2]. There is not a single process defined on how to handle these documents, and what to do when the e-AWB contracted customers provide both a paper copy and an e-AWB, but these two documents do not match. Just like at LAX station, it was observed that in Canada all shipments are also attached with a paper copy of the AWB, while it seems that the majority is handled as an e-AWB. During the internship within the AOP program, it was noted that this was the actual situation in Canada. The following data of Toronto (YYZ) station supports this insight.

YYZ data dashboard (2022):

- e-AWB contracted customers: 62.1%
- e-AWB handled: 88.9% (dashboard) > **~ 0%** (reality)

After several interviews and additional observations, it became clear that the hardcopies of the AWBs present were not stations specific for LAX and YYZ, but country dependent in the USA and Canada.

4.2 OVERVIEW OF MAIN BARRIERS

Drawing on the empirical evidence, this study has identified the underlying factors contributing to the continued use of paper hardcopies in certain processes within AFKLMP Cargo. An overview of the identified barriers toward the complete implementation of paperless documentation within AFKLMP Cargo is constructed.

4.2.1 BARRIER OVERVIEW

According to the empirical findings, an overview of the main barriers is constructed. Three empirical data input sources are used to arrive at the final constructed overview. First, the semi-structured interview outcomes were coded and an overview was constructed while using the conceptual theoretical overview as a lens and employing the template analysis method. Following, the sub-categories were classified using content analysis, and a table with the classified outcomes is displayed in Appendix G. Then direct observations and expert insights aided in constructing the final main and sub-categories and insights were added. Finally, Table 7 indicates the main barriers that followed from the semi-structured interviews along with their occurrence recognized by direct observations or expert insights. In Appendix E the sources of the direct observations and expert insights are displayed. The sub-categories have been arranged in order within their main category, from top to bottom, based on the frequency of their mention.

Internal/ External	Barrier Main Category	Barrier Sub-Category	Direct Observations	Expert insights
Internal	Organizational Barriers	Insufficient communication channels	X	
		Deficient e-Freight project design	X	X
		Performance measurement gap	X	X
		Unsupportive organizational structure		X
		Lack of training, education and guidance	X	
	Social & Cultural Barriers	Lack of commitment from top management	X	X
		Organizational inertia	X	
		Cultural rigidity	X	
		Lack of qualified personnel		X
	Economic & Financial Barriers	Lack of budget allocation		X
Internal & External	Technical / Technological Barriers	Lack of technological integration	X	X
		Misaligned technology solutions		X
		Lack of infrastructure facilities	X	X
External	Market Barriers	Incorrect customer input	X	
		Conservative industry and attitudes	X	X
		Customer resistance to change		X
		Lack of competitiveness		X
		No collaboration with external partners		X
	Regulatory Barriers	Restricting regulations		X
		Missing or inadequate regulations		X
Trend	Standardization Barriers	Lack of standards	X	X

Table 7: Empirical overview main barriers

This section highlights the most mentioned barriers identified through semi-structured interviews. Figure 9 depicts the distribution of these main categories indicated by content analysis on the transcripts, based on the frequency of mention by respondents. The Market & Network barrier category and Organizational barrier category were mentioned most frequently, while the Economic & Financial barriers were mentioned the least. It is noted that all barrier main categories, except for Economical & Financial barriers, were frequently mentioned by the respondents. Furthermore, the Standardization barrier category was created, which overlaps with several main barrier categories and represents a trend that affects multiple categories.

Furthermore, the importance of the sub-categories identified through the semi-structured interviews are indicated. Table 8 provides a list of the sub-categories mentioned by the respondents, with the upper sub-category being mostly mentioned, down to least mentioned. The most mentioned barriers are the incorrect customer input, restricting regulations and conservative industry attitudes, all being external. These are followed by internal organizational barriers; insufficient communication channels, deficient e-Freight project design and performance measurement gap.
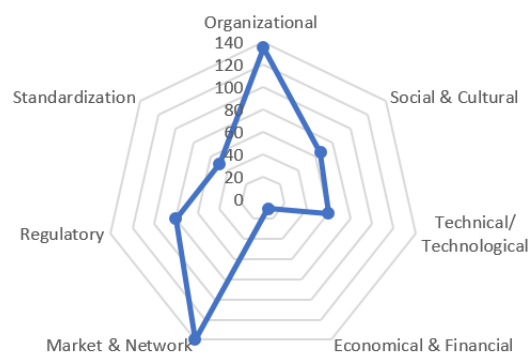
Figure 9: Radar chart semi-structured interview barrier main categories

Main Category	Sub-Category
MB	Incorrect customer input
RB	Restricting regulations
MB	Conservative industry and attitudes
OB	Insufficient communication channels
OB	Deficient e-Freight project design
OB	Performance measurement gap
SCB	Lack of commitment from top management
Trend	Lack of standardization
SCB	Organizational inertia
OB	Unsupportive organizational structure
TB	Lack of technological integration
MB	Customer resistance to change
TB	Misaligned technology solutions
TB	Lack of infrastructure facilities
SCB	Lack of qualified personnel
OB	Lack of training, education or guidance
SCB	Cultural rigidity
RB	Missing or inadequate regulations
MB	Lack of competitiveness
EFB	Lack of budget allocation
MB	No collaboration with external partners

Table 8: Importance sub-categories empirical findings

This section explains all identified sub-categories of the barriers, displayed in Table 7.

4.2.4.1 ORGANIZATIONAL BARRIERS

Insufficient communication channels

A lot of respondents highlighted the lack of communication both internally and towards the customers as an important barrier [1][2][3][4][7][10][15]. Some of them pointed out that there is a lack of action on communication towards customers promoting or following up on the e-AWBs [1][2][3][15]. There is an insufficient feedback loop towards the customers, with some reporting that there is no follow-up on customers' performance after the initial e-AWB check executed by the e-Freight team when 'applying' for a contract. The structural communication towards the customers to educate and help them is missing. One of the reasons that is mentioned, is the behavior of the sales people; ''het promoten van e, of een slecht gesprek met de klanten, dat gaan ze liever uit de weg'' [1].

In addition, the lack of communication internally was also highlighted, with some respondents noting that communication was unclear and needed improvement [2][4]. It is mentioned by several respondents that there is a lack of interdepartmental collaboration [2][3][4]. All departments have their own goals and values and are not always on the same page. The lack of having a uniform vision, structurally communicating, and collaborating to ensure a smooth process, counteracts achieving change. Clear communication channels need to be set up between all departments (OPS, CSO, Sales), while they are interdependent and their collaboration is paramount to achieve successful change implementation. This lack of communication channels not only affects the implementation of the e-Freight project internally but also influences the relationship between AFKLMP Cargo and its customers and leads to incorrect customer input. A customer for example clearly states that the customer has no knowledge/insight on their documentation process and does not even know about their incorrect input. This indicates the lack of structural communication on e-AWB or e-Freight implementation.

Deficient e-Freight project design

According to most respondents, the e-Freight project faded [4][8]. A respondent describes his feeling about the project as: ''bij e-AWB krijg ik het gevoel van een soort kaarsje dat is uitgewaaid'' [9]. There was an initial initiative from the e-Freight team a while ago with the marketing of; #let's go digital, starting with the e-AWB implementation. However, eventually, it did not hold its attention and the message did not come through, ''the focus is not so fully on it anymore'' [4]. Many respondents indicate that there is not much project attention, priority or reach anymore [4][11][9][16]. Currently, there are no clear targets and goals on the implementation of e-Freight.

Some argue that the story we pass within the project needs to be more clear to trigger one's intrinsic motivation. ''We often tell people what to do, but do not to tell them why?'' [1]. The vision of the project along with the story that supports the project and triggers ones intrinsic motivation needs to be captured clearly and passed along accordingly. Only then, it is possible to achieve full commitment towards the implementation of the project from all relevant parties. To reach this, a manager mentions ''I do think that our story also needs to be a lot more

engaging and also has to come back, so two sides just motivate it intrinsically with a good story.'' [9] The manager also argues that the positioning of the team within the organization was not very clear; ''I know who was in the team, but it was a bit shuffling around and didn't belong anywhere, it was not quite operations, not quite commerce, but somewhere in between'' [9]. Therefore, the KPIs and goals came by occasionally in other structural projects, flights plans etc, but it was always a side note and not a specific project with clear attention. It was not structurally included in a central initiative in the KPIs or had clear performance targets. In addition, it was observed that the e-Freight team assigned to execute the project disintegrated over time. Initially, three full-time employees (FTEs) were designated to the team, but they gradually departed one by one, and their positions were not filled. According to a former member of the e-Freight team, ''the e-Freight team is currently understaffed, with just one FTE left, and waiting for the positions to be filled. It is a struggling team doing its best, but too small to perform its duties'' [17]. Furthermore, the former member noted that as team members left, this subsequently resulted in an empty chair at the IATA e-Freight working group, where possibilities for e-Freight development and implementation are discussed [17].

Another reason that was mentioned by respondents for losing attention is the decisions made by top managers/decision-makers. At some point, top management decided to stop investing in the development of ONE Record (the newest suited technology for e-Freight) and decided to move on with messaging (the second best option) [17].

Finally, it is observed at the end of the interviews, that respondents elaborately thank the interviewer for finally listening to them and ask what are the next steps. This substantiates the current lack of attention to and action on the e-Freight project, including the lack of communication with the local teams. However, there are still opportunities for the project as one respondent mentioned ''The spark, the little candle is already turned on, so we really need to explore how to put more gas to this little flame, and we will succeed'' [5].

Performance measurement gap
The lack of monitoring and review of e-Freight performance at outstations has been identified as a major hindrance to the implementation of e-Freight [1][4][7][8]. The underlying cause of this issue can be attributed to unreliable and inaccurate performance measurement tools, as well as a lack of consistent and effective performance measurement follow-ups. In this situation where a project needs to be implemented across multiple geographically dispersed locations (outstations), it is crucial to observe the process in actual practice to identify the real situation [15]. However, conducting on-site visits to all relevant outstations is exceedingly time-consuming. Consequently, the lack of reliable performance measurement tools and structural performance measurement follow-ups leads to a lack of knowledge on the e-Freight status of the outstations [4][9]. This complicates the task of remotely managing local teams and ensuring progress toward e-Freight implementation.

Only a few tools exist to measure the performance of all stations on e-Freight: the #GoPaperless dashboard and some e-AWB quality checkers. However, respondents mention that it was observed that the data is not always reliable and conform reality, ''the theory often does not match the actual situation'' [2][4][6][17]. As already indicated in section 4.1.3, the assumptions made from the dashboard data do not always conform the actual situation. The same was discovered on the 'e-AWB' and 'paperless' tab in the dashboard on the amount of e-AWBs

handled. A more elaborate explanation on these errors and deviations can be found in Appendix H. Next to the performance measurement deviations from the dashboard, some respondents also mentioned the deviations discovered on the e-AWB quality checking tool [1][2][17]. It is mentioned that the tool checks the quality, but in reality, it is not about quality, but the fact that customers send the e-AWB. The tool indicates that it is an e-AWB with correct quality, while in reality: ''er allemaal puntjes en streepjes en onzin in staat, wat nu wordt gezien als kwaliteit'' [1]. Thus, the incorrect parameters of the e-AWB quality check tool lead to the assumption of receiving a correct e-AWB from the customers, while accepting an incorrect e-AWB that cannot be used further in the process and need to be adjusted and updated by operations. Due to the incorrect system capture, these customers do not get any encouragement to use the digital alternative, while they evade the paper fee. A recognized problem is that the performance measurement tools are not working conform their intentions. As a respondent mentioned ''This is where we need to stop being in the theory part and be more practical'' [17]. In Appendix H, the errors noticed from the performance measurement tools are listed. Furthermore, the absence of structural follow-ups on the performance of all stations regarding e-Freight, in combination with the lack of central targets and updates on the e-Freight status, leads to a failure in incentivizing the outstations to implement e-Freight.

Unsupportive organizational structure

Respondents have mentioned various issues with the unsupportive organizational structure, including a lack of guidelines, concrete instructions, and unclear allocation of responsibilities from headquarters towards the outstations [2][6][9][11][12]. Some also mention that the corporate strategy is not translated correctly into the project and implementation structure to execute e-Freight at the local levels [1]. The absence of a clear organizational structure and instructions for implementation at local levels are highlighted [1][9]. Additionally, many respondents have stated that there is too much dependency on individuals, rather than a defined decision-making process [10][11][12]. Some have criticized the lack of communication standards, structure, and guidelines, as well as the complexity and unclear operational process regarding e-AWB and e-Freight handling [2][5][9]. A respondent emphasized the need for clear policies and guidelines, such as a "Jip and Janneke guide" that outlines the steps to be taken in a straightforward manner, and the need for top-down support in order to address these issues [10]. In addition, in the current organizational structure there is a lack of local empowerment to aid in the decision-making on the e-Freight project. The decision-making is quite similar to a machine bureaucracy, where business plans are not produced locally, but at the headquarters [4]. There is top-down decision-making from headquarters with almost no empowerment of local teams in the decision-making. There is room to implement its own initiatives, but the creation of business plans is done top-down. A more elaborate analysis on this structure is provided in Section 5.2.

Lack of training, education or guidance

Some respondents argue that they are willing to change, and they want to correctly implement the e-AWBs and push for e-Freight [2][5][7][10]. However, they point out that they do not get the training, education or guidance to do so. Currently, some indicate that they set up their own local strategy and decide whether they want to execute and how they want to execute the e-Freight project [6][7][10][11][12]. It is dependent on their own initiative. However, for some customers that do not have their own systems to provide the e-AWBs, the instructions and guidance towards the customers go further than only telling them to submit the e-AWBs and providing feedback on their performance to improve. These customers need to make use of an external system (CPS) to submit e-AWBs [7]. With the current lack of training, education, and guidance, the AFKLMP Cargo local teams do not have knowledge of this system and are therefore also not able to educate and help the customers with the use of CPS.

4.2.4.2 SOCIAL & CULTURAL BARRIERS

Lack of commitment from top management

An important barrier mentioned by the respondents from the outstations is the lack of commitment from top management [9][11][12][15][16]. Insufficient leadership, lack of support, and motivation from headquarters result in a dearth of direction and focus on e-Freight. Top managers hold on to traditional practices. They rather stick to old practices and ways of working than take risks, which is clearly represented by the decision to focus on messaging instead of developing new API standards [16][17]. This leads to the inability to adapt to and keep up with the emerging trends of digitalization. The choice to focus on messaging is an old approach, not taking too many risks while other projects also rely on messaging (CargoBUS) [16]. '' Because this decision of moving to a new system based on messaging was done before, but waaaay before you see what I mean. It was on 2018. Meanwhile, the word changed, technology changed, people changed, but we didn't took a step back and say; are we still doing the right thing?'' [17]. This is typically how big machine bureaucratic organizations take decisions on big projects, they ''go straight ahead with their decision made from a long time ago and don't take any step back to see if they are still heading in the right direction or not'' [17]. It is rather an old traditional, habitual way of tackling projects in a non-agile or iterative way. Moreover, top management does not allocate budget to develop the e-Freight project. They stopped investing in the new proposed API technology (ONE Record) development team [16]. Subsequently, it is observed that there is a lack of replacement of e-Freight team positions. Lastly, it was observed that top managers did not give priority to holding an interview regarding the e-Freight topic. All top managers that were approached declined the interview invite.

In order to address these issues, it is crucial for top management to take a more active role in driving change within the organization. As one respondent highlights, "it needs to go all the way to the top, and they need to make it snow in the organization." [7] This requires a willingness to take risks, challenge the status quo, and provide clear direction and support to the rest of the organization. As another respondent emphasizes, "you need involvement from at least the highest management in the market, and I think even a level above, especially when it comes to target setting" [10]. Ultimately, it is up to top management to provide the leadership and motivation necessary to drive change and achieve the organization's objectives.

Organizational inertia:

Organizational inertia and thus the tendency to maintain the current state of affairs, is a recognized barrier that affects employees, managers, and top management of AFKLMP Cargo. This leads to the presence of paper-based documents within the organization when they are not strictly required to be hardcopies due to technical reasons, but it is just embedded in the internal process. Both respondents and observations of the researcher recognize that a lot of old people work at AFLKMP Cargo that is used to their processes and the way of working; paper ''is just something that we like, but we don't need'' [4][8][14]. As another respondent mentions: ''toen kwam dat agile en al dat soort dingen, en toen ging bij mij het licht uit. Toen dacht ik nu moet ik iets anders gaan doen, want dit is te IT-achtig. Ik werd daar helemaal zenuwachtig van'' [15]. This indicates that there is a tendency to hold on to traditional ways of working. Next to the recognized organizational inertia, employees often have the perception that paper hardcopies are required. This is due to their lack of knowledge of the possibilities and results in indirect organizational inertia. The employees rather have no knowledge than resistance to change. Regarding the top-management, they hold on to the traditional set-up of the e-Freight team, do not hire new people when team members leave.

Cultural rigidity

Cultural rigidity is a recognized barrier and refers to resistance to change, but rather due to cultural differences. As a respondent mentions it is important to play with the culture, while people within this continent are not necessarily proactive people in general [5]. They need a kind of incentive or stimulation. Therefore, within this market it is important to use emotional intelligence when communicating with the team and with customers [8]. Within another market, it is emphasized that people do not like to have a conversation with the customers addressing their lack of performance on e-AWB, ''they prefer to avoid it'' [1]. When problems regarding e-AWB are addressed within the local team, the people who have to communicate to the customers (CSO), counteract the implementation practices of e-AWB. Furthermore, it is observed that people from certain countries have different manners and perceptions regarding communication, while they do not show up at the interview without communicating this. This observation is also important to consider in their relationship and communication toward customers.

Lack of qualified personnel

The lack of qualified personnel represents a barrier to the implementation of e-Freight, as evidenced by various respondents that mention shortcomings in skills, knowledge, and understanding [1][4][8]. First and foremost, the lack of skills among personnel, such as export agents, hinders the effective use of the e-Freight system, as they may make mistakes due to their inability to navigate the system correctly or understand the language of the text codes [1][16]. The absence of an understanding of the data exchange standard, such as the XML standard, further exacerbates the problem, as individuals may not comprehend how to exchange data correctly [6]. This issue is compounded by the fact that lower-educated personnel may be tasked with making important decisions in complex processes, leading to potential errors and delays [1]. Moreover, the rotation of personnel, along with a lack of skills, creates a situation where individuals must repeatedly learn the e-Freight process, leading to inefficiencies and lost time [1][2]. This barrier mainly results from the lack of communication channels and training, education, and guidance.

Lack of technological integration

The absence of a central IT system, and the presence of multiple, disparate IT systems was noted [5][6][17]. This undermines the interoperability and integration of these systems in the cargo process and makes the use of digital documents even more complex [3][16]. The existence of numerous IT systems is attributable to the absence of industry and infrastructure standards and the international context. The lack of a standardized approach creates challenges for establishing a uniform e-AWB format standard, e-AWB descriptions and finally e-Freight standards for all documentation [7]. As a result, the use of multiple systems contributes to a high level of complexity in both the processes and tools utilized in the cargo process. Furthermore, the international nature of the system leads to the presence of a diverse array of systems in use. This diversity of systems was observed during the internship within the Acceptance Outstations Program (AOP), where a list of nearly 20 IT systems is reviewed to determine which systems are being used at each station. In addition, during on-site visits to SPL and SIN, it was observed that the systems utilized to manage e-AWBs were different.

Misaligned technology solutions

Mainly experts mentioned the misaligned technological solution that is currently in place for the digital data exchange of the e-AWB [16][17]. The current technology that is used for digital documentation exchange is peer-to-peer 'messaging', which employs a fire-and-forget system for document exchange between stakeholders. As an expert mentions: ''it is a very old technology'' [16]. The use of messaging for document exchange gives rise to several significant issues and leads to misalignment of its purpose to increase efficiency and compliance. Firstly, messaging does not allow for centralized updating of documents. Consequently, changes made to an e-AWB in one system are not synchronized with other systems. For example, if an e-AWB is updated according to the actual captured information in the airline system, the document in the customers' or customs' system may not be updated accordingly. This leads to discrepancies in document versions across different stakeholders; one updates the document in one location and the other still uses the old document version. As an expert mentions ''we discovered that data is often not complete, not correct, and not compliant, so we cannot go digital with messaging'' [17]. It is not enough to take this digital contract to the next level and execute all freight documentation digitally'' [17]. Secondly, messaging does not enable the data flow to be ahead of the physical flow of shipments, as required to ensure the documentation is in order before accepting shipments [16][17]. Lastly, it does not provide real-time data sharing or the ability to track and trace shipments with all relevant updated information. The decision to focus on messaging was done a long time ago by the top management of AFKLMP Cargo, but ''meanwhile, the world changed, technology changed, people changed, but we didn't take a step back and say; are we still doing the right thing?'' [17] For now we are stuck with the messaging also due to this technology in another huge project called CargoBUS. ''We try to sort it out and build all kinds of tricks around it to make it work as we are pioneering in the e-AWB'' [17].

Meanwhile, IATA has identified ONE Record as a more suitable technology for digital data exchange. This API allows for real-time data sharing and updating with plug-and-play capability, thereby enabling real-time tracking and tracing [17]. However, given that the industry's current systems are designed for messaging, transitioning to new technology could

carry significant risk, as no industry standards have been established yet for APIs. Developing an API at this stage poses a risk, as it may not eventually align with the industry standard [16]. This entails being a pioneer or frontrunner, which may result in either losing or saving a significant amount of money, depending on whether the developed standard becomes the industry norm.

Furthermore, some respondents raise their doubts about the use and provision of the external system CPS for small and medium customers that do not have their own systems to submit e-AWBs [6][7]. ''Maybe it is better to provide internal systems, while CPS does not always work'' [7]

Lack of infrastructure facilities

Respondents mainly from less developed countries identified that the lack of infrastructure facilities could be an important barrier [13][14]. It mainly implies insufficient technological resources available or the lack of a sufficient internet connection [13]. This was also observed when conducting the interviews with respondents from less developed countries. It was not possible to conduct the interviews with cameras on due to the unstable internet connection, and often during the interviews, the connection was interrupted. The availability of features to use or develop technical systems and tools is dependent on the economic development of a country. This could therefore be a restricting barrier for a specific geographical location. Challenges like this include unstable or interrupted internet connectivity, and technical or IT failures. Thus, these factors contribute to the misalignment of technological solutions across different countries and regions and counteract standardization.

4.2.3.4 ECONOMIC & FINANCIAL BARRIERS

Lack of budget allocation

Several expert respondents identified the lack of budget allocation from AFKLMP Cargo as a barrier that obstructs the development and implementation of e-Freight [16][17]. One respondent highlighted that AFKLMP Cargo withdrawn from the development of an industry standard: ''In de ontwikkeling van ONE Record heeft AFKLMP Cargo 1,5 jaar meegedaan met een team developers, en dat team hebben ze stop gezet. Investeren we niet meer in, punt'' [16]. This suggests a strategic decision not to allocate budget for the development of e-Freight any longer. Another respondent mentioned that the organization is currently overall hesitant to invest in innovation after the financial difficulties caused by COVID [17]. The respondent explained, ''we took this bad habit as an organization that we need to proof the quick return of investment (ROI) of all money we spend'' [17]. This poses a significant obstacle to innovation overall, and the development and implementation of e-Freight specifically. Without allocating budget for test and learn due to its lack of proof of quick Return On Investment (ROI), it is impossible to develop, implement and innovate with e-Freight. This leads to the fact that the organization is blocked by this lack of budget allocation if we want to develop new technology. ''If you want to innovate, you need to spend money without knowing the result and without having a guaranteed ROI. So, if you don't invest or allocate budget in innovation, we will not progress'' [17].

Incorrect customer input

A major challenge that is recognized by a lot of respondents is the incorrect input from customers regarding the e-AWB submission [1][2][4][6][13]. Several performance issues exist. Either they do not submit an e-AWB at all [13][14], they submit an incorrect, incomplete or non-compliant e-AWB [3][17], or they submit two documents 1 paper hardcopy and 1 digital version) with inconsistencies and discrepancies [1][2][3][4]. While the digital documentation performance and thus e-Freight implementation of AFKLMP Cargo is dependent in the input from the customers, this is an important barrier. There exist several reasons for the customers to provide this incorrect input. Respondents indicate that it could be big, medium and small customers providing this incorrect input in different forms. The big customers often have the possibilities but lack quality of the e-AWB due to either lack of knowledge or cheating [13][14]. The medium and small customers often do not have the systems to provide e-AWBs, so they provide paper AWBs which is also seen as lack of input. The incorrect customer input thus means that the customers deliver or submit documents that are not conform the desired standards of AFKLMP Cargo regarding e-AWB or other digital documents.

Conservative industry

The respondents agreed on the conservative, old-fashioned, non-innovative industry that works slowly [1][2][5][8][15]. One reason is the industry culture and the identified reluctance to take action on things that are working fine and not causing major problems: ''Als het niet stuk is, waarom zou je het proberen te maken?'' [1]. It concerns mainly people with traditional, non-innovative mindsets and the mentality to stick to habitual routines and old processes. They don't see the benefits and prefer to work manually, it is in the culture and the routine [6]. They rather act in a firemen like way: ''Ze vinden het fijn als er dingen verkeerd gaan, want dan kunnen we dat repareren, krijgen we aandacht en hebben we iets goeds gedaan'' [1]. Moreover, the decision-makers are also still thinking in an old-fashioned way, without much innovation and are not pro-active to take decisions towards change. However, the respondents believe that in the future, the ''younger generation will more easily understand the potential and take action to change'' [9]. Another reason that is being observed and mentioned by experts, is the lack of action in the broader cargo industry [16]. The airline industry is already ahead of the maritime industry. There is no push from other parties and no examples exist to follow.

Customer resistance

The resistance to change from customers is perceived as an important barrier that partly explains the incorrect customer input. The resistance is present in several different forms. The respondents mention that some customers are just not interested [5][14], reluctant [11][12][17], and some are even actively resistant either because they want to cheat the system tot safe money, or they have the feeling that the airlines have become lazy and are trying to give them more work [14].

Lack of competitiveness

The lack of competitiveness is mentioned by several respondents as a barrier. Inaction of competitors or other external parties in the market leads to a lack of enforcement and makes it more difficult for AFKLMP Cargo to implement e-Freight [10][16]. With a lack of standards and guidelines in combination with a lack of competition, there is no enforcement from the

environment at all. Also, it makes it more difficult to convince customers as others are not emphasizing the importance [9]. At dense locations, customers could easily switch to other airlines that do not push for this [16].

No collaboration with external partners
Within the current situation with the lack of industry standards and missing or inadequate regulations, the collaboration of several parties could develop a standard together and support the implementation of e-Freight [17]. AFKLMP Cargo could partner up with external parties such as other airlines, customers (FFs) or GHAs and take action by developing standards. However, currently, there are no solid collaborations in the industry that invest in proper cooperation to develop the data exchange standard.

4.2.4.6 REGULATORY BARRIERS

Missing or inadequate regulations
This is mainly connected to the lack of standardization. There is no international macro regulation that sets a standard for the digital data exchange of cargo documents [5][16]. This results in confusion and inconsistencies in the implementation of e-Freight. Due to the lack of macro regulation, the range of different regulations in different countries creates a barrier. As a respondent mentions: ''Today, regulatory topics are pushing us to go digital in many countries, but at the same time, blocking us in some other countries'' [17]. There is not one uniform way to do it.

Furthermore, there is a lack of a central entity that is capable of setting adequate and central regulations for the entire industry. IATA proposes standards as XML, but they do not have restricting power. They are just a branch organization of several airlines and Freight Forwarders, but they are not able to determine a standard and enforce the industry to follow it [16]. They can try to influence the regulation but do not have the power to determine and make restricting decisions. It has to come from the governments that need to introduce rules, laws, and regulations that enforce the standardization of these document versions. However, that still lacks which creates freedom of using whatever document versions one wants for all parties. A regulation that is initiated by the EU, ICS2, is coming close to a regulation that will force the industry to move. Therefore, it is noted that such a big party as the EU does have the power to set adequate regulations, but lacked action until now.

Restricting regulations
Many respondents mention that there are many different rules and regulations across different countries, with some enforcing the use of hardcopies and restricting the use of digital documents. These restrictions exist in many different forms and vary across different geographical locations and thus outstations. Firstly, the customs often require the paper AWBs for checks and stamps [4][8][15]. Secondly, security authorities require papers to execute their checks [2][3][4]. This is a restricting regulation and results from the fact that digital brings transparency, which has two sides for governments. In general, governments want transparency on the documentation for security and regulatory purposes. However, in several countries, you should ask yourself the question; ''do they really want that transparency?'' [17] There could be several reasons for this blocking and non-willingness to change to digital, such as not wanting

transparency [17], having an interrupted internet connectivity [13][14], and corruption [16][17]. The non-willingness of governments results in restricting power.

4.2.4.7 STANDARDIZATION BARRIERS

Standardization barriers are seen as a significant trend in the e-Freight implementation process, encompassing both internal and external barriers, such as regulatory, organizational, social, technical, and market barriers. Respondents mention the lack of standardization across all these categories. They indicate that a lack of standardization of internal processes due to varying IT systems, regulations, and country specifics, makes the process complex and unclear [1][2][5][6][11][17]. They often do not mention the exact source of the lack of standards, but rather indicate it as a common and important barrier to the implementation e-Freight.

One commonly recognized obstacle in the cargo industry is the absence of industry-specific standards for document exchange. Currently, there is no established standard for data exchange within the industry, as reported in several references [1][6][12][16][17]. As a result, each stakeholder is at liberty to select their preferred approach for sharing documents, such as using paper hardcopies, employing peer-to-peer digital 'messaging', or developing APIs to enable real-time data sharing [16][17]. However, this diversity of options that is present due to the lack of set industry standards, poses significant challenges in establishing a consistent and uniform process to implement e-Freight among all stakeholders, each with their unique objectives and priorities. Moreover, in the absence of industry-wide standards, there is a risk associated with creating one's own IT standard. One may establish a successful business case, set an example and standards for the rest of the industry, and generate revenue. Alternatively, if the developed and implemented IT (API) standard is not accepted as the industry standard, the costs incurred will be significant [17]. Therefore, the industry conditions with a lack of both technical and regulatory standards and guidelines create a difficult situation for AFKLMP Cargo when aiming to implement e-Freight. The question then arises whether you want to pioneer and take risks by developing your own new standards for digital data exchange or stick to the old proposed industry standard of messaging. This external lack of IT standards and macro regulations [5] works through internal processes. Especially in the international context where a lot of different IT systems are being used and a lot of different regulations exist, it is difficult to establish a standardized process and approach. The earlier mentioned observation at the AOP where a list of approximately 20 IT system was showed, emphasized this lack of standardization and complexity. When also not having standardized organizational guidelines, steering and communication, the implementation is even more obstructed. In turn, it is difficult to develop standard guidelines, when there is a lack of IT standardization. This shows the complex interconnection. Overall, the absence of commitment to set standards within the whole industry and organization, adds to the complexity and lack of implementation.

4.3 OPPORTUNITIES & SOLUTIONS

In conjunction with the barriers identified in the empirical findings, the respondents also highlighted certain opportunities and solutions. The identified opportunities and solutions are connected to the process of barrier identification, while barriers reveal areas i.e. categories of focus and indicate where hindering factors or gaps exist. The identification of these areas suggests where to focus and pay attention for opportunities that could address or overcome these challenges. In this way, opportunities can be identified or unlocked by first indicating what barriers exist. Furthermore, the barriers themselves serve as a foundation for devising appropriate solutions and eventually strategies. This section therefore sets out the found opportunities and solutions from the empirical findings. Unlike to the empirical barrier identification where three data input sources were used, the opportunities and solutions are solely indicated based on the mention of respondents.

4.3.1 OVERVIEW OPPORTUNITIES

As indicated, the barrier overview in section 4.2 reveals the areas of concern that hinder the complete implementation of e-Freight within AFKLMP Cargo. Therefore, the opportunities are connected to these areas i.e. categories identified. It is rather important to identify opportunities while they lead to the discovery of potential solutions or strategies to eventually overcome existing barriers. The opportunities recognized within this case are set out below in Table 9.

Opportunities	Main Category	Sub-Category
Internal	Organizational	Other project raising attention (AOP)
		Transformation to digital
	Social & Cultural	The young generation
	Economic & Financial	X
Internal & External	Technical / Technological	Working groups of branche organizations
External	Market	Action of stakeholders on implementation
	Regulatory	Reinforcing regulation and standards
		Digital document acceptance

Table 9: Empirical Overview Opportunities

Reinforcing regulation and standards

As indicated in section 4.2.4.6, there are currently missing macro regulations and standards that enforce the parties in the air cargo industry to provide and submit digital document versions. Therefore, many respondents indicate the implementation of the new customs pre-arrival security and safety program of the European Union, Import Control System 2 (ICS2), as a paramount opportunity for the adoption and implementation of e-Freight [1][3][6][7][8][9][16][17]. This collective commitment of a consortium of European Union (EU) countries mandates that all stakeholders involved in the air cargo supply chain, seeking to transport goods into the EU, adhere to established digital document standards [1][16]. By introducing harmonized document versions and codes, standardization is enforced on an eco-system level. This commitment from a macro regulatory body serves as a binding requirement for ensuring compliance across the supply chain and underscores the importance of

standardization and harmonization in the industry. AFKLMP Cargo can embrace this opportunity and take on the momentum to share this responsibility with the customers and together change and implement technologies and processes to realize e-Freight [6]. This is a perfect chance to underpin the urgency to change to digital documentation and AFKLMP Cargo can use this in their story on WHY to change to e-Freight. It is not only that they want to change, but it becomes mandatory and exactly this is the moment [17].

Digital document acceptance

The existence of restrictive regulations across different countries and governments, as discussed in section 4.2.4.6, poses a challenge to the organization's complete e-Freight implementation, as these regulations are beyond their control. However, in certain countries, there have been notable changes in these regulations, with customs and authorities implementing pilots or accepting digital document versions that were initially declined. The recognition and acceptance of digital document versions by customs and authorities are viewed as crucial opportunities at the outstations. It is important to note that the specific digital document versions that present opportunities vary based on geographical location, influenced by the level of digital maturity and state-of-the-art documentation practices. Respondents have highlighted specific examples, such as the use of e-AWB/e-Manifest in Lagos (LOS) and the adoption of e-Fito in Lima (LIM) [5][8]. In LIM, the development and testing of a digital document version for supporting perishable shipments has eliminated the need for paper hardcopies, creating a major opportunity for e-Freight implementation (particularly considering the high volume of perishable shipments). Additionally, the implementation of a virtual service desk by customs in LIM has further reduced the reliance on paper copies. These opportunities hold particular significance in less developed countries where paper-based practices are still prevalent. Embracing digital document acceptance in such contexts can lead to improved efficiency, reduced paperwork, and enhanced overall e-Freight implementation.

Other projects raising attention

The Acceptance Outstations Program (AOP) at AFKLMP Cargo presents a significant opportunity for the awareness and implementation of e-Freight. This program, aimed at enhancing cargo acceptance processes at outstations by implementing a worldwide implementation plan, has garnered attention and generated enthusiasm among respondents regarding e-Freight. One respondent remarked, "Bij het acceptance verhaal ging bij mij toen een lampje aan" [8]. This highlights how the AOP served as a catalyst for recognizing the importance of e-Freight. Another respondent expressed, "Hiervoor stond het eigenlijk niet op de radar, maar toen ik dat hoorde dacht ik laten we hem nu gelijk meepakken. Dan zijn we in ieder geval de eerste" [10]. The AOP's implementation included specific building blocks, with the e-Freight component being one of them. This allowed certain outstations to become aware of their e-Freight status and motivated them to take proactive measures towards its implementation. Additionally, the program's standardized approach created a sense of uniformity across all outstations. A respondent emphasized, "The acceptance program was the perfect momentum" [6], underscoring the opportunity it provided to rollout something new and capitalize on the momentum. The AOP has not only raised awareness of e-Freight but also cultivated a heightened commitment and attention within the team; "The AOP has given us the opportunity to get better at this and has given a lot of light to this. There is attention and commitment from the team is created" [7]. This exemplifies how the program has instilled a sense of dedication and illuminated the significance of e-Freight implementation.

Transformation to digital

The digital transformation of a certain process could be an important opportunity to also digitally transform another process. For example, respondents mention that the booking process i.e. e-Booking is currently a hot topic in Lagos, which could be an opportunity to directly take on the transformation to e-AWB or e-Freight. As a respondent mentions ''use one stone to key two beds'' [13]. While the outstation team of AFKLMP is already putting effort in explaining, educating and training customers to take on this digital process, it would be efficient to take this momentum and implement the e-AWB along in one go. This contact with the customers is an important opportunity to promote and train e-AWB immediately, when training for e-Booking.

The young generation

Some respondents mention that the young generation represents an opportunity to implement e-Freight [6][8], while they are more likely to accept, adopt and even initiate new technology implementation due to several reasons. They have innovative mindsets compared to older people and are often not prone to sticking to embedded routines. This leads to the fact that they are less likely to be resistant to change overall and are more inclined towards embracing digital transformations. They solve the social and cultural barrier organizational inertia, while they do not tend to maintain the current state of affairs, but rather focus on innovation. Therefore, it is important to focus on young talent and young people to create a story that passes along the message, brings forward the WHY and finally really take action.

Working groups of branche organizations

An important opportunity is to join the working groups of branche organizations regarding going digital and e-Freight implementation [16][17]. Within these working groups, plans are made and conversations are held on possibilities for going digital. When joining these working groups, an organization can aid in developing and indicating suited technology and help the industry in changing. Currently AFKLMP Cargo has two chairs at the IATA working group, but only one is filled [17]. It is important to take this opportunity and also fill the other chair with someone representing the organization. Furthermore, possibilities at other branche organizations than IATA, such as ACN should be discovered.

Action of stakeholders on implementation

The action of stakeholders within the industry on prioritizing digital documentation is seen as an important opportunity. For instance, a major customer in Lima, has started using e-Airway Bills (e-AWBs), creating an opportunity for AFKLMP Cargo to adopt digital documentation at the respective outstation [8]. Additionally, Lufthansa, another airline, is actively promoting their digital transformation [9][17]. This presents an opportunity for AFKLMP Cargo to align with industry trends and leverage the momentum towards digitalization. It is important for AFKLMP Cargo to pay attention to the initiatives of other stakeholders in the supply chain and capitalize on the growing awareness and acceptance of digital solutions.

Both barriers and opportunities serve as input for the identification of solutions. The respondents indicated solutions, which are set out below in Table 10. While the opportunities were categorized within the indicated barrier categories from the empirical overview, the same is done for the mentioned solutions.

Solutions	Main Category	Sub-Category
Internal	Organizational	Attach priority and tell the story
		Start small and try to grow faster
		Strict/hard measures and targets
		Structural follow-ups
		Educate employees (steering, guidance and training)
		Allocate project implementation responsibility
	Social & Cultural	Change attitude top-management
	Economic & Financial	X
Internal & External	Technical / Technological	Develop API Standards
External	Market	Educate customers
	Regulatory	Get customs and local authorities on board

Table 10: Empirical overview solutions

Attach priority and tell the story; intrinsically motivate people

To achieve complete e-Freight implementation, respondents indicate that it is crucial to attach priority to the project and effectively communicate its purpose and significance throughout the organization [1][4][7]. Respondents mention that top management plays a pivotal role in assigning priority to the project [8][12][14]. By conveying why the project is important, not just focusing on the how and when, employees can better understand and connect with the objectives [1]. This approach fosters intrinsic motivation and a genuine desire to participate. The importance of storytelling is highlighted in this context. As a respondent mentions: ''Het verhaal moet verteld worden. Je moet mensen niet alleen maar sturen als een directieve tiran, maar je moet mensen ook juist intrinsiek motiveren om iets te willen'' [9]. By sharing the story and rationale, individuals can be intrinsically motivated to contribute to the project's success [16]. Ensuring that the entire organization comprehends the what, how, and WHY of e-Freight is crucial. Intrinsic motivation can be further reinforced by emphasizing the benefits and win-win situations both internally and externally. Additionally, passing on the story to industry stakeholders and external parties helps garner support and engagement. By highlighting the advantages for customers, such as improved efficiency and service quality, the case for e-Freight becomes more compelling [16].

Start small and try to grow faster
During the interviews, respondents emphasized the importance of starting small and aiming for faster growth in e-Freight implementation [4][7][17], as a respondent mentioned: '' ''you start small and you try to grow faster'' [17]. They highlighted the need to create small functional systems and obtain digital proof of their effectiveness before connecting them, similar to the development of the internet [17]. It was suggested to begin by making the system work internally and then expand it to include key ecosystem partners, such as customs, first-line customers, and ground handling agents. Furthermore, respondents recommended focusing on outstations with favorable circumstances as an initial step [17]. By following this approach, organizations can achieve successful e-Freight implementation and pave the way for future expansion.

Strict/hard measures and targets
A solution proposed by the respondents was the incorporation of realistic strict measures and targets [2][8][9]. This solution encompasses two key aspects: measures within the organization and measures directed towards customers. Within the organization, the implementation of hard targets and Key Performance Indicators (KPIs) is crucial [10]. These targets act as benchmarks and milestones to track progress towards e-Freight adoption. Additionally, capturing central policy ensures that the implementation strategy is clearly defined and communicated across all levels of the organization [19]. Towards the customers, a customer-centric approach is vital. The solution involves only accepting e-AWB contracted customers and closing the accounts of those who do not comply (as demonstrated by the SIN example) [10]. Organizations should not hesitate to communicate the deadline to customers and make it clear that failure to sign up for e-AWB will result in their exclusion [11]. This firm stance is necessary to steer customers towards embracing e-Freight practices. Refusing to accept paper AWBs and introducing associated fees further reinforces this message. It is believed that by imposing financial consequences, customers will be incentivized to adopt e-AWBs [7][17].

Structural follow-ups
Respondents from the interviews proposed implementing structural follow-ups as a solution for complete e-Freight implementation [11]. This involves internally and externally monitoring the current state of e-Freight and actively communicating with customers [3][9]. Internally, it is important to provide regular updates and clarify responsibilities within the team, ensuring everyone is aligned [11]. Externally, it is crucial to stay engaged with customers and consistently follow up on their progress and reasons for not providing the expected input [3][9]. This ongoing effort is necessary to keep customers motivated and prevent the adoption of e-Freight from fading [11]. By maintaining focus and establishing effective communication channels, AFKLMP Cargo can achieve their goals and drive successful implementation of e-Freight [11].

Educate employees (steering, guidance and training)
The importance of educating customers is recognized as a solution for complete e-Freight implementation. The respondents highlighted the need to focus on changing the documentation process and ensuring accuracy by providing adequate training to staff [2][5][6][7][14]. The respondents also emphasized the significance of being well briefed to effectively implement e-Freight [13]. By prioritizing customer education and providing comprehensive training to staff

members, organizations can minimize errors and ensure smooth operations in the e-Freight process.

Allocate project implementation responsibility
Respondents emphasized the importance of allocating project implementation responsibility as a solution for complete e-Freight implementation [1][10][16]. A suggestion was made by a respondent: ''I think that the highest managers within market should get the responsibility, either the MTs or the AODs'' [10]. Additionally, they recommended including e-Freight in the targets of a specific function, which would provide clarity and ease of steering. By clearly assigning responsibility and incorporating e-Freight into specific functions' targets, organizations can ensure effective project implementation and streamline the overall process.

Change the attitude of the top-level management
According to the respondents, a crucial solution for achieving complete e-Freight implementation is changing the attitude and commitment of top management. Their insights highlighted the significance of top-level management's thinking [5] and the need for commitment from the highest ranks of the organization. The respondents emphasized that the direction and actions of the company heavily depend on the priorities set by top management [11]. They expressed that if the decision to pursue e-Freight is made at the top level, the organization will be able to move forward successfully. The respondents particularly emphasized the role of top management in target setting, emphasizing that their commitment is essential in driving the necessary changes. They stressed the importance of top management's commitment trickling down throughout the organization [9], creating a culture of change and a sense of urgency.

Develop standard API structure
A respondent proposed developing a standard API structure as a solution for complete e-Freight implementation [17]. They emphasized the need to prioritize the establishment of a new standard API that allows AFKLMP Cargo to pioneer and remain competitive [17]. This approach aligns with other airlines in the industry, enabling seamless plug-and-play integration and real-time data exchange [17]. By adopting a standardized API structure, AFKLMP Cargo can enhance operational efficiency, improve collaboration with industry partners, and facilitate the smooth flow of e-Freight processes [17]. This solution contributes to their goal of achieving complete e-Freight implementation and staying at the forefront of technological advancements in the cargo industry.

Educate customers
The solution proposed for complete e-Freight implementation includes focusing on the education of customers, as suggested by the respondents. They emphasized the need for efforts to convince and onboard customers [6]. To facilitate this process, the respondents recommended creating a comprehensive guide that provides clear instructions on how customers can easily make the transition to e-Freight practices [10]. They emphasized the importance of taking customers by the hand and guiding them through the process [10]. One crucial aspect of customer education is to explain the importance and benefits of e-Freight. By clearly articulating the advantages, such as improved efficiency, reduced paperwork, and enhanced supply chain visibility, organizations can help customers understand the value of embracing e-Freight practices. This includes convincing and onboarding customers, providing

a comprehensive guide for easy transition, explaining the importance and benefits of e-Freight, and implementing structural follow-up measures. By prioritizing customer education, organizations can foster understanding and facilitate a smooth adoption of e-Freight practices.

Get customs and local authority on board

Some respondents emphasized the importance of getting customs and local authorities on board as a solution for complete e-Freight implementation [4][17]. It was highlighted that in order to achieve a fully paperless process, it is crucial to involve customs and gain their support [4]. Additionally, the need to evolve and motivate the authorities and customs at a local level was mentioned [17]. Overcoming initial restrictions requires effort and a proactive mindset, focusing on the opportunities rather than the limitations. By actively engaging customs and local authorities, organizations can foster collaboration and cooperation, leading to smoother e-Freight implementation and successful digital transformation.

The reclassification of barrier categories and the additional identification of opportunities and solutions led to the following revised visualization of this study.
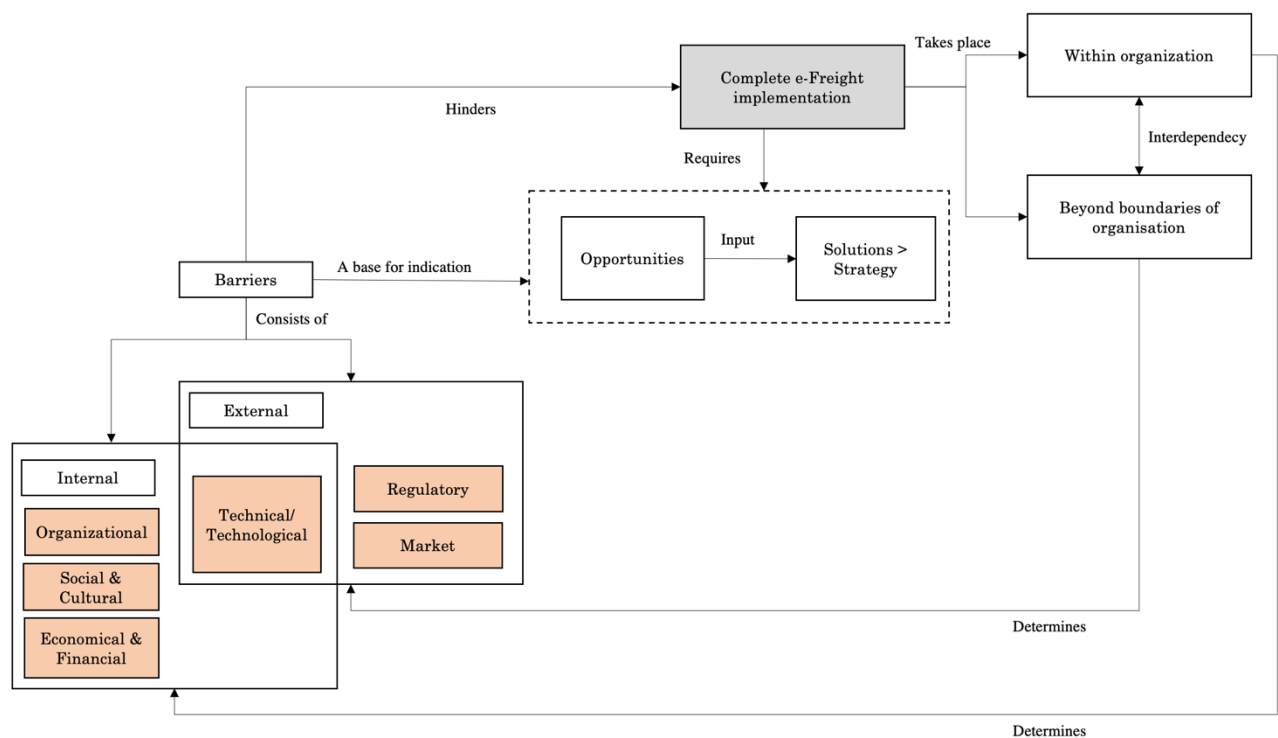

Figure 10: Revised Conceptual Model

4.4 ANALYSIS RESULTS

This section analyses and indicates insights on the differences and specificities of the results regarding the differences in outstations and respondents.

4.4.1 ACROSS LOCATIONS

It has been noted that there exist multiple differences across outstations. These differences vary from differences in culture, the behavior of individuals, technical developments, or market specifics and influence e-Freight adoption and implementation. They are both form internal and external origin.

The external factors that differ among different geographical locations and thus outstations are:
- Restricting regulations; customs or local authorities
- Infrastructure facilities
- Customer performance

Internally speaking, some barriers are influenced by geographical dispersion such as cultural rigidity and organizational inertia. The outstations differ in the occurrence of both cultural rigidity and organizational inertia. This is due to the fact that knowledge differs a lot per outstation. Also, the lack of commitment from top management and therefore the lack of strict steering results in differences of attention and priority on the project. It now comes down to the local teams and their own willingness to prioritize the project and take action, leading to huge differences regarding implementation practices or approaches.

Overall, differences in cultures lead to differences in behaviors. It is recognized that at some outstations the attitude towards e-Freight implementation is rather positive and at some stations people have no knowledge or are resistant. Furthermore, the economic development of a country of the respective station has a big influence on the possibilities towards e-Freight implementation. When having inaccurate infrastructure facilities, the implementation is counteracted.

4.4.2 ACROSS RESPONDENTS

Within the respondents it is recognized that differences exist between job functions regarding their knowledge on the e-Freight project, emphasis on implementation practices and strategic insights. The differences are indicated per job function.

The operational core mainly talks about the implementation process and its detailed step-specific hurdles. They mainly indicate the problems with customers on a detailed level regarding their performance and behavior, leading to acquiring a comprehensive understanding of the customer-related barriers. Through the interviews with the operational core, the inconsistency in data exchange from the customers is recognized. Furthermore, they indicate their lack of knowledge of the process and emphasize the lack of guidance and steering from the top. They ask for education and training to better execute and improve their implementation practices.

Furthermore, a differentiation in attitude between the Operational Staff (OPS) and Customer Service Officers (CSO) can be distinguished, whereby OPS possesses greater knowledge of the e-Freight initiative, resulting in greater commitment and willingness to adopt change. This disparity can be attributed to the fact that OPS are close to the operational processes and are primarily affected by the inadequate e-AWB practices. Hence, when customers submit incorrect documents, OPS are the first to identify the issue and are tasked with addressing it. Conversely, CSO exhibit less enthusiasm towards e-AWB and may initiate negative conversations with customers. However, this perception is attributable to their insufficient knowledge of e-AWB, which prevents them from conveying the message effectively to customers.

In addition, middle managers accentuate the strategic barriers, highlighting deficiencies in the e-Freight project and the absence of a compelling narrative. They emphasize the need for intrinsic motivation among stakeholders through a well-crafted story. Furthermore, they draw attention to the unclear allocation of the e-Freight team within the organization.

The experts have by far the most knowledge on the e-Freight subject and provide even more strategic and high-level insights, including the presence of misaligned technology solutions. They acknowledge that messaging is an outdated technology and underscore the greater suitability of API standards, as well as the significance of research and development of these standards. In addition, they offer additional insights into the intricate interplay among all barriers.

4.4.3 VALIDITY RESPONDENTS' OPPORTUNITIES & SOLUTIONS

The respondents provided valuable insights and identified various opportunities and solutions related to e-Freight implementation. Overall, they demonstrated a good understanding of the challenges and offered feasible solutions. It is seen that the respondents' suggestions regarding opportunities and solutions for e-AWB implementation varied based on their roles and expertise. Each perspective offered valuable contributions, but on different levels. The operational core managers proposed mainly practical opportunities and solutions that affect their day-to-day tasks. They emphasized the importance of training to enhance their skills in handling e-AWB, acknowledged the need for guidance towards customers and stressed the importance of having dedicated personnel to review documents and identify specific areas of concern. The middle management identified more high level opportunities and solutions. Their high over view and understanding of the operational and commercial landscape allowed them to accurately pinpoint valuable ideas for resolving the for the entire organization. They highlighted the importance of storytelling and indicated the adaptive approach of starting small and trying to grow bigger from there. The experts provided more 'factual' opportunities and solutions regarding the regulatory and technical field.

The mentioned opportunities and solutions largely rhyme with the indicated barriers, which means that the respondents have a good idea on the situation, where to focus and how to solve it. Each perspective offered valuable contributions. When considering the complete implementation, fundamental change needs to be generated across all outstations and the middle managers and experts had a better insight. The operational core indicated the practical executive solutions mainly. It is remarkable that no economic opportunities nor solutions were mentioned, but this matches with their lack of representation in the barriers.

5. DISCUSSION: ANALYSIS AND IMPLICATIONS

This chapter discusses the results, consisting of an elaborate analysis with its implications mentioned. First, the empirical results are compared to the literature exploration by reflecting on the categorization as well as the importance of the barriers mentioned in the empirical study. Second, the results were analyzed more interpretively in a triangulation fashion using different theories. Third, the methodology will be reflected on. Finally, the contributions and transferability are emphasized.

5.1 COMPARISON TO LITERATURE

In this section, the barriers identified through the empirical study are compared with those obtained through the literature review in chapter 3. The categorization of the empirical barrier overview is compared to the conceptual literature overview. Also, the differences in amount of times mentioned between the literature exploration and the results from the empirical study are discussed per category.

5.1.1 COMPARISON MAIN CATEGORIES

For both the main categories of the literature exploration and the empirical findings, the radar charts are displayed below in Figure 11 and Figure 12 to indicate the similarities and differences in both the main categorization and the importance of the barriers.

Figure 11: Importance theory *Figure 12: Importance interviews*

The main categories from the conceptual theoretical overview are recognized within the empirical outcomes. The structure of the main categories of the empirical barrier overview is largely consistent with the main categories from the conceptual theoretical overview. However, a remarkable difference is the addition of a main category: Standardization Barrier. Furthermore, the Economic & Financial barrier category was shifted from being a both internal and external to be solely an internal barrier.

The sub-categories identified in both the conceptual theoretical overview and the empirical overview were classified based on their frequency of mention in the literature and the semi-

structured interviews. They have been arranged in Table 11 and Table 12, respectively, in descending order of their frequency of mention.

Main Category	Sub-Category
SCB	Lack of qualified personnel
SCB	Resistance to change
SCB	Lack of knowledge or information
SCB	Lack of commitment from top management
TB	Lack of technological integration
OB	Unsupportive organizational structure
TB	Lack of infrastructure facilities
RB	Lack of government support
OB	Lack of training, education or guidance
MB	Customer resistance to change
OB	Lack of functional cooperation
RB	Missing or inadequate regulations
OB	Project vision and strategy deficiency
EFB	High initial investment / cost
EFB	Lack of budget
OB	Lack of employee empowerment
OB	Performance measurement gap
RB	Restricting regulations
MB	No collaboration with external partners
MB	Lack of industry specific guidelines
MB	Conservative industry
MB	Lack of customer performance
OB	Inadequate or lack of resources
SCB	Lack of awareness
EFB	Difficult access to financial resources
TB	Data security risks
EFB	Investment aversion
TB	IT implementation gap
TB	Misaligned technology solution
MB	Lack of competitiveness

Main Category	Sub-Category
MB	Incorrect customer input
RB	Restricting regulations
MB	Conservative industry and attitudes
OB	Insufficient communication channels
OB	Deficient e-Freight project design
OB	Performance measurement gap
SCB	Lack of commitment from top management
Trend	Lack of standardization
SCB	Organizational inertia
OB	Unsupportive organizational structure
TB	Lack of technological integration
MB	Customer resistance to change
TB	Misaligned technology solutions
TB	Lack of infrastructure facilities
SCB	Lack of qualified personnel
OB	Lack of training, education or guidance
SCB	Cultural rigidity
RB	Missing or inadequate regulations
MB	Lack of competitiveness
EFB	Lack of budget allocation
MB	No collaboration with external partners

Table 11: Classification sub-categories theory Table 12: Classification sub-categories empirical data

Differences, similarities and remarkable findings between the literature exploration and the empirical results will be discussed.

Economic & Financial Barriers least present in empirical findings
The empirical findings in the case of AFKLMP Cargo reveal notable differences in the economic barriers mentioned by respondents compared to the sub-categories identified in the literature. While the literature shows various sub-categories of economic barriers with quite some significance, the empirical findings only highlight the lack of budget allocation as an internal barrier within the organization. This barrier is indicated more as an organizational choice rather than a prominent main category and is least mentioned. A potential explanation on this divergence between the literature and empirical findings is that the emphasis primarily on the lack of budget allocation is specific to this case and thus organization. While AFKLMP Cargo is a huge organization with a lot of capital it is rather seen as a choice than a hard restriction. It may be noted that this finding may be strengthened by the respondents, while they perceived other barriers to have a greater impact, resulting in less emphasis on financial factors. Moreover, it is important to consider that the respondents may have had limited information or expertise regarding the Economic & Financial barriers, potentially underestimating their

relevance within the specific context of AFKLMP Cargo. This could be an explanation while experts recognized the significance of the lack of budget allocation, indicating it as an important barrier that may be underestimated within these findings.

Organizational Barriers important in empirical findings
The empirical findings highlight a greater emphasis on the organizational barriers as compared to the literature. This difference can be attributed to the specific context of the case study and is probably strengthened by the perspectives of the respondents. One possible explanation is that the organizational structure and processes at AFKLMP Cargo play a significant role in shaping the implementation of e-Freight. The respondents, being individuals directly involved in the implementation process from the organization, may have a deeper understanding of the internal dynamics and organizational barriers they encounter. This firsthand experience and knowledge may lead them to prioritize and emphasize the Organizational main category in their responses.

Furthermore, a notable difference is the lack of attention given to insufficient communication channels in the literature. In the case of AFKLMP Cargo, the inadequacy of communication channels emerged as a significant barrier. This lack of communication channels was rather seen as part of the unsupportive organizational structure within the literature. Therefore, it may be noted that this finding is case specific. The same goes for the deficient e-Freight project design and the gap in performance measurement within the organization, which are also specifically important in this case.

Market Barriers important in empirical findings
The market main category is more important in the empirical findings compared to the indications from the literature. This difference can be explained by the case-specific characteristics of high external stakeholder dependencies, the conservative nature of the industry, and the direct involvement of respondents with external stakeholders in their daily work. In the market sub-categories, both literature and empirical findings recognize the significance of customer-related barriers. However, while the literature emphasizes customer resistance to change, the empirical findings highlight the issue of incorrect customer input. The empirical evidence suggests that customers often provide inaccurate or incomplete information without indicating whether it is resistance or due to another reason (no knowledge, no facilities e.d.). This may be because the customers in this case do not explicitly express resistance but instead provided incorrect input due to other reasons just like a lack of understanding, miscommunication or limited knowledge of the e-Freight.

Social & Cultural similarly overall but less in sub-category
The empirical findings in this research may confirm the importance of the main category Social and Cultural barriers due to the specific characteristics and context of AFKLMP Cargo. While there may be industry-specific nuances, the fundamental social and cultural dynamics that influence change and innovation are likely to remain consistent. The similarity in the representation of the main category Social and Cultural barriers between the literature and empirical findings can be attributed to the broad applicability of these barriers across industries, the common human dynamics underlying them, and the comparable importance within the specific context of AFKLMP Cargo. However, when looking at the sub-categories, the empirical findings suggest that social and cultural barriers may appear less important than within literature. However, these barriers are still present and manifest in various ways. It is

important to note that the participants in the study, being the executors themselves, may be less likely to explicitly indicate resistance to change. Instead, the root causes and origins of social and cultural barriers can be traced back to organizational factors. Organizational inertia, lack of knowledge dissemination, and cultural rigidity contribute to the existence of these barriers. Therefore, while social and cultural barriers may not be explicitly highlighted, their influence is observed indirectly through the organizational barriers identified in the study. This contributes to the organizational barriers being more represented within empirical findings.

Interlink Organizational vs. Social & Cultural categories
It must be noted that the separate barrier categorization of Organizational barriers and Social & Cultural barriers based on the literature was detained, but is not always clear-cut. The interviews revealed that the root cause or main origin of barriers within these categories is often difficult to determine. These two categories are intertwined and strongly interrelated and interdependent, making it difficult to distinguish between them. In terms of organizational barriers, most sub-categories align with existing literature. However, inadequate communication channels emerged as a distinct sub-category in this study, contrary to previous research. It was recognized as significant and deserving of its own category due to its relevance in the case. This sub-category absorbed two sub-categories from the social & cultural category, highlighting the interrelation between these barrier categories. The specific context of the case study and the perspectives of the respondents contribute to this complexity, highlighting the interconnected nature of barriers within organizations. Furthermore, this merging explains the greater presence of organizational barriers compared to social & cultural barriers found in this case study.

External over internal in empirical findings
The empirical findings indicate that external sub-category barriers, such as incorrect customer input, restricting regulations, and conservative industry attitudes, are more prevalent compared to internal (social & cultural) sub-category barriers. This contrasts with the emphasis on internal barriers found in the literature. The case-specific nature of e-Freight implementation in AFKLMP Cargo/airlines contributes to this difference. The success of implementation relies heavily on external factors, including customer input, regulatory context, and industry characteristics. While social and cultural barriers are commonly recognized in the literature as impediments to change and innovation, the dominant presence of external, followed by organizational barriers in this case underscores the need to address external challenges and enhance organizational readiness for successful e-Freight implementation in the air cargo industry.

Technical/Technological Barriers
In contrast to the theoretical indications, the empirical findings suggest that the technical/technological barriers are a little less important within the context of AFKLMP Cargo. While the identified technical/technological barriers align with the theoretical framework, two specific barriers, data security risks and the IT implementation gap, were not mentioned by the respondents. Regarding the IT implementation gap, the empirical data indicates that this aspect was not explicitly recognized as a separate technical barrier. Instead, it was mentioned within the internal barriers as a lack of action from within the organization. This suggests that the respondents attributed the challenges of IT implementation to organizational factors rather than purely technical issues. The case-specific explanation for the perceived lesser importance of the technical/technological main category in the empirical findings lies in the feasibility of the

current technology being used by AFKLMP Cargo. Although the existing technology is deemed feasible, experts highlight that it may not be the optimal solution for the intended purpose. This implies that while technical barriers exist, they are overshadowed by other factors and are not as pronounced in hindering the implementation of e-Freight within the organization. Overall, within the technical category, the sub-barriers extracted from the literature and the barriers mentioned by the respondents are very similar. There is consensus that the lack of technological integration is a prominent barrier. However, misaligned technology solutions are more prominent within the case. This could be attributed to the focus on messaging instead of the new introduced technology that is better suited for its intended purpose, API/ONE Record.

Regulatory Barriers
For the regulatory barriers, the categorization and importance is similar. This is logical, while regulatory barriers are inherent challenges faced in various industries and sectors when implementing new initiatives or changes. The literature on regulatory barriers provides a foundation for understanding the common types of obstacles organizations encounter. Within the regulatory category, the barriers that are indicated in the literature and mentioned by respondents are very similar. As mentioned in Section 5.1.1.3, the sub-category lack of government support is not specifically mentioned by the respondents. However, this barrier is recognized within the empirical findings but scaled under/combined with missing or inadequate regulations. Therefore, the regulatory barriers identified in the literature and empirical findings exhibit substantial agreement.

Standardization
The empirical findings reveal the addition of a distinct category called "Standardization barriers" to the existing literature on e-Freight implementation. Unlike the exclusive nature of other barrier categories, the standardization barriers are observed across all identified categories and are challenging to attribute to a single main category of origin, thus considered a trend. The multi-domain nature of standardization barriers highlights their importance in various aspects, including technical, market, organizational, and regulatory domains. Standardization plays a crucial role in connecting different systems, processes, and stakeholders, making it an essential consideration in e-Freight implementation and thus in this case. While the lack of standardization was previously expressed as a sub-category within different main categories in the literature, its significance in this specific case prompted the creation of a separate barrier category to address this pervasive concern.

The purpose of this section is to enhance the comprehension of the identified barriers in the empirical data. To achieve this, certain theories are employed to better elucidate the observed barriers and their interrelationships. Through triangulation, additional theories are integrated to explicate the phenomena observed in the empirical data.

5.2.1 BUREAUCRATIC ELEMENTS

Machine bureaucratic elements within a dynamic and complex environment

Certain organizational characteristics of AFKLMP Cargo correspond to machine bureaucratic elements, as explained by Mintzberg (1979). However, it is mentioned by Mintzberg that such a structure is most effective in a simple and stable environment with repetition and standardization, but the opposite is the situation in this case. A gap exists between the organizational desired environmental aspects and the actual environment, due to the fact that the organization is geographically scattered (multi-unit) and a lot of different contexts exist. It is rather a dynamic and complex environment with international and multi-stakeholder dependencies, where a standardized process is not in place and is difficult to achieve. This leads to the fact that AFKLMP Cargo is not that strictly organized as a machine bureaucracy. However, the tendency to hold on to routine in work practices is noticed within the organization. These indicated organizational characteristics rather emphasize the need for standardization, which appears to be especially relevant while it can improve efficiency and foster cooperation among units of an organization (Bartlett & Ghoshal, 2002; Prahalad & Doz, 1987). While this cooperation is crucial, it is recommended to look for ways how to standardize and make the process as uniform as possible. This is currently not the case but can try to steer towards this. Moreover, the recognition of machine bureaucratic elements within AFKLMP Cargo in combination with these environmentally complex factors, can explain the identification, significance and relevance of identified barriers to e-Freight implementation within the empirical data.

Centralized hierarchy of strategic decision-making and strategy formulation

One of the organizational characteristics of AFKLMP Cargo that corresponds to a machine bureaucratic structure, according to Mintzberg's (1979) theory, is the centralized hierarchy of decision-making for strategy formulation. This structure emphasizes the strong dichotomy between formulation and implementation, where the top management formulates the strategy, and the middle management and operational core ensure its implementation through action plans. Therefore, due to the geographical dispersion of local teams and their dependence on top management decisions, it is crucial to have top management commitment towards the e-Freight project in terms of making key decisions such as budget allocation and formulating a suitable strategy for the project. The current lack of such commitment is thus emphasized within this structure and has a direct link to the deficient e-Freight project design, insufficient budget allocation, and lack of clear strategy and implementation practices for the local teams. This leads to an unsupportive organizational structure with a dependency on local teams' initiatives and their priorities, unclarity on their responsibilities, and ultimately, less strict enforcement and implementation of the e-Freight project. Moreover, this characteristic of centralized decision-making at the top also influences the misalignment of technology, while the top management needs to take the decision to adopt a new technology or invest in R&D to develop

a new technology. When they fail to make this decision, the introduction of the new technology stays out. Furthermore, it is noted that the environmental factors of this case regarding the geographical dispersion of the local teams at outstations and the multi-actor dependency, contribute to the complexity of such strict steering. Therefore, the need for commitment from top management is emphasized and its importance as a barrier is understood.

This structure and its implications could be analyzed through the lens of contingency theory (Lawrence & Lorsch, 1967). According to this theory, an organization's structure should align with its environment to be effective. In the case of AFKLMP Cargo, the centralized decision-making structure struggles with the environmental complexities presented by the company's geographical dispersion and multi-actor dependency. A potential solution to address the issue of a deficient e-Freight project and lack of implementation practices is to decentralize strategic decision-making, empower local teams and establish sufficient communication channels to construct strategies. Decentralization of this decision-making, as suggested by literature, could empower local teams and increase their responsiveness to environmental changes (Chandler, 1969; Bartlett & Ghoshal, 2002). Additionally, establishing sufficient communication channels is key to integrating local knowledge into the broader strategy (Nonaka & Takeuchi, 1995), thereby improving the e-Freight project's effectiveness. Currently, worldwide knowledge is not brought together and incorporated into a strategy due to insufficient communication channels, leading to lacking project attention.

Focus on performance rather than solving problems
Another aspect of a machine bureaucracy, as identified by several respondents, is the emphasis on performance rather than problem-solving. In this type of organizational structure, where the top management at headquarters formulates strategies that affect the entire organization (including the outstations), performance measurement is critical in assessing the outstations' performance and specificities. Given the international context, there is limited direct control on all outstations, making reliable performance measurement tools essential. However, this is currently not in place. This, in combination with insufficient communication channels, leads to a lack of knowledge of the strategic top on the local situations and their performance. The headquarters' reliance on potentially flawed data and measurements to steer the outstations might not align with local needs and conditions. This misalignment might lead to ineffective decision-making and potential underperformance. It implies that the standard set of performance metrics may not adequately capture the diversity of challenges and situations faced by different units in different locations (Simons, 2000). Consequently, the steering may not match the actual situations and lead to a disconnect between local needs and strategic decisions made by headquarters. Therefore, it is crucial to reassess these tools and ensure that they are reliable and effective. It is imperative that they work as intended.

In addition, the emphasis on performance could be a reason for the organization's reluctance to adopt a more suitable technology (API over messaging). Since the management prioritizes performance over problem-solving and the current technology is not causing any issues, they may have the attitude of "Why fix something that isn't broken?". This aligns with Cheng's mention that a bureaucracy rather uses the ''good enough'' alternative that does not deviate too much from organizational routines (1990). This once again highlights the significance of these tools and their critical role in advancing the organization. It is essential that they function as intended to facilitate progress.

Through the lens of technology adoption theory

Although experts and IATA acknowledge that the current messaging technology is outdated and that ONE Record/developing APIs is the most appropriate technology, AFKLMP Cargo has yet to implement it. The reasons for this delay can be better understood through the lens of technology adoption theory. This theory proposes that the adoption of a new technology depends on various factors, including perceived usefulness, perceived ease of use, compatibility, complexity, observability, and trialability (Almaiah et al., 2022). By examining these factors, it becomes clear why it may be challenging for AFKLMP Cargo to transition to a new technology and could explain the presence of this barrier.

Compatibility doubts

There are mainly doubts regarding technology compatibility. According to this concept, the degree to which a technology is consistent with existing values and needs of adopters influences the likelihood of adoption. In the case of AFKLMP Cargo, messaging technology is already deeply ingrained in the organization and plays a crucial role in another major project, CargoBUS. This makes it difficult to introduce a new technology like APIs, which would require significant organizational change and integration efforts. Therefore, the compatibility of APIs with existing technologies and practices is an important consideration in the adoption decision. Another important identified barrier that complexifies this adoption decision, is the lack of standardization from the industry i.e. industry-specific standards and guidelines. This was also mentioned by respondents, mainly experts. As mentioned in Section 4.2.4.3, there is a risk associated with creating one's own IT standard. It will either lead to beneficial circumstances or loss of a lot of invested money. The lack of standards within the industry thus leads to uncertainties regarding its compatibility with the industry standards. Moreover, this lack of standards leads to the presence of multiple different IT systems, leading to difficulty in assessing the API compatibility with all other present systems.

This uncertainty regarding the compatibility of the new technology could explain the lack of commitment from top management. Without compatibility of the new technology with the existing internal systems and processes and unclarity about its compatibility with the external environment/industry, top management may resist its adoption or not commit to its implementation. This leads to AFKLMP Cargo facing a significant obstacle in adopting the new technology of ONE Record. The decision of whether or not to adopt the technology ultimately lies with top management and their lack of commitment could hinder progress in this area. Therefore, it is crucial for top management to demonstrate their commitment to the adoption of ONE Record, as without it, the adoption of the technology may not be possible.

Given that top management's lack of commitment to adopt the new technology could be largely due to the uncertainty surrounding its compatibility with existing systems and processes, it is important to conduct trials to verify its compatibility. Designing and conducting pilots would be crucial in determining the viability of the new technology and ensuring that a well-informed decision is made on the technology used. This is especially important because it significantly affects the organization.

5.2.3 CUSTOMER INNOVATION DIFFUSION

When considering the incorrect customer input on e-Freight overall, the innovation diffusion theory explains customer adoption. This theory can be linked to the categories of adopters as well as the stages of the adoption process and could explain the incorrect customer input within this case.

Adopter categories

When considering the adopter categories in this context of business (AFKLMP Cargo) to business (customers) (B2B), the theory suggests that the adoption of new processes or technologies by small or medium customers is influenced by the behavior of larger, more established customers The theory suggests that the adoption of new processes tends to follow a predictable pattern, with innovators being the first to adopt, followed by early adopters, the early majority, the late majority, and finally the laggards (Rogers, 1995). In the case of e-Freight adoption at AFKLMP Cargo, this adoption pattern among customers is observed. At stations where e-AWB implementation is already initiated, it is noticed that large customers who are innovators and early adopters quickly change their processes towards e-AWB. However, AFKLMP Cargo is also faced with the challenge of dealing with the late majority and the laggards that do not provide e-AWBs, which are mainly medium and small customers, but can also include some large customers. The question therefore arises; how to get the late majority and laggards on board? According to the innovation diffusion theory, smaller and medium customers (mainly the laggards) are influenced by larger, established customers (i.e. the innovators or early adopters). This knowledge is crucial when implementing e-AWB at outstations. To begin with, larger customers should be approached, and their successful implementation should be ensured. Once these large customers have adopted and benefitted from the new process, they can serve as positive influencers for smaller customers and act as examples. However, in some cases, laggards still exist, and it is important to identify the reasons for their reluctance to submit e-AWBs.

Reasons that are indicated are mainly the lack of knowledge of customers on e-AWB, the lack of ability to submit the e-AWBs due to lack of resources or tools to submit them, or resistance to change towards e-AWB, mainly from small and medium customers. This leads to a two-split in customers;
- The innovators/early adopters; mainly big customers that have their own internal systems to submit e-AWBs
- The late majority/laggards; mainly small/medium customers that either do not want to change or do not have the resources/systems to submit e-AWBs

It should be noted that some innovators have the capability to submit e-AWBs but may not provide them with the correct quality. Consequently, a portion of the large customers who do submit e-AWBs can also be classified as laggards. This highlights the importance of systematic performance measurement of customers' inputs and communication channels towards customers. Performance measurement is necessary to identify performance gaps and communication channels are essential for addressing these gaps with customers and educating them accordingly. The lack of adequate performance measurement tools or communication channels makes it challenging to bring laggards on board, which is crucial for complete e-Freight adoption. Therefore, the barriers of performance measurement gaps and insufficient

communication channels are explained and should be emphasized in order to address the barrier of incorrect customer input.

Stages of the adoption process

As mentioned, a potential reason for customers being laggards is the lack of knowledge on e-AWB. When looking at the stages of the adoption process, it can be seen that the adoption process has not even been started when there is a lack of knowledge of the customers. The indicated lack of communication channels and performance measurement gap towards customers, leads to lack of knowledge and therefore explains the incorrect customer input barrier. While the lack of knowledge indicates the first stage of the adoption process and is already insufficient. It emphasizes the need for sufficient communication channels towards the customers, followed by structural performance measurement to keep track of their performance and inform the customers accordingly. The first step of the adoption process of the customers is them becoming aware of the innovation and its potential benefits. Only when this is sufficiently done by AFKLMP Cargo, attention should be given to further implementation steps.

5.3 REFLECTION ON METHODOLOGY

A variety of methods were employed to collect and analyze data in order to obtain the results for this study. These methods are discussed and a reflection is provided, which includes both the limitations and recommendations.

5.3.1 EXPLORATORY RESEARCH

At the initial stage of the research, it appeared that there was limited existing literature available regarding the underlying problems of e-Freight implementation in the air cargo industry. Consequently, an exploratory literature review was conducted to gain insights into potential barriers by investigating barriers and their categorization in several research fields. The research fields that were chosen included various types of barriers to change or innovation, sustainability innovation, digitalization, and paperless documentation. This search included a broader field of research due to the lack of research on barriers specifically focusing on paperless documentation. The primary objective of the literature review was to generate novel insights and knowledge regarding the categorization and options for potential barriers to paperless documentation implementation by constructing an overview that could be utilized as a foundation for examining the specific case at hand.

However, the additionally recognized theory within the empirical findings shows that a more focused literature search can be conducted to enhance understanding. This search should specifically target the barriers associated with the underlying phenomena recognized in this case, as discussed in Section 5.2. By leveraging these insights, a more comprehensive understanding of the barriers within this particular context can be achieved. Furthermore, the identified theoretical phenomena from Section 5.2 can serve as a foundation for formulating refined search terms and strings, enabling further research to undertake a more focused literature review. For example, the theory on barriers to standardization implementation in decentralized organizations with international and multi-stakeholder dependencies, will allow

for a deeper exploration and explanation of the challenges related to e-Freight implementation at AFKLMP Cargo. In turn, the case findings can contribute to this literature field. Therefore, it is recommended that further research builds upon the insights gained in this study to conduct a targeted and refined literature review, aligning the search terms and keywords with the identified theoretical phenomena.

The barriers could be searched within the following research topics/theory and consequently more refined search terms should be incorporated:
- Standardization or bureaucratization in decentralized/fragmented/multi-unit organizations; gain more insight into the underlying organizational structure
- Machine bureaucracy; gain more insight into the underlying organizational structure
- Technology adoption theory; gain more insights on the reasons behind the currently used and implemented technology
- Innovation diffusion theory; gain more insights into the interaction between the organization and the market/customer (B2B)
- Contingency theory

5.3.2 QUALITATIVE RESEARCH INCLUDING INTERVIEWS

Qualitative research is not typically representative and often conducted on a small scale. However, these characteristics do not undermine its value; instead, they enhance the research design and clarify the unique nature of qualitative research (Kvale, 1994). In-depth interviews aim to delve deeply into participants' experiences and perspectives, providing a nuanced understanding of their subjective realities. This qualitative approach captures the richness and depth of participants' experiences, contributing to a comprehensive understanding of the research topic. Quality criteria for qualitative research ensure rigor, credibility, and validity in the research process and findings (Knott et al., 2022).

5.3.2.1 INCREASED CREDIBILITY THROUGH TRIANGULATION

The use of triangulation in this research enhances the robustness and credibility of the interpretations made by cross-checking findings obtained from different sources. Two types of triangulation were employed to strengthen the findings. Firstly, multiple data gathering sources were utilized to gather empirical evidence, including semi-structured interviews, direct observations, and informal expert conversations. This approach ensures that different perspectives and sources of information are considered, reducing the risk of bias and enhancing the reliability of the findings. Secondly, triangulation of additional theory was employed to provide a more comprehensive and nuanced understanding of the empirical outcomes. By integrating multiple theoretical perspectives, the research sought to explain the findings from different angles and validate the interpretations. This triangulation of theory helps to ground the interpretations and ensures that they are not solely reliant on the constructed theoretical overview. The use of triangulation through the combination of multiple data sources and additional theory strengthens the research by providing a more comprehensive, reliable, and grounded interpretation of the empirical findings. It enhances the credibility of the research outcomes and contributes to the overall rigor of the study. However, it may be noted that although triangulation is executed, such research stays confined to the specific context and participants involved.

5.3.2.2 SAMPLING INFLUENCE ON THE DEPTH OF INSIGHT

Continuing on the mention that samples in qualitative research are typically not representative and often small in size, there is not criticized on their representativeness or generalizability but rather on the influence on the depth of insight. The depth of insight is crucial as it allows researchers to explore the rich and nuanced aspects of participants' experiences and perspectives. By delving deeply into the subject matter, researchers aim to uncover the underlying meanings, complexities and nuances associated with the phenomenon under investigation (Knott et al., 2022).

Within this research the use of in-depth semi-structured interviews provided an opportunity to capture the participants' subjective realities and gain a comprehensive understanding of the barriers to e-Freight implementation within AFKLMP Cargo. Through open-ended questions and probing, the researcher acquired information beyond surface-level and gained a detailed understanding of the barriers, challenges, opportunities, solutions and underlying dynamics that influence the implementation process. However, it is important to acknowledge that the depth of insight obtained from this qualitative approach comes with certain limitations.

Firstly, the depth goes as far as the respondent pool allows for. Due to the respondent pool mainly including middle managers and the operational core from within AFKLMP Cargo, the outcomes represent insights into the topic from their point of view. When considering transferability to the entire organization, caution should be applied due to the specific respondent pool. It is important to note that the insights are mainly focused on the executive implementation level. This narrow scope could potentially overlook alternative viewpoints or fail to capture barriers that may exist in the organization. A more evenly distributed pool of respondents indicating experts, top level managers, middle managers and the operational core would provide a more diverse presentation of perspectives for the entire organization. Secondly, the exclusive focus on participants from AFKLMP Cargo may limit the diversity of perspectives represented in the study. Respondents from other organizations within the air cargo industry or experts could lead to gaining a broader range of perspectives and potentially uncover additional insights. This would enhance the overall richness and depth of understanding of the barriers to e-Freight implementation within the air cargo industry

5.3.2.3 CONDUCTING INTERVIEWS

The primary aim of conducting interviews in this study was to identify the barriers, opportunities and solutions to implementing complete paperless documentation within an airline organization. However, some respondents found it challenging to explicitly identify the barriers, opportunities or solutions resulting in implicit mentions. In addition, due to the international origins of some respondents, there were occasional difficulties in understanding their statements or explanations. Some had limited proficiency in the English language, which made it challenging for them to articulate their thoughts effectively. Although the researcher had ensured beforehand that the respondents could speak English at a proficient level, a more comprehensive investigation into the level of English proficiency among all respondents would have helped to mitigate this issue. Furthermore, due to the international origins of most respondents, the interviews were mainly conducted online. However, whenever possible, the researcher conducted in-person interviews to better facilitate follow-up questions by observing

body language, expressions, and emotions, as well as allowing for the use of visual aids to explain specific concepts. This approach often aided the researcher's understanding of the process. Conducting all interviews in person could have further facilitated a better understanding of certain processes and allowed for the use of drawing visual aids to explain specific concepts. This would have helped in acquiring depth of insights.

5.3.2.4 BIAS OF INDIVIDUAL CODING AND CATEGORIZING

The data collected, was iteratively coded and categorized to construct the empirical overview of the barriers to complete implementation of e-Freight at AFKLMP Cargo. The conceptual theoretical model was utilized as a lens to facilitate the categorization of the empirical findings. Nonetheless, it is crucial to acknowledge that research bias is unavoidable within the coding and categorizing process of qualitative research, potentially prioritizing certain barriers over others. This is due to the researcher's perceptions of the significance of particular barriers based on the frequency of their mention during interviews. Despite efforts to mitigate bias by triangulating outcomes, it is impossible to completely avoid its influence.

However, the researcher aided to minimize this bias and increase objectivity and neutrality of the findings by grounding the interpretations in the data. This means presenting evidence upon which interpretations rely, such as quotes and extracts (Knott, et al., 2022). The extensive use of quotes within the presentation of the results allows the reader to evaluate whether the interpretations of the researcher are grounded in the data. To further enhance confirmability, techniques such as peer debriefing and keeping an explicit record of the researcher's reflexivity could be executed. Within this reflexivity the researcher should acknowledge one's own biases, assumption and subjectivity throughout the research process.

5.3.2.5 CONTENT ANALYSIS ON INTERVIEW TRANSCRIPTS

Within this study, a content analysis was conducted on the interview transcripts to identify and categorize the barriers to e-Freight implementation. The importance of this approach lies in the ability to analyze the frequency of mentions for each barrier category, providing insights into the relative importance or prevalence of different barriers. By counting the number of times each category was mentioned, the researchers aimed to present a quantitative representation of the data. However, it is important to note that qualitative data, such as interview transcripts, cannot be fully captured or accurately represented through quantitative counting alone. Quantifying qualitative data may oversimplify the rich and nuanced information contained within the interviews, potentially leading to a loss of depth and context. While the frequency of mentions can provide a rough indication of the relative emphasis placed on different barriers, it is crucial to interpret these results with caution. The importance of the findings lies more in the identification and categorization of barriers, as well as the insights gained from the qualitative analysis of the interview content. To complement the content analysis, a qualitative discussion of the barriers, incorporating relevant quotes and examples from the interviews was executed to provide a more nuanced understanding of the barriers and their impact. This qualitative analysis helps to capture the depth, complexity, and contextual nuances that quantitative counting alone may overlook. Overall, it is important to note that the content analysis and counting of barrier mentions provide a basic understanding of the frequency of different barrier categories, the true importance of the study lies in the qualitative insights and contextual understanding gained from the analysis of the interview transcripts.

5.4 TRANSFERABILITY & CONTRIBUTIONS

This section indicates to what extent the empirical outcomes can be transferred. Next, the contributions of the study are discussed.

5.4.1 TRANSFERABILITY OF RESULTS

5.4.1.1 TO OTHER ORGANIZATIONS

As the research conducted is confined to a specific investigation within AFKLMP Cargo, it is important to exercise caution when attempting to generalize the findings to other organizations. According to van Aken (2004), it is necessary to further develop the findings of situated research in order to formulate general solutions for a specific category of problems. Unlike quantitative studies, where generalization is a crucial criterion for evaluating the research (Kerlinger, 1996), the process of generalization in qualitative studies is more complex and debatable. The reason being that qualitative findings are intricately woven into a specific context, making extrapolation difficult to justify (Polit and Beck, 2010). The lack of representativeness of the context in relation to the larger population poses a significant challenge, rendering generalization potentially impossible in such research (Barnes et al., 2004-2022). Consequently, this becomes an initial critique of qualitative research (Rodon and Sesé, 2008). When confronted with qualitative research conducted in a situated environment, a more suitable approach may be to assess the transferability of the results. Transferability allows for the application of the findings to different contexts (Barnes et al., 2004-2022). Determining the transferability involves delineating the characteristics of the specific setting in which the results are applicable (Rodon and Sesé, 2008). Some characteristics of the indicated setting may have influenced the research results and may differ across other organizations or industries. Therefore, these characteristics need to be analyzed and compared when transferring the research results to other organizations. The following characteristics are important to consider when one aims to transfer the results:

- Stakeholder dependency
- Organizational structure
- Organizational network (national/international)
- Size of the organization
- Financial situation of organization
- Documentation handling process
- Documentation content
- Currently implemented technology for digital documentation
- Regulatory field
- Industry practices

Thus, the above mentioned characteristics need to be analyzed and compared to the setting of AFKLMP Cargo, when transferring the findings to other organizations. A more elaborate description of the setting is given in Appendix H.

To organizations in the air cargo industry
When considering the transferability of results to organizations within the air cargo industry, it is evident that several characteristics align with those identified in the study. External factors such as industry practices and the regulatory landscape are shared among organizations in this

industry. Consequently, the findings related to these external aspects are likely to be transferable and applicable to other organizations within the air cargo industry. Furthermore, when examining other airlines specifically, similarities in stakeholder dependencies and organizational networks further enhance the potential transferability of the study's findings. However, for the transferability of findings pertaining to the internal category and certain external specificities, a careful comparison between the context of AFKLMP Cargo and the target organization becomes crucial. It is necessary to assess the similarities and differences in the remaining characteristics identified in the study to determine the degree of applicability to the specific organization under consideration.

It is important to acknowledge that empirical findings exhibit varying degrees of specificity. Findings with a high degree of specificity, such as the deficiencies in the e-Freight project design specific to AFKLMP Cargo, are less likely to be transferable to the broader industry. On the other hand, findings with a lower level of specificity, such as the lack of industry standards, represent more general barriers and are therefore more likely to be applicable to the broader industry.

5.4.1.2 TO THE ENTIRE ORGANIZATION OF AFKLMP CARGO

The transferability of the research results to the entire organization of AFKLMP Cargo is a critical consideration, given the decentralized nature of the organization and the presence of multiple outstations with varying characteristics. The research encompassed one hub and four outstations, which were carefully selected to represent diverse geographical locations, different levels of digital maturity, and significant operational scale. By incorporating this range of outstations within the study, the research findings offer insights that have broader applicability to the entire organization of AFKLMP Cargo. The variation in geographical locations ensures a degree of representativeness across different operational contexts and regulatory environments. The inclusion of outstations with different digital maturity levels allows for a comprehensive understanding of barriers and challenges that may exist at various stages of digital transformation. Additionally, the consideration of outstations of significant size ensures the coverage of critical operational aspects and potential complexities associated with large-scale operations.

While the specific findings and observations may have been drawn from the selected hub and outstations, the underlying principles and dynamics identified in the research have the potential to be transferable to other outstations within the organization while the diverse case selection led to an inclusion of almost all potential characteristics that could arise within the stations. The barriers, opportunities, and solutions highlighted in the research shed light on the common challenges that may be encountered when implementing e-Freight initiatives across a decentralized organization like AFKLMP Cargo.

However, it is important to note that the transferability of the research results should be approached with caution. The unique characteristics and dynamics of each outstation within AFKLMP Cargo, such as local regulations, customer profiles, and operational contexts, may introduce additional nuances and specific challenges that need to be considered. Therefore, while the research provides valuable insights applicable to the entire organization, a localized

adaptation and contextualization of the findings may be necessary when implementing e-Freight initiatives at individual outstations within AFKLMP Cargo.

5.4.2 CONTRIBUTIONS

Bearing in mind the reflection that were previously executed, this section elaborates how the research findings contribute to the practice and theory. By the indication of these contributions, future research direction are addressed.

5.4.2.1 PRACTICAL CONTRIBUTIONS

The constructed conceptual theoretical barrier overview has practical relevance for organizations and practitioners involved in e-Freight implementation. It highlights the main categories where barriers may occur and serves as a starting point to indicate barriers present at the respective organization. It could guide organizations and practitioners in identifying, understanding, and addressing the barriers that may impede e-Freight implementation. By utilizing this overview, organizations can develop informed strategies and actions to overcome these barriers, leading to more successful and efficient implementation efforts. Furthermore, the empirical overview can serve as input for practitioners involved in e-Freight implementation in the air cargo industry in specific.

This research study offers a comprehensive examination of the current state of documentation practices within the air cargo supply chain and explores the underlying factors contributing to this state. It delves deep into the barriers present at an airline, identifies potential opportunities, and suggests solutions. The study makes a significant managerial contribution by providing detailed insights into the state of documentation practices and the reasons behind it. The research equips managers and practitioners in the air cargo industry with valuable knowledge. They can use this knowledge to make informed decisions, develop targeted strategies, and implement solutions that support complete e-Freight implementation. In this way, managers are empowered to address the challenges and bottlenecks related to documentation practices in a structural and effective manner. Ultimately, the findings can inform decision-making processes and guide the identification of strategies tailored to overcoming these barriers within the specific organizational context of AFKLMP Cargo.

The recognition of specific theoretical phenomena, such as AFKLMP Cargo being a decentralized organization with bureaucratic elements, can significantly assist managers in developing appropriate solutions. By gaining this additional insight, managers and decision-makers can take these factors into account when formulating strategies and structuring the organization. This understanding allows them to consider the implications of the organization's decentralized nature and bureaucratic elements in designing effective strategies and optimizing the organizational structure. By incorporating this knowledge, managers can make informed decisions that align with the unique characteristics of AFKLMP Cargo and promote successful implementation of strategies and organizational initiatives.

5.4.2.2 SCIENTIFIC CONTRIBUTIONS

The scientific contribution of qualitative research is not determined by arguments of legitimization, but rather by the generation of substantial new knowledge pertaining to the socially constructed world as expressed through language (Kvale, 1994). While certain knowledge gaps were indicated, the scientific contribution lies in bridging these gaps by the generation of substantial new knowledge.

Firstly, a theoretical framework is constructed based on an elaborate explorative literature review. This study is the first to combine barriers indicated in the research streams of change or innovation, sustainability innovation, digitalization, and paperless documentation in organizations and the supply chain. Therefore, the constructed overview adds to the theory by a new theoretical categorization of barriers for the implementation of paperless documentation. The categorization of the 'main categories' in this overview can be used in future research when aiming to indicate barriers towards paperless documentation. Moreover, the categorization of the overview was slightly adapted when applying the case results to the overview. This adapted categorization of the overview can be used in future research to indicate barriers to paperless documentation in the air cargo industry specifically.

Secondly, this study solves the knowledge gap of the scarcity of empirical studies within the air cargo supply chain. An elaborate understanding of the barriers, opportunities and strategies present within the organization AFKLMP Cargo on the implementation of e-Freight is derived by delving deeper into a real-world setting. It provides mainly an elaborate contribution into the barriers and indicates potential opportunities and solutions. This leads to substantial new knowledge on the air cargo documentation process, the state-of-the-art of e-Freight within the air cargo industry, and indicating underlying reasons for this state. These new generated knowledge also solves the knowledge gap on the lack of research precisely focusing on the documentation process in the air cargo supply chain.

Furthermore, this comprehensive understanding of the underlying reasons for the limited implementation of e-Freight within AFKMP Cargo, as derived from this case study, makes a valuable contribution to the field of science. The study goes beyond the surface-level barriers and identifies additional theoretical explanations that have emerged from the empirical findings, indicated in section 5.2. By recognizing and elucidating these additional theoretical explanations, the study enriches the existing body of knowledge and provides new insights into the complexities of e-Freight implementation. By linking the identified barriers and the theoretical phenomenon of standardization implementation within a decentralized or fragmented organization with bureaucratic elements, this study generates new knowledge regarding the complexities and challenges of implementing standardization in such organizational contexts. It provides insights into the interplay between organizational structure, decentralization, bureaucratic elements, and the barriers encountered in the adoption of standardized practices. This new knowledge contributes to the field by deepening our understanding of the underlying dynamics that influence the successful implementation of standardization initiatives within such decentralized organizations with bureaucratic elements. Overall, this case study's contribution lies in its ability to uncover and acknowledge additional theoretical explanations that shed light on the challenges faced by AFKMP Cargo in implementing e-Freight. By bridging the gap between theory and practice, it advances the field

of science and provides valuable insights for both academia and industry professionals seeking to enhance the successful adoption of e-Freight initiatives.

The identification of these theoretical explanations serves as a stepping stone for future research endeavors. It opens up avenues for further exploration and investigation into the specific mechanisms, dynamics, and interrelationships underlying e-Freight implementation. Researchers can build upon these findings to delve deeper into the theoretical underpinnings, validate the identified explanations, and explore their applicability in other organizational contexts.

6. CONCLUSIONS

This chapter concludes this research. First, the main insights are presented in Section 6.1 specific for the case and its wider applicability. Next in section 6.2, the recommendations are presented that follow from the limitations of this study, including organization-specific recommendations and recommendations for future research.

6.1 MAIN INSIGHTS

Despite recognized inefficiencies in the current documentation process, combined with projects and initiatives aimed at eliminating paper documents, the implementation of e-Freight in the air cargo industry has been slow in comparison to digitization in the airline industry. Therefore, the main goal of this research was to obtain the existing barriers, and potential opportunities and solutions to complete e-Freight implementation within the air cargo supply chain by analyzing a specific case. The following main research question was formulated:

''Which barriers, opportunities, and solutions can be identified to support the complete implementation of e-Freight at AirFrance-KLM Cargo?''

The initial focus will be on indicating the main insights of the case in specific, followed by an indication of the applicability of these findings.

6.1.1 CASE SPECIFIC

6.1.1.1 BARRIERS & OPPORTUNITIES

The empirical findings provide a comprehensive inventory of barriers within and beyond the control of AFKMP Cargo categorized as organizational, social and cultural, economic, technical/technological, market, regulatory, and standardization barriers. While some barriers were more important and significant than others, it is evident that the barriers to the complete implementation of e-Freight at AFKLMP Cargo are multifaceted and interdependent. There exists a complex network of interrelationships and interdependencies among them. Given the complexity of the implementation with the organization's international system context and dependency on multiple stakeholders, not just one barrier can be pinpointed as most important and there is no easy solution. A silver bullet does not exist.

The lack of a national overarching macro regulation or industry standards on the documentation within the air cargo industry leads to an increased complexity within this case. The decentralized structure of AFKLMP Cargo means that it operates across multiple regions, countries and even continents. With the lack of the industry standards, each branch (outstation) within the organization may have its own established processes, systems, cultures, customs restrictions and relationships with local stakeholders. It creates space for constraining factors regarding the implementation of e-Freight, such as restricting regulations of local authorities or customs requiring paper hardcopies. Therefore, this decentralized structure of the organization in combination with no industry standards leads to differences in e-Freight implementation states across all outstations. This makes it difficult to achieve one consistent and standardized approach to implementing e-Freight across the entire organization. Therefore, the introduction

of standards or internationally restricting regulations regarding the submission of digital documents such as the Import Control System 2 (ICS2), is seen as a crucial step and opportunity towards standardized and unified digital documentation across the globe. Moreover, it is crucial to acknowledge that the international context in which AFKLMP Cargo operates includes less developed countries that pose unique challenges to digital documentation. These countries may lack the necessary infrastructure facilities, such as reliable network connectivity, which makes complete digital documentation or the air cargo industry currently infeasible. This in turn, emphasizes opportunities regarding the acceptance of digital documents by local authorities or customs in the respective countries. This development presents a crucial breakthrough for certain outstations, as it effectively resolves the limitations imposed by initial regulations. The use of digital documents within their operations is no longer restricted, unlocking new possibilities, and ultimately paving the way for complete e-Freight implementation.

Another main challenge identified is the gap between the organization and the market. Within AFKLMP Cargo, a challenge emerges in the form of a lack of awareness and attention on the e-Freight project, which affects the interaction with their customers and hinders effective communication. Respondents from AFKLMP Cargo have highlighted that customers often provide incorrect e-AWB input. However, the root cause lies in the absence of a shared understanding between the organization and their customers regarding the specific information and format required for e-AWB submissions. Lack of customer prioritization and ineffective communication by AFKLMP Cargo hinder progress in e-Freight implementation. By failing to communicate standards and guide customers in submitting correct e-Freight, AFKLMP Cargo becomes a fool who allows customers to provide what they want, resulting in inaccurate input.

The lack of effective communication can be attributed to several reasons, the origin being the lack of commitment from the top toward developing e-Freight. Within such an internationally decentralized multi-unit organization with bureaucratic elements, the commitment of top management is crucial while they make strategic decisions. Their reactive firemen attitudes towards e-Freight enforce further challenges regarding implementation such as a poor e-Freight project design, insufficient communication channels, a lack of budget allocated and a misaligned technology solution. Consequently, the organization becomes stagnant, stuck in its ways, and lacks attention and priority throughout the entire organization. The conservative nature of the industry itself doesn't help matters either. The current situation seems like trying to steer a massive ship against the tides of tradition and established systems. The organization's inadequate attention, communication, and tools for measuring e-Freight status hinder top management's awareness of existing issues and their ability to make informed decisions. Their reactive approach of "why fix something that isn't broken?" hampers their ability to take action based on a limited understanding, often influenced by a lack of knowledge or potentially unreliable and misleading data from performance measurement tools. This leads to lack of investing in new technologies while the current technology seams feasible. The organization finds itself at a crossroads, caught between the outdated technology it currently employs (messaging) and the potential benefits offered by the new API technology standards (ONE Record). However, developing an API standard offers AFKLMP Cargo an important opportunity to pioneer and achieve complete e-Freight implementation, enabling them to stay competitive and reap the benefits of technological advancements. Additionally, the successful implementation of the Acceptance Outstations Program (AOP) serves as a shining example of

standardized implementation across outstations, presenting top management with a valuable opportunity to allocate resources and establish a suitable e-Freight project.

6.1.1.2 SOLUTIONS

Due to the complex and fragmented industry landscape where the documentation is dependent on a wide range of stakeholders, a silver bullet does not exist. Addressing the multi-faceted challenges demands a collaborative approach to arrive at complete implementation within the entire supply chain. Through fostering a culture of collaboration, the organization can create a unified front with shared goals. Yet, AFKLMP Cargo cannot embark on this journey alone. It requires industry-wide cooperation, with stakeholders setting aside individual interests for the greater good. This collective force will establish standardized practices and drive progress towards complete implementation. To initiate this transformation, AFKLMP Cargo must invest in adaptive change management strategies that inspire and engage. Focus needs to be given to the communication within the organization and towards the outside world. An engaging story will intrinsically motivate people, rally employees and attract other parties within the air cargo industry, starting change and setting the wheels in motion.

However, the story on its own is not enough. AFKLMP Cargo must guide its customers through this transformation, simplifying complex processes with clear guidelines such as a 'Jip en Janneke' story. By leading the way and fostering customer confidence, the organization can facilitate the adoption of e-Freight. Breaking down barriers between the organization and the market requires showcasing the mutual benefits and emphasizing the win-win scenario. When external stakeholders exhibit resistance or remain unresponsive, stronger measures need to be taken. This approach refers to the "carrot and stick" method, where an initial attempt is made to invite the external stakeholders with the "carrot" (a compelling narrative), and if this fails to yield results, a firmer approach is taken with the "stick" to assert clear direction and guidance.

Furthermore, the success of this endeavor lies in the people. The recognition of the significance of individuals in driving change is evident through the lack of action from the top and the initiative and action taken by individuals in Singapore. Their proactive approach and willingness to embrace change have demonstrated the pivotal role of people in the success of such endeavors. To replicate this success, AFKLMP Cargo must ensure the presence of individuals in key positions who are not only receptive to change but also possess the capability to propel it forward. Empowering people with innovative mindsets such as the younger generation at management positions brings fresh perspectives and energy to the organization, laying the foundation for a transformative performance.

Starting small, AFKLMP Cargo carefully selects stations that embody the desired characteristics, free from regulatory and technical limitations. These initial successes become the stepping stones for expansion, gradually resonating e-Freight throughout the entire organization. An adaptive approach is suitable to tackle this kind of implementation in such complex setting. In this journey of transformation, AFKLMP Cargo not only pioneers change but also narrates it to the world. Through a captivating story that emphasizes the importance of change and its impact on all involved, AFKLMP Cargo leads the industry towards a future where e-Freight thrives and the air cargo industry flourishes.

6.1.2 APPLICABILITY OF RESULTS

The findings from the case study have varying degrees of applicability to the entire air cargo supply chain. They range from highly specific findings tailored to the unique circumstances of AFKLMP Cargo to more general in nature. Some findings that have a more general nature make them applicable to the industry as a whole. These include external characteristics such as industry practices and the regulatory landscape, which are commonly shared among organizations in the air cargo supply chain. Moreover, findings related to airlines specifically have a higher potential for transferability to other airlines. They tend to share additional characteristics such as stakeholder dependencies and organizational networks, enhancing the applicability of the findings to airlines in particular.

However, the exact application of the findings to other organizations within the air cargo supply chain should be assessed by comparing the characteristics of the target organization with the context-specific characteristics of AFKLMP Cargo. This analysis will determine the level of applicability and the need for further testing to ensure the findings' suitability for the specific organization under consideration. By considering the similarities and differences in these characteristics, the transferability of the study's findings can also be effectively assessed and applied to organizations in other industries.

6.2 RECOMMENDATIONS

In this section first the case-specific recommendations are indicated. Following, some limitations of the study in combination with future recommendations are presented. It may be noted that limitations are also already indicated in Chapter 5, along with some recommendations.

6.2.1 CASE-SPECIFIC RECOMMENDATIONS (TO AFKLMP CARGO)

Given the complexity of the implementation with its international system context and dependency on multiple stakeholders, there is no easy solution, and a silver bullet does not exist. Therefore, AFKLMP Cargo should adopt an incremental approach and tackle the barriers it can address in a systematic manner. This adaptive strategy is particularly suitable because the environment is dynamic and complex, and barriers are likely to change. As one barrier is overcome, others will still exist and move. Thus, an adaptive innovation and implementation approach is recommended.

In the first instance, it is crucial to acknowledge that, unlike the e-AWB, there is no established digital document version for other supporting documents required for various special cargo. Therefore, the digitalization of these supporting documents is currently unfeasible, and AFKLMP Cargo should prioritize the implementation of the e-AWB and the establishment of a successful implementation process over the entire e-Freight initiative.

When devising an implementation strategy, it is important to distinguish between internal and external barriers. The focus should be on addressing internal practices that are within AFKLMP Cargo's power before tackling external barriers, while there are fundamental internal issues that hinder the implementation of e-AWB and also influence some external barriers, such as insufficient communication channels, performance measurement gaps, and a deficient e-Freight project design that influence the customer-related barriers. While these barriers are within the organization's direct control, it is crucial to prioritize their resolution.

6.2.1.1 RECOMMENDATIONS FOR TOP MANAGEMENT

AFKLMP Cargo's organizational structure has characteristics of a machine bureaucracy, which functions most efficiently with standardized processes in place. In this structure, top management creates strategies, so it is crucial to address their lack of commitment to the e-Freight project to achieve desired practices. While they have the power to enable a suitable organizational structure for implementation across all outstations and allocate budget to the project, it is important they have a commitment to the respective project. The organizational structure currently does not coordinate standardized activities or have clear responsibilities and practices, leading to the project's decline. Although the e-Freight project still exists, it lost its momentum and gas needs to be put into the little flame. Currently, the team is understaffed to fulfill its duties and only consists of 1FTE. Top management must restore the e-Freight team with innovative change-makers and reformulate the project's vision and strategy, as well as its performance measurement tools. The story that is passed along needs to be more engaging in order to motivate the implementers intrinsically. It is important to emphasize the why instead of only the what and the how. Clearly emphasize the benefits for all parties and indicate the mutual wins.

Also, the performance measurement tools need to be reassessed while currently, gaps exist between their intended measures and the actual outcomes. The theory does not always match the actual situation. Consequently, communication channels are important to be established to obtain an understanding of e-Freight performance, pass on knowledge on e-AWB implementation, and follow up on performance. Internal communication channels play a crucial role in disseminating necessary knowledge on e-Freight implementation within the organization, both top-down and interdepartmental. Once internal communication is established, creating effective communication channels with customers becomes paramount. Proper communication channels with customers can help overcome external customer-related barriers. AFKLMP should focus on improving the content of their communication with customers by explaining, guiding, and educating them to enhance their input and performance.

6.2.1.2 RECOMMENDATIONS FOR E-FREIGHT PROJECT DESIGN

The aforementioned recommendation pertains to standardization to the extent possible. However, exceptions also exist that must be considered when devising a strategy to implement e-Freight at all outstations. These exceptions are mainly created by the external environment. While these barriers are beyond the control of AFKLMP Cargo, they should initially avoid focusing on outstations that are subject to these restrictive barriers. It is recommended to implement in pilots instead of all outstations simultaneously.

Designing pilots and deciding on which outstations to start with, and how to proceed are crucial steps in implementing e-Freight. The initial step is to evaluate the e-AWB performance of all outstations and identify the stations where the external factors are favorable. It is advisable to commence with stations that have beneficial external conditions. Additionally, it is recommended to initiate the process with a large customer who is willing and has the potential ability to submit correct e-AWBs from their own systems. This initial step can be used as a foundation to further expand the implementation. In the event that these initial pilot projects prove to be successful, their achievements can be utilized as a guide for future projects. The successful elements of the e-AWB implementation such as in Singapore (SIN) can be employed as a reference. Additionally, any potential shortcomings that may arise should be documented as lessons learned to be taken into account during future expansion efforts.

Overall, it is clear that complete e-Freight implementation within the air cargo supply chain is a complex issue, and there is no one-size-fits-all solution. However, by taking small steps, and following a structured and iterative process, it is possible to make progress toward the complete implementation of e-AWB and ultimately of e-Freight.

As mentioned earlier, the focus of the approach should primarily be on addressing internal practices that can be resolved. Nevertheless, once these practices are addressed, the airline could also contemplate resolving the restrictive regulatory barriers that have been identified. There is often more scope for achieving solutions than what might be initially perceived. With regards to restricting regulations, it is suggested to engage in dialogue with customs and government officials and persuade them to reconsider their stance. Often, technical restrictions are not the main issue, and there may be underlying reasons why these processes are still in place. The same applies to e-Freight and supporting documents. If a proper implementation process is in place for e-AWB, it is recommended that AFKLMP Cargo invest in exploring possibilities for digitizing supporting documents.

A list with practical recommendations and steps to be taken by AFKLMP Cargo can be found in Appendix I.

Additional recommendations for AFKLMP Cargo:

- In order to know whether developing API standards would be a suitable approach for handling digital freight documents, it is recommended to design and execute pilots with the established ONE Record standards at the hub/outstations that have desired environmental circumstances and test whether it works.
- Use this barrier overview as a starting point to construct strategies
- While the strategy of AFKLMP Cargo includes being a pioneer, investing in the R&D of ONE Record, and taking the risk is recommended.

6.2.2 LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

6.2.2.1 EXPLORATORY RESEARCH

- **Limitation**: The limitation of this study is that it is constrained by time restrictions, which impacted the extent to which additional underlying theories could be incorporated. Although the study recognized and pinpointed theories that could further explain the identified barriers and their interrelations, there was insufficient time to extensively explore and integrate these theories into the literature review and research. As a result, the findings were limited to recognizing these theories and demonstrating their connection through triangulation.
- **Recommendation**: future studies can utilize this thesis as a reference to test and validate the newly identified theories in a more comprehensive manner. Two options are proposed on how to use this indicated theory in further research. Firstly, further studies could use the organization of AFKLMP Cargo as a case study to gain a comprehensive understanding of the additionally identified theories. The case of AFKLMP Cargo could generate rich and context-specific insights on these indicated theories while these phenomena are recognized within this organization. Secondly, using these theories as a research focus for investigating e-Freight implementation at AFKLMP Cargo could help understand the barriers even better. It is recommended to execute a similar study, but focusing on these theories as a literature focus could explore how these theories can address the identified barriers. It could provide valuable insights for developing tailored strategies and interventions for successful e-Freight implementation at AFKLMP Cargo. More specific recommendations for future studies are indicated based on the three identified theories:
  - o A similar study investigating the reasons for the lack of e-Freight implementation at AFKLMP Cargo, but then with literature focus on the barriers towards the implementation of standardization in a decentralized and international multi-unit organization with bureaucratic elements.
  - o The technology adoption theory could examine the use of old technology in the air cargo industry. This recommendation suggests conducting further research to investigate a real-life case in the air cargo industry, aiming to shed light on

the factors contributing to technological lock-in and exploring potential strategies for overcoming this challenge.

o The innovation diffusion theory could be utilized to assess customer (FF) behavior and adoption patterns within the air cargo industry. By understanding the innovator and laggard profiles among customers, airlines like AFKLMP Cargo can tailor their strategies to encourage widespread adoption of innovations.

6.2.2.2   QUALATATIVE RESEARCH INCLUDING INTERVIEWS

- **Limitation**: The qualitative nature including interviews hinders the ability to make substantiated statements about ranking or generalizability of the findings. While this research generated new knowledge and insights, it cannot provide definitive statements on the applicability or transferability of the findings. Although indications and potential transferability conditions can be identified, caution must be exercised when applying the results to external contexts, such as the air cargo industry. No hard statements can be made due to the specific interwoven nature of the findings within this study.

- **Recommendation**: To further validate the findings related to barriers, opportunities and solutions, it is recommended to conduct a comparative analysis with carefully capturing the characteristics of the targeted organizations. Comparing another airline that shares similar characteristics with AFKLMP Cargo will provide additional evidence and enhance statements on transferability of the results. Furthermore, executing a comparative analysis on organizations outside the air cargo industry can offer insights into the broader applicability of the findings across different industry settings. This analysis aids in understanding which barriers are commonly encountered across organizations within the air cargo industry and which may be more specific to the studied organization.

- **Recommendation**: A more extensive quantitative analysis of the barriers, opportunities, and strategies, potentially through larger scale surveys, could yield further insights. The employment of a center of gravity analysis may elucidate which barriers, opportunities, and solutions are perceived as the most critical.

- **Recommendation:** Future research could approach several experts in this field and validate the results of this study. Subsequently, the barriers, opportunities and solutions can be supplemented.

- **Limitation**: The research is limited by the qualitative nature of the study, which resulted in a limited sample size and range of respondents due to time constraints. This limitation affected the depth of insights, as not all relevant functions influencing the e-Freight implementation at AFKLMP Cargo could be interviewed. Consequently, the findings may not fully capture the perspectives and experiences of all key stakeholders involved in the implementation process.

- **Recommendation**: Future research should aim to diversify and extend the respondent sample to include a wider and more evenly distributed range of participants from within the organization. In addition to the operational core and middle management, experts and top-level management should be evenly included to obtain more comprehensive insights that cover all parties influencing the implementation process. This will provide a more holistic understanding of the barriers and contribute to more effective solutions.

- Conduct a comparative analysis of the perceived usefulness and ease of use of the messaging technology and the ONE Record/API technology. The research could evaluate how these factors influence the adoption of new technologies, especially in dynamic and complex environments such as the air freight industry.

- Further explore the role of top management in the adoption of new technologies. Research could focus on identifying the factors that influence top management's commitment to technology adoption, such as compatibility, complexity, observability, and trialability.

- Future research could conduct a survey targeting Freight Forwarders to ascertain their awareness and perspectives on innovation implementation and their attitudes towards e-Freight in specific. This could identify the principal cause of the customer performance and would enable airlines to acquire a deeper comprehension of the reasons underlying their performance. Test the opinions and needs of the Freight Forwarders, and develop solutions to approach the customers or provide more appropriate services.

- While machine bureaucratic elements are recognized within AFKLMP Cargo in combination with its dynamic and complex environment, a recommendation for future research could be to explore how machine bureaucracy organizational theory can be adapted or modified to better suit dynamic and complex environments with decentralized units that are internationally settled. This could involve examining how the traditional characteristics of machine bureaucracy (such as strict hierarchy, centralized decision-making, and standardized procedures) may need to be adjusted to allow for greater flexibility and responsiveness to changes in the external environment.

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APPENDIX A: NETWORK AND CASE SELECTION

The network in which AFKLMP Cargo operates is a so called Hub-and-Spoke network. A Hub-and-Spoke network is a type of transportation network in which a central hub (i.e. airport) serves as a connecting point for several smaller spoke airports. In the context of AFKLMP Cargo, the hub airports serve as a main cargo transfer point, where cargo from multiple origins is consolidated and then sorted for onward transportation to its final destination. The distribution of the cargo can be achieved through aircrafts (passenger or freighters) and trucks.

The hub airport can also function as either an origin or destination for final delivery of the cargo to the consignees. In the case of origins, the cargo is collected from several shippers via Freight Forwarders (FFs) (instead of spoke airports) and consolidated at the hub, before being sorted and distributed to the final destinations. In case of destinations, the cargo is collected from the spoke airports and distributed to the consignees for final delivery.

The international network of AFKLMP Cargo consists of two hub airports, Amsterdam Schiphol Airport (AMS/SPL) and Paris Charles de Gaulle (CDG), and 217 spoke airports globally. In order to gain a comprehensive understanding of the barriers faced by the organization in implementing e-Freight, this study will focus on one hub airport (AMS) and several outstations located across different continents, including the USA, South America, Asia, and Africa. The choice on the amount of stations is made while considering the appointed time and resources given within this thesis.

A visualization of the AFKLMP Cargo Hub-and-Spoke network is provided in Figure 13, where the red circles indicate the stations of focus within this study.
- Hub: Amsterdam Schiphol Airport (AMS/SPL)
- Outstations: Singapore (SIN), Los Angeles (LAX), Lima (LIM), Lagos (LOS)
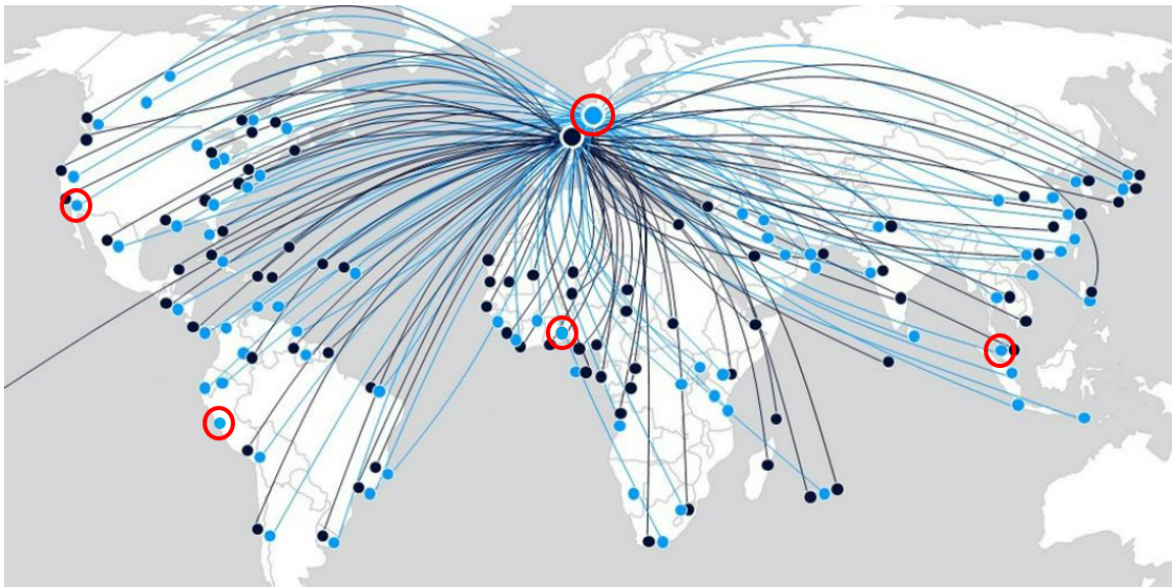

Figure 13: Network visualization and with selected cases

B1: DOCUMENT TYPES

Four different types of documents exist that subsequently need to be transferred to electronic versions. This includes the customs documents, transportation documents, commercial documents and Special Cargo documents. Each air cargo document needs a corresponding electronic version in the air cargo industry standards. In the Figure 14, there can be seen what documents are required under the different document types. Following, a brief description will be given on these document types and the digitalization of these document types.
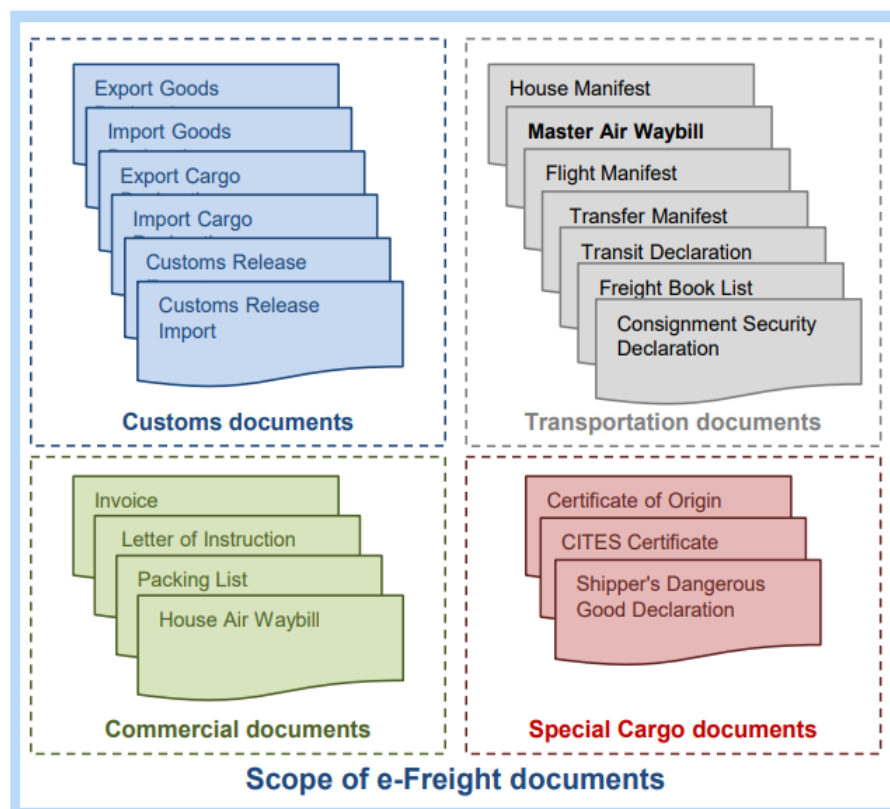
Figure 14: Document types

Customs documents*:*

The customs documents are documents that are required for the clearance of goods through customs for international air cargo shipments.

- Key customs documents: Import/export goods or cargo declaration are documents that provide information on the goods being shipped, including the quantity, value, weight, origin and destination of the goods or of the shipment. It is required by the government agencies for customs and trade compliance purposes.
- Why: These customs documents are needed because they provide essential information to customs authorities, allowing them to assess the applicable duties, taxes and regulations for the shipment. Also, they serve as a proof of compliance with customs regulations and help to ensure the accuracy and security of shipment information.
- Benefits of digital: The electronic processing of customs documentation reduces risks of errors, ensures accuracy of the shipment information, and provides a clear and easily accessible record of compliance with customs regulations. By providing customs authorities with the necessary information electronically in advance, a more

smooth and efficient clearance of goods through customs for international air cargo shipments can be realized.

- Current situation on digitalization:
    - o Trade lane; there are still some unfeasible trade lanes, where paper documents are required by international authorities (the Montreal Protocol No.4 of 1975 (MP4) or the Montreal Convention of 1999 (MC99).
    - o Local/government authority; still some local authorities require paper documents
- Challenges:
    - o External dependency: One major challenge is the lack of standardization among different countries' customs regulations. This makes it difficult to standardize the digitalization process globally, and requires coordination and cooperation among multiple stakeholders, including airlines, freight forwarders, customs authorities, and other government agencies.
    - o There could be resistance to change as the air cargo industry has been using paper-based documentation for many years already. The customs especially may be reluctant to adopt new digital processes as a reliable and secure technology infrastructure, as well as a high level of data privacy and security is paramount for these kind of documents/information.

Transportation documents:
The transport documents are the key documents used in the air cargo industry to facilitate the transportation of the goods from one place to another. The main documents are:
- The Air Waybill (AWB) is the main and most critical air cargo document that constitutes the contract of carriage between the ''shipper'' and the airline. It serves as a receipt for the goods being shipped. It serves as the legal basis for transportation of goods by air and is a crucial document for the shipment process. Also, the AWB contains the basic crucial information on the shipper, consignee and goods, making it the single source of information for the shipment. Finally, it is used to track the shipments throughout its journey, providing a complete history of the shipment.
- When transferred to an electronic document, the AWB is called the e-AWB or FWB and the function of contract of carriage remains. The Electronic Air Waybill Resolution of IATA (MeA) removes the requirement for a paper Air Waybill and validates the e-AWB as the contract of carriage. By implementing e-AWB, the information can be electronically shared and accessed by all stakeholders, reducing the time and effort required to manually process and exchange paper-based documentation.
- Benefits: Therefore, the AWB is seen as the key document and a logical starting point for implementing e-Freight. This is due to its central role in the shipment process and its potential to greatly improve the efficiency and transparency of air cargo transportation. By implementing the e-AWB/FWB, stakeholders in the air cargo industry can reduce the time and effort required to manually process and exchange paper-based documentation as well as improve the accuracy and security of shipment information.
- Current situation: still some transportation documents are paper based
- Challenges: the external dependency as indicated under the customs documents

Commercial and Special Cargo documents:

An AWB is often accompanied by a commercial set of documents, either attached to the AWB or placed inside the pouch. These are mainly commercial or special cargo documents. Commercial documents are often needed for the consignee, these are documents like the invoice, letter of instruction, packing list and house air waybill. These documents are often put into the pouch and regard the documentation process between the shipper and consignee. This process pass the airline, but the airline cannot interfere in this process. It is the choice of the shipper whether they want to book a pouch or not.

Special cargo is a type of shipment that requires specific documentation to ensure the proper handling of the goods. These types of shipments need additional documents in order to be transported conform security and safety reasons. These are documents like, certificates (human remains, live animals), checklists (lithium), DGD, fito, carnes. These documents are often not developed in a digital version and therefore these documents pose a restriction to completely go paperless.

B2: DOCUMENTATION PROCESS

In Figure 15 underneath, the documentation process including its steps and important document handover moments is shown. Also, an indication is given on the main documents that need to be submitted.
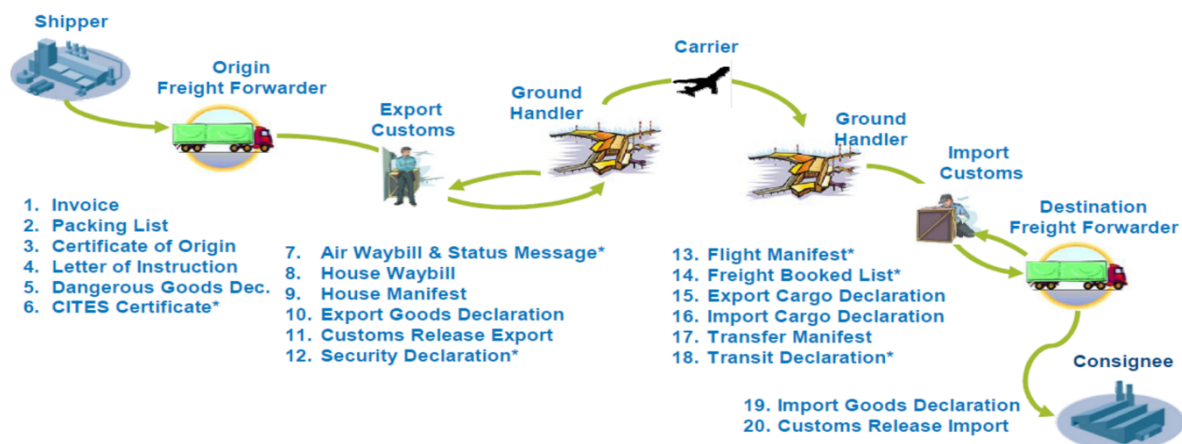
Figure 15: Documentation process with handovers (ICAO-WCO Joint Workshop, z.d.)

B3: STATE-OF-ART E-AWB & E-FREIGHT

The e-AWBs are recognized as a more efficient alternative and improvement while e-AWB leads to skipping of steps. In the figure below it can be seen what documentary check steps can be skipped due to e-AWB implementation. The step of requesting a paper AWB and manually capturing the paper AWB data can be skipped.

Figure 16: Documentary checks at acceptance

e-AWB

While the most important transportation document is the AWB, the digitization will start with the AWB (IATA, 2018). For this document type, an electronic version is developed already, the electronic-AWB (e-AWB). The **e-AWB** is the electronic version of the paper Master Airwaybill (MAWB), called the Freight Way bill (FWB). The **FWB** is the electronic i.e. digitalized contract of carriage between the shipper/customer and the airline.

Firstly, focus is given to the e-AWB as it serves as proof of the contract of carriage between the shipper and airline and is considered the most important document in the air cargo industry. By focusing on digitization of the AWB as a starting point, it can serve as a foundation for the digitization of the other documents. It provides a common platform for exchanging electronic information between various actors and creates a more interconnected and efficient supply chain. When the e-AWB is implemented, it becomes easier to link other documents. The strategy of prioritizing e-AWB implementation and then focus on the digitization of the other documents, has also been used as an approach in the e-Freight program of IATA and can be found in the three pillars (IATA, 2018).

The actual paperless handling of the AWB is dependent on two input and one output requirement. For the input requirements, the airline is firstly dependent on whether the customers (FFs) have an e-AWB contract, and secondly whether they provide the e-AWB fully electronic or with accompanying paper documents in the pouch (i.e. an envelope attached to the shipment with paper documents inside).

To indicate the specifications and details of an e-AWB, four different Special Handling Codes (SHC) exist. These four SHCs are divided in two different types: there are two codes to indicate the type of e-AWB a shipper/customer books (EAW or EAP) and there are two codes to indicate whether the shipment needs to be accompanied by a mandatory printout of the AWB (ECC or ECP). First, the Shipper/Freight Forwarder/customer will select the SHC EAW or EAP. This SHC is to allow forwarders to advise to the airline/carrier whether the shipment is tendered with a pouch or accompanying documents (e.g. DGD). This SHC is indicated by the customers as they can choose and select whether they would like to book the shipment EAW, which is fully paperless or they need a shipment with an accompanying pouch of documents and they book EAP. Then second, the airline/carrier needs to identify ECC/ECP SHC. This SHC indicates whether a printout of the AWB needs to be sent with the shipment to the final destination. In Figure 17, an overview of the e-AWB SHC types is presented.

Figure 17: Dutch e-AWB SHC and their meanings

Of these two types of SHCs, only the ECC/ECP secures the FWB is an e-AWB. The ECC means that the final destination does not need additional paper documents and ECP means that a printout of the AWB is mandatory and made at the hub. For this SHC an automated trigger is provided by the airline/carrier to tag the e-AWB (it musn't be removed or added manually). As mentioned before, the SHC will only be triggered and thus the FWB will be validated, when two conditions are fulfilled:

- An FWB must have been received from a Customer
- The Customer must be EDI with AFKL

So, for the final overview:
1. Final destination dependent (ECC/ECP) –an automated trigger provided by the **airline** to tag the e-AWB
   o ECC: e-AWB is enough. No printout of the AWB is needed by the final destination.
   o ECP: printout of the AWB needs to be sent with the shipment to the final destination.
2. Customer dependent (EAW/EAP) – EAP/EAW is a piece of information provided by the Customer, whether with or without pouch of documents.
   o EAW: Fully paperless shipments are indicated with the Special Handling Code 'EAW'.
   o EAP: Shipments that include a pouch of documents have the Special Handling Code 'EAP'

The combination of the freight forwarder codes (EAW/EAP) with the airline's codes (ECC/ECP) leads to the scenarios displayed in Figure 18. **e-Freight** means that a shipment is fully paperless and there is no paper involved at all. This is corresponds to scenario 1 displayed in Figure 18, where the e-AWB shipment has both the SHC EAW and ECC.
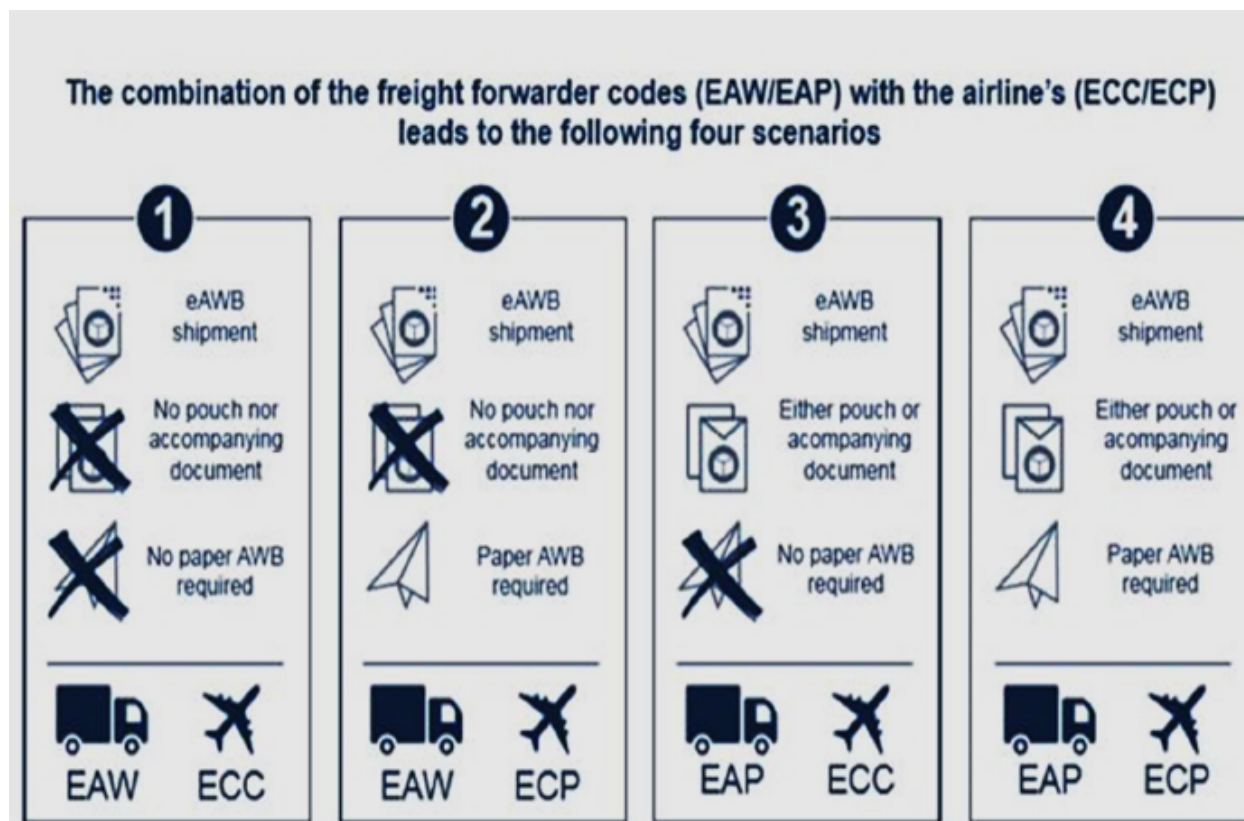
Figure 18: Scenarios SHC combinations

APPENDIX C: INITIATIVES AND PROJECTS TOWARD E-FREIGHT

C1: INDUSTRY INITIATIVES

e-Freight IATA

Initiated by IATA in 2006, the program became an industry-wide initiative involving carriers, freight forwarders, ground handles, shippers, customs brokers and customs authorities. The e-Freight program provides a unique opportunity to actively participate in the digital transformation of the air cargo supply chain. This initiative is set-up to achieve at an end-to-end paperless supply chain collaboration from shipper to consignee.

The e-Freight is based on three main pillars: (IATA, 2018)
1. Customs documents
   ''Engaging regulators and governments worldwide to create an 'e-freight route network' with fully electronic customs procedures and where regulations support paperless shipments''

2. Transport documents

''Working collaboratively within the cargo supply chain to digitize the core industry transport documents, starting with the Air Waybill (AWB)''

3. Commercial & Special cargo documents

''Developing a plan to digitize the commercial and special cargo documents typically accompanying airfreight today, in or outside of the 'Cargo pouch'''

Benefits e-Freight are recognized:
- Increased efficiency
- Reduced costs (AWB fee, printing papers)
- Quicker, more efficient and accurate communication, because when the AWB is digitized it can be stored electronically and shared with relevant parties in real-time, reducing the need for physical copies of the document and increasing the speed, efficiency and accuracy.
    o Reduce the amount of controls by customs
    o Better information regarding the controls
- When e-AWB is implemented, it becomes easier to link other documents, such as commercial invoices, packing lists, and flight manifests. This can help improve the accuracy of all information and reduce the risk of errors or miscommunications.
- Therefore, there is also increased visibility.
- Reduces the handlings and responsibility of the employees involved at operational level
- Environmental sustainability for the whole air cargo supply chain
- Leverage benefits of e-commerce and e-business to create a more streamlined and integrated supply chain
- Easier to track and manage cargo shipments
- Modernizing and improving air cargo industry
- Creates a more interconnected and efficient supply chain

The first targets were set way in the past by IATA. The end goal of the e-Freight project in 2013, was to have paperless e-Freight air transport at the end of the year 2015 (Pieters, 2014). From this can be concluded that the implementation of e-Freight is already a long lasting ongoing process. For some reason it has not been implemented yet, and therefore it is of great importance to indicate what barriers exist in to use as a starting point.

e-AWB

The key component and starting point of this program is the electronic air waybill (e-AWB), which serves as a crucial step towards achieving a fully paperless process. The transition from a traditional paper air waybill or hardcopy of the air waybill to the e-AWB, will lead to time and cost savings for all stakeholders involved. There is no longer a need to print, handle or archive the paper AWB simplifying the air cargo process. The e-AWB process skips steps in the chain and prevents the customer from paying a fee.

Regulatory framework:

Feasible trade lanes: The use of e-AWB is regulated by international treaties and/or laws (MP4/MC99) (IATA, 2018). The e-AWB is only authorized and thus recommended on feasible trade lanes. A feasible trade lane is defined as such when country of origin and country of

destination ratified the same treaty. Outside of this regulatory framework, the use of paper AWBs is still required. However, even within the right regulatory framework, paper AWBs might be required by local authorities.

Government (local) authorities:
The use of e-AWB may also depend on the government authorities, whether they recognize or accept the e-AWB, or not.

Single process:
With the single process, the Freight Forwarder does not need to face these questions. Regardless of the trade lane, the Freight Forwarder should always send an e-AWB to the airline and the cargo is accepted without paper AWB. If required, the paper AWB can be printed by the airline or the GHA. In Figure 19 can be seen that the Freight Forwarder always sends the FWB message. Only at the step where the cargo is already accepted from the FF, the airlines and GHA will determine whether a paper AWB is required either due to the international treaties and/or laws (unfeasible trade lane) or for local authorities.
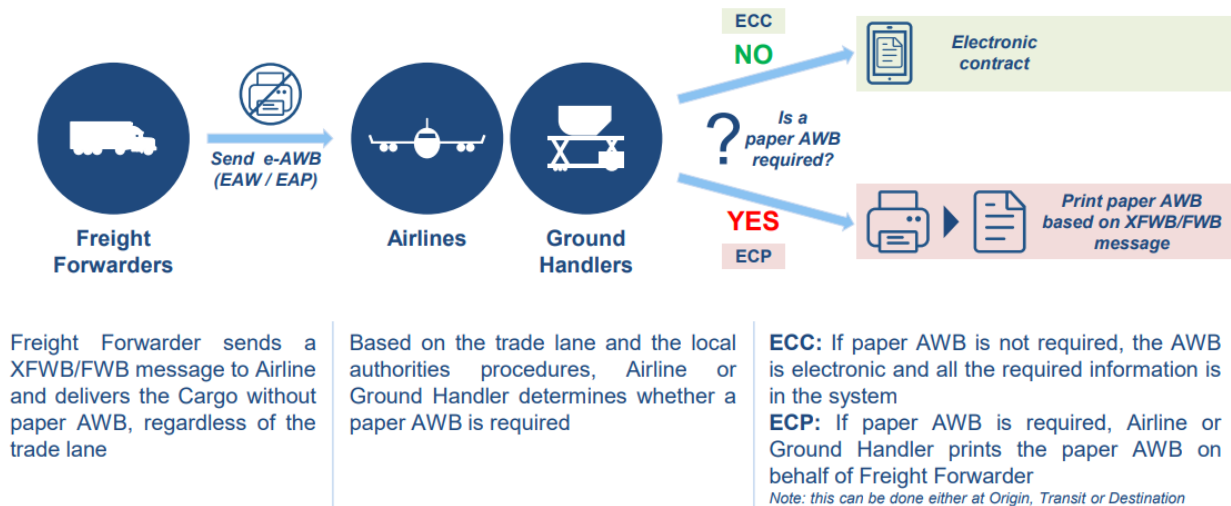
Figure 19: e-AWB process and its critical points

eLink
Digital pre-registration, implemented as a local initiative at Amsterdam Schiphol Airport (AMS/SPL), has been introduced to reduce paperwork and enhance operational efficiency. Since January 2021, handlers at the airport have adopted digital pre-notification for local export cargo. To support this initiative, major ground handling agents (GHAs) including WFS, dnata, AFKLMP Cargo, Menzies, and Swissport signed a "Best Effort" statement in 2020. The primary objective of this digitization process is to streamline the delivery, administrative processing, unloading, and loading of export goods, promoting efficiency, sustainability, safety, and reliability. The use of digital pre-registration allows for minimal physical contact, aligning with the requirements of maintaining social distancing in the context of the 1.5 meter society.

The implementation of digital pre-registration is facilitated through the eLink tool, developed in collaboration with Cargonaut and Amsterdam Airport City (ACN). This initiative is part of

the broader Smart Cargo Mainport Program (SCMP) at Amsterdam Schiphol Airport. By fostering collaboration among various stakeholders, the program aims to improve operational efficiency throughout the airport. The successful implementation of this digital pre-registration initiative has the potential to provide a competitive advantage for AFKLMP Cargo, further strengthening Amsterdam Airport's position as an international hub. This advantage is beneficial to all parties involved and contributes to the overall competitiveness of the airport on a global scale. The main stakeholders, and initiators of the e-Link project are:

- Customs
- Schiphol Group
- Air Cargo Netherlands
- AFKLMP Cargo
- Amsterdam Connecting Trade (ACT)

The process step-by-step:

1. The freight forwarder accesses the web application.
2. The ACN-card is linked to the truck through software at the freight forwarder's end.
3. The freight forwarder transports one or multiple parts of the shipment to one or more handling agents.
4. The handling agent receives a pre-notification.
5. Upon arrival of the truck at the handling agent's gate, information about the driver and the freight is available. If the shipper is identified and no inspection is required, an unloading dock is assigned and displayed to the truck driver.
6. After the truck driver is identified, the freight can be unloaded.
7. Upon completion of unloading, an electronic confirmation is signed and all parties are registered and identified. All relevant information is now available to both the handling agent and the freight forwarder.
8. If there is an issue with the freight, E-link will display the problem to all parties involved.

ONE Record IATA

ONE Record, as introduced by IATA in their initiative "ONE step closer to digital cargo," is a standardized approach to data sharing that aims to streamline cargo operations. It establishes a unified view of shipment information by creating a single record. The key feature of ONE Record is the utilization of a common data model for sharing data through standardized and secure web APIs (Application Programming Interfaces).

This standard is built upon established and advanced data sharing technologies, aligning with industry-leading practices adopted by major airlines. As a result, ONE Record is readily accessible to IT teams and service providers, facilitating its implementation and integration into existing systems. By leveraging this standard, stakeholders in the air cargo industry can achieve improved efficiency, transparency, and interoperability in their operations. ONE Record represents a significant step towards digitalizing cargo processes, bringing about enhanced collaboration and seamless information exchange across the supply chain.

Import Control System 2 (ICS2):

The European Union is currently implementing a customs pre-arrival security and safety program known as Import Control System 2 (ICS2). This program is a key component of the EU's efforts to enhance customs risk management through the common risk management framework (CRMF) and establish a more integrated approach. ICS2, the new advance cargo information system, is designed to support the implementation of the customs safety and security regulatory regime, with the aim of safeguarding the EU single market and its citizens. The system will gather comprehensive data on all goods entering the EU before their arrival. Economic Operators (EOs) will be required to submit safety and security information to ICS2 by means of an Entry Summary Declaration (ENS). The timing of this obligation will vary for different EOs, depending on the nature of their services in international goods transportation and corresponding to the three release dates of ICS2

C2: AFKLMP CARGO

AFKLMP mission, pillars and acknowledged benefits of e-Freight

'' Our mission is to provide its customers a high quality service adaptable to their changing needs''

To be the preferred partner as an airline for the customers, several pillars concerning documentation are of high importance. The pillars that are considered most important are **compliance, quality, sustainability, time** and **innovation**. The compliance means that the shipment and all required documentation complies with security and governmental requirements. The quality means that all information on the documentation is correct and complete. For the sustainability, airlines want to reduce their carbon footprint as much as possible. Considering time, the aim is to handle and process all documentation as quick and efficient as possible. And finally, airlines could gain a competitive advantage and increase their efficiency by considering the latest innovations. However, in the air cargo industry this is a critical topic as most processes are outdated and not flexible.

The abovementioned pillars of AFKLMP Cargo to fulfill its mission and be the preferred partner for their customers can be achieved by the complete implementation of e-Freight. Below will be indicated how e-Freight will positively influence these pillars. For **compliance**, digitalization will lead to quickly comply with security & governmental requirements and mitigate security risks. When providing information/data in an electronic way, a specific format will be required, which is called ACI/PLACI. This centrally used format will lead to ease of indicating whether a shipment complies with security and governmental requirements and lead to a more efficient process. The advance electronic transmission of air cargo data is primarily aimed at offsetting security risks. Customs administrations sufficient time to undertake an adequate risk assessment of cargo prior to the arrival of the carrying aircraft in their territory. Furthermore, future regulation/legislation will form a legal basis to switch to digital. The program of ICS2 entails to collect data from all shipments and products entering the EU, prior to the arrival of the aircraft. The program will be launched in March 2023, which forms a hard driver/incentive to switch to digital and comply with standard messaging formats and protocols. For **the quality**, e-Freight will lead to secured high quality data, not losing any documents anymore and excluding manual errors. From a **sustainability** point of view, the implementation of paperless documentation will strengthen the leading position, and reduces carbon footprint. The digitalization will lead to the exclusion of a lot of paper. Considering **timeliness,** the

transition will lead to receiving on the spot info and the possibility of sharing real-time information, which will decrease the acceptance time and document processing workload. It will be a big opportunity to comply with the first time right principle and
- First time right
- CGOMONMAWB

For the innovation pillar, which currently is still very outdated and not up to date, the digitalization will enable digital opportunities, strategic advantages, and have a positive impact on shipment journey.

e-Freight team:

''#GoPaperless''

While recognizing most benefits of e-Freight implementation and with sight on coming regulations, AFKLMP Cargo appointed a team that specifically focuses on the implementation of e-Freight, called the e-Freight team. The team consists of AFKLMP Cargo employees from both hubs: AMS and CDG. Their main tasks: check on customers that want to become e-AWB contracted. First customers need to sign an agreement with IATA, and then they apply at AFKLMP Cargo to become e-AWB contracted. The e-Freight team estimates whether the customers are approved by checking the quality of their first provided FWBs. Also, they aim to form an internal policy around e-Freight implementation and create action/implementation plans to approach customers and get them on the e-AWB board.
- GCC: included a paragraph stating that when a customer provides both the FWB and paper AWB, that the FWB is always leading over paper AWB

The main project being: #GoPaperless. Within this project, the paperless processes are being described, as well as the processes to get customers e-AWB contracted and what are the procedures. This is shown in Figure 20.

Main tasks:
- Check e-AWB contracts with customers (FFs), form implementation plan to get all customers e-AWB contracted**.**
- Developing tools to check quality of FWBs; MIP2.0
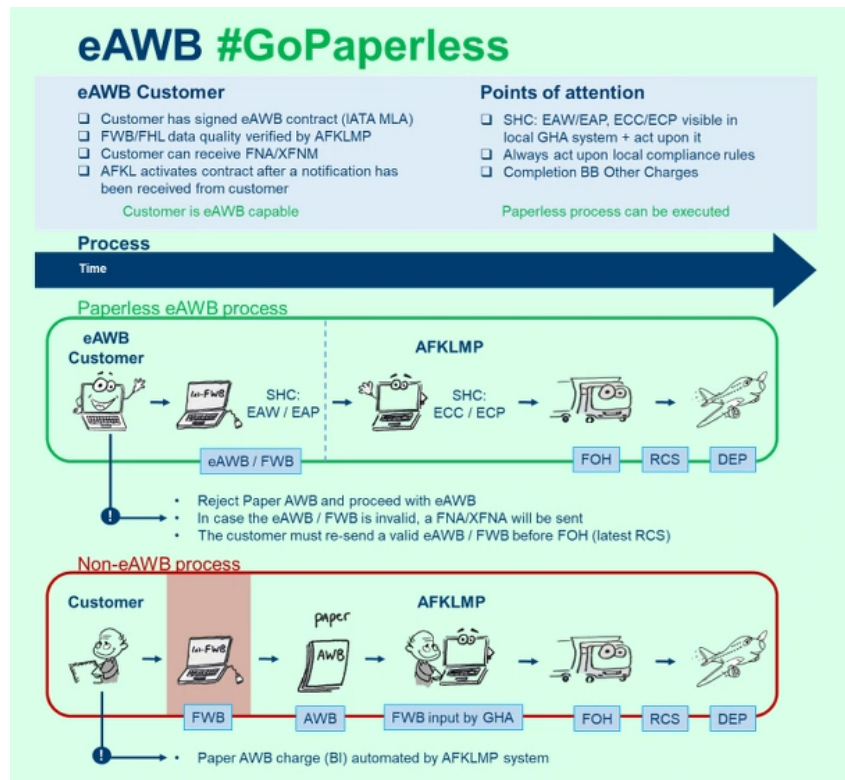
Figure 20: OnePager e-Freight team on e-AWB implementation

e-AWB contracted customers:

The FWB is validated as an e-AWB only when the FWB sender role is an EDI validated customer with AFKL. When a customer has a digitalized contract of carriage, they become an EDI validated AFKL customer. A customer officially gets a digitalized contract of carriage and thus becomes officially EDI when he:

- Has signed **the IATA Multilateral Agreement (MeA):** which provides the legal framework for parties to conclude cargo contracts by electronic means.
- Has received the **Activation notice** (bilateral agreement with our airline): which is a formal means for an airline to confirm to freight forwarder, after the validation process, about the location(s) and date(s) where they mutually decide to start e-AWB.

Semi-structured interviews were conducted mainly with respondent from inside the organization AFKLMP Cargo. Before starting the interview, consent for the use and recording of the interview has been requested from the person interviewed.

D1: INTERVIEW SCHEDULING
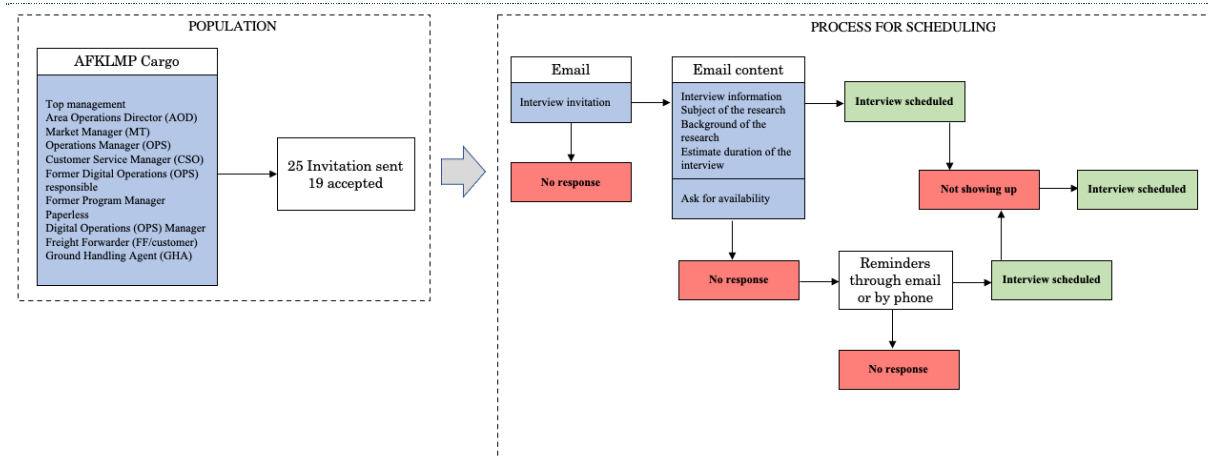
Figure 21: Interview population and scheduling

D2: INTERVIEW QUESTIONS

Overall (AOD/Market Manager)
1. **What is your role within AFKL Cargo?**
   a. Can you give a brief description of your role?

2. **How is your role connected to e-AWB/e-Freight? Wat is your responsibility?**
   a. How is your role linked to e-AWB/e-Freight implementation?
   b. What is your influence on e-AWB/e-Freight implementation? (What actions can you execute or decisions can you make to implement e-AWB/e-Freight?)
      i. Are you dependent on others to execute these actions/make these decisions?
      ii. What actions did/do you already execute?/decisions did you already make?
      iii. What other actions do you want to execute? Next steps?
      iv. What prevents you from executing other actions?/making other decisions?
      v. Do you communicate your decisions to others?
         1. If yes, to who?
         2. If yes, how? (do you guide/monitor/structural feedback?)
         3. If no, why not?
   c. What is your view on e-AWB/e-Freight implementation?
      i. Is it high on your priority list?

3. **What is the e-Freight status of your area/station?**

The real-life situation:
   a. Customer mix:
       i. Do you have insights on the percentage of e-AWB contracted customers?
           1. How?
           2. Do you use the dashboard?
       ii. Are customers encouraged to become customers with an e-AWB contract?
           1. If yes, how?
       iii. How was the change from paper AWB to e-AWB announced?
       iv. Do you see a difference in Key Accounts vs. local customers and the e-AWB contracts?
           1. Ease of communication?
           2. Digital maturity?
           3. Feedback acceptance or possibility to receive?
   b. E-AWB customers
       i. Do all e-AWB contracted customers really provide e-AWBs?
       ii. When in transition phase: did you give feedback to e-AWB contracted customers in case of errors?
           1. If yes, how?
       iii. Can you give an indication on the EAW/EAP distribution?
           1. Is there communication on providing EAW > EAP to e-AWB contracted customers?
   c. Paper documents/paperless
       i. What paper-based documents are present at your station?
           1. AWB
           2. Pouch? (EAP) Related to sorts of products?
           3. Required paper documents; which ones? (list)
       ii. Do you think these documents can be skipped/digitalized?
       iii. What is your view on becoming 100% paperless at your station?
           1. Possible in near future yes/no?
           2. When?
           3. Why do you think?
   d. Station vs. area
       i. What is the status of the specific station compared to the area?
       ii. Why do you think?
   e. Responsible digital person?
       i. Is there a responsible person that steers on e-AWB/e-Freight?
       ii. If yes, who is it?
       iii. If yes, how does this person executes his/her job?
   f. What was the status of the home carrier at your station regarding e-Freight? Does it influence the status of AFKL at your station?

4. **What do you think are barriers to completely implement e-Freight in your area/station? (past and future)**

a. What are the main internal barriers?
    i. What prevents the AFKL organization (within) from implementing e-Freight?
        1. Technological?
        2. Economic/financial?
        3. Regulatory/institutional?
        4. Social/cultural?
            a. Resistance?
        5. Organizational?
            a. Responsibilities?
        6. Other?
    ii. How do you deal with this in reality?
b. What are the main external barriers?
    i. ''
    ii. E-AWB contracted customers?
    iii. ECP destinations
    iv. EAP
c. Do you have any other comments on the barriers for complete e-Freight implementation?

5. **What do you think are opportunities to completely implement e-Freight in your area/station? (past and future)**
    a. Internal opportunities
        i. Short term?
        ii. Long term?
    b. External opportunities

6. **How do you think the e-Freight team needs to be organized/positioned within the AFKL organization to have sufficient support, reach and direct guidelines to external parties (GHA and customers)?**
    a. What functions need to be fulfilled?
    b. How many FTE's?
    c. How divided over the company?
    d. How needs the responsibility be divided?
    e. Communication structure?
        i. Feedback?
    f. Are you familiar with central e-Freight team?
        i. What are your expectations?
        ii. What do you hear from them (communication)?

7. **What do you think could be the next steps towards the complete implementation of e-Freight in your area/station? (past and future)**
    a. Strategy?
    b. Changes? Action points?

8. Do you have any additional thoughts? Something you want to add?

E1: DIRECT OBSERVATIONS LONG TERM

Date	Event	Reason	Function	Station
10/01/2023	Respondent did not show up at interview without communicating	Forgot due to busy schedule	Market Manager (MT)	LAX
17/01/2023	Respondent ended interview by thanking the interviewer for finally listening and asking what the next steps would be on the e-Freight implementation	The willingness to change and take action, with the desire for more and better guidance, coaching and education	OPS Manager	LAX
23/01/2023	Issues for effective communication	Language barrier	OPS Manager	LOS
23/01/2023	Interrupted network connectivity during interview	Lack of infrastructure facility	OPS Manager	LOS
30/01/2023	Respondent did not show up at interview without communicating	Too busy with unexpected issues, cultural	CSO Manager	LAX
03/02/2023	Rescheduling interview last-minute	Too busy with unexpected issues, cultural	CSO Manager	LAX
07/02/2023	Declined interview invitation	Not specialist, so reference to another manager - no commitment	Top manager [Robert]	SPL
15/02/2023	Declined interview invitation	No time, so reference to another manager – no commitment	Top manager [Koen]	SPL
21/02/2023	Declined interview invitation	No knowledge/expertise – organizational inertia	OPS Manager [Kester]	SPL
24/03/2023	Respondent ended interview by thanking the interviewer for finally	The willingness to change and take action, with the desire for more and better	Market Manager (MT)	LIM

	listening and asking what the next steps would be on the e-Freight implementation	guidance, coaching and education – lack of training & unsupportive organizational structure		

Table 13: Direct observations on interview scheduling and planning

Date	Event/Insight	Reason	Where	Station
15/04/2022	Checking a list with all outstations to gain insight in current situation of IT systems used by OPS and GHA	A lot of different IT systems are present in the process – lack of technological integration	AOP	All
Q1 2022	Local teams asking how to approach their customers to contact them on their performance	Lack of communication channels and no feedback loop (outstation > customers)	AOP	Some
Q1 2022	All outstations have different processes, systems, regulations; no standardization	Country specific regulations, no industry specific standards, every station has it station specifics	AOP	All
Sept 2022	Negotiation and convincement needed for operational changes	Cultural differences/cultural rigidity	AOP	DEL
Q1 2023	Some stations taking a very long time to implement changes	Conservative industry/organizational inertia/cultural rigidity	AOP	Some
Q1 2023	Sub Sahara structurally not attending planned meetings at AOP	No internet connectivity, lack of communication when not available, forgetting, no attention, cultural rigidity	AOP	Africa

Table 14: Direct observations long-term (AOP internship)

#	Insight	Effect
1	Still taking paper AWBs (little pile), that is not used and not charging paper fees	No hard measurements on the customers
2	No communication or feedback from documentation department towards CSO on customers that still deliver hardcopies of the AWB	No internal communication and collaboration
3	No communication or feedback towards the customers that they should not deliver paper	No awareness on this inconsistency/feedback to the customers
4	Regarding e-Freight; still AWBs that need to be printed at the hub when a destination is an ECP destination	Papers present at the hub
5	Customers submitting e-AWBs that are incomplete (address), incorrect (descriptions) and non-compliant	Incorrect customer input

Table 15: On-site visit SPL 27/10/2022

#	Insight	Activity	Function
1	Implementing unpopular measurements with hard targets; using paper fees, only accepting e-AWB contracted customers leads to success	Action from team/individuals (dependent)	MT/Team
2	Using penalties as spare change	Using penalties in communication towards customers	MT
3	Regarding e-Freight; still papers needed for the flight manifest and the NOTOC	Document handling	OPS
4	Using AOP as an opportunity to switch to e-AWB	Prioritizing e-AWB	Local team SIN
5	Government granting subsidy when switching to e-AWB	Incentive to switch rather than restriction	Local authority

Table 16: On-site visit SIN 5/12/2022

F1: KNOWLEDGE GAP

Nr	Author		Research on air cargo supply chain	Mentioning shortcomings on data documentation and communication in cargo supply chain		Indicated barriers	Suggesting means of improvements
				Paper based documentation	Low digitalization grade		
1	Diefenbach et al.	2021	X	X		- Expertise of right use of technologies - Acceptance of operational staff	X
2	Vural et al.	2020				Varying perceptions	
3	Kovynyov & Mikut	2019					
4	Hofmann & Osterwalder	2017					
5	Heilig, Schwarze & Voß	2017				Alignment of digital strategies between stakeholders	
6	Feng, Li & Shen	2015	X				
7	Bierwirth & Schocke	2017	X	X	X	Gap between perception of supply chain thinking and existing electronic data exchange	X
8	Sieke	2010	X				
9	Vancroonenburg et al.	2014	X				
10	Kamel	2005					
11	Kern	2021	X	X	X	- High investment costs - Lack of standards - Unclear benefits	
12	Zhang et al.	2015	X				
13	Freightos	2019			X		
14	IATA	2018		X			
15	Berland	-		X			

Figure 22: Literature knowledge gap identification

F2: CHANGE/INNOVATION

Barriers to Innovation	Focus	Source (APA)	
Innovation	Barriers to innovation	Piatier, A. (1984). *Barriers to innovation*. London; Dover, NH: F. Pinter.	(Piatier, 1984) (Hadjimanolis, 2003) (Hölzl, W., & Janger, 2012) (Madrid-Guijarro, Garcia & Van Auken, 2009) (Reynolds & Hristov, 2009) (D'Este Iammarino, Savona & Von Tunzelmann, 2012) (D'Este et al., 2012)
	Barriers to innovation	Hadjimanolis, A. (2003). The barriers approach to innovation. In *The international handbook on innovation* (pp. 559-573). Pergamon.	
	External across firms and countries	Hölzl, W., & Janger, J. (2012). *Innovation barriers across firms and countries* (No. 426). WIFO working papers.	
	In Spanish manufacturing SMEs	Madrid-Guijarro, A., Garcia, D., & Van Auken, H. (2009). Barriers to innovation among Spanish manufacturing SMEs. *Journal of small business management*, 47(4), 465-488.	
	In retailing	Reynolds, J., & Hristov, L. (2009). Are there barriers to innovation in retailing?. *The International Review of Retail, Distribution and Consumer Research*, 19(4), 317-330.	
	Firms	D'Este, P., Iammarino, S., Savona, M., & Von Tunzelmann, N. (2012). What hampers innovation? Revealed barriers versus deterring barriers. *Research policy*, 41(2), 482-488.	
Innovation adoption	Radical Innovation	Sandberg, B., & Aarikka-Stenroos, L. (2014). What makes it so difficult? A systematic review on barriers to radical innovation. *Industrial Marketing Management*, 43(8), 1293-1305.	(Sandberg and Aarikka-Stenroos, 2014) (Stornelli, Ozcan & Simms, 2021)
	Advanced manufacturing technologies	Stornelli, A., Ozcan, S., & Simms, C. (2021). Advanced manufacturing technology adoption and innovation: A systematic literature review on barriers, enablers, and innovation types. *Research Policy*, 50(6), 104229.	

Table 17: Included literature on barriers to change and innovation

Barriers to Sustainable Innovation	Focus	Source (APA)	
Sustainable supply chains (interactions)	Interaction in sustainable supply chain management	Al Zaabi, S., Al Dhaheri, N., & Diabat, A. (2013). Analysis of interaction between the barriers for the implementation of sustainable supply chain management. *The International Journal of Advanced Manufacturing Technology*, 68, 895-905.	(Al Zaabi, Dhaheri & Diabat, 2013) (Movahedipour, Zeng, Yang & Wu, 2017) (Narayanan, Sridharan & Ram Kumar, 2019) (Moktadir, Ali, Rajesh & Paul, 2018)
	Sustainable supply chain management	Movahedipour, M., Zeng, J., Yang, M., & Wu, X. (2017). An ISM approach for the barrier analysis in implementing sustainable supply chain management: An empirical study. *Management Decision*, 55(8), 1824-1850.	
	Interactions sustainable supply chain management	Narayanan, A. E., Sridharan, R., & Ram Kumar, P. N. (2019). Analyzing the interactions among barriers of sustainable supply chain management practices: A case study. *Journal of Manufacturing Technology Management*, 30(6), 937-971.	
	Interrelationships sustainable supply chain management in leather industry	Moktadir, M. A., Ali, S. M., Rajesh, R., & Paul, S. K. (2018). Modeling the interrelationships among barriers to sustainable supply chain management in leather industry. *Journal of cleaner production*, 181, 631-651.	
Sustainable innovation	Eco innovation in manufacturing SMEs	de Jesus Pacheco, D. A., ten Caten, C. S., Jung, C. F., Navas, H. V. G., & Cruz-Machado, V. A. (2018). Eco-innovation determinants in manufacturing SMEs from emerging markets: Systematic literature review and challenges. *Journal of Engineering and Technology Management*, 48, 44-63.	(de Jesus Pacheco et al., 2018) (Gupta & Barua, 2018) (Arranz et al., 2019) (Kiefer et al., 2019)
	Green innovation in manufacturing organizations	Gupta, H., & Barua, M. K. (2018). A grey DEMATEL-based approach for modeling enablers of green innovation in manufacturing organizations. *Environmental Science and Pollution Research*, 25, 9556-9578.	
	Eco-innovations in Spanish firms	Arranz, N., Arroyabe, M. F., Molina-García, A., & De Arroyabe, J. F. (2019). Incentives and inhibiting factors of eco-innovation in the Spanish firms. *Journal of Cleaner Production*, 220, 167-176.	
	Eco-innovations in sustainable transitions	Kiefer, C. P., Del Rio Gonzalez, P., & Carrillo-Hermosilla, J. (2019). Drivers and barriers of eco-innovation types for sustainable transitions: A quantitative perspective. *Business Strategy and the Environment*, 28(1), 155-172.	
Adoption of sustainability innovation (some are agricultural technology adoption)	Innovation adoption in agriculture in Australia	Greenland, S., Levin, E., Dalrymple, J. F., & O'Mahony, B. (2018). Sustainable innovation adoption barriers: water sustainability, food production and drip irrigation in Australia. *Social Responsibility Journal*.	(Greenland et al., 2018) (Long, Blok & Coninx, 2016) (Senyolo, Long, Blok & Omta, 2018) (Luthra et al., 2014)
	CSA adoption in Australia in agriculture	Long, T. B., Blok, V., & Coninx, I. (2016). Barriers to the adoption and diffusion of technological innovations for climate-smart agriculture in Europe: evidence from the Netherlands, France, Switzerland and Italy. *Journal of cleaner production*, 112, 9-21.	
	CSA innovation adoption	Senyolo, M. P., Long, T. B., Blok, V., & Omta, O. (2018). How the characteristics of innovations impact their adoption: An exploration of climate-smart agricultural innovations in South Africa. *Journal of Cleaner Production*, 172, 3825-3840.	
	Adoption of smart grid technologies	Luthra, S., Kumar, S., Kharb, R., Ansari, M. F., & Shimmi, S. L. (2014). Adoption of smart grid technologies: An analysis of interactions among barriers. *Renewable and Sustainable Energy Reviews*, 33, 554-565.	
Transition to sustainability	Eco-innovation	De Jesus, A., & Mendonça, S. (2018). Lost in transition? Drivers and barriers in the eco-innovation road to the circular economy. *Ecological economics*, 145, 75-89.	(de Jesus & Mendonca, 2018)
Implementing sustainability initiatives	Implementing types of sustainability approaches	Stewart, R., Bey, N., & Boks, C. (2016). Exploration of the barriers to implementing different types of sustainability approaches. *Procedia Cirp*, 48, 22-27.	(Stewart, Bey & Boks, 2016)
Industrial sustainability	Industrial sustainability	Neri, A., Cagno, E., Di Sebastiano, G., & Trianni, A. (2018). Industrial sustainability: Modelling drivers and mechanisms with barriers. *Journal of Cleaner Production*, 194, 452-472.	(Neri, Cagno, Di Sebastiano & Trianni, 2018)

Table 18: Included literature on barriers to sustainable innovation

Barriers Digitalization	Focus	Source (APA)	
Digital transformation (DT)	In maritime transport; drivers, success factors and barriers	Tijan, E., Jović, M., Aksentijević, S., & Pucihar, A. (2021). Digital transformation in the maritime transport sector. *Technological Forecasting and Social Change, 170*, 120879.	(Tijan, Jović, Aksentijević & Pucihar, 2021) (Jović, Tijan, Vidmar & Pucihar, 2022). (Vogelsang et al., 2021) (Cichosz, Wallenburg & Knemeyer, 2020) (Kern, 2021) (Durão, Ferreira, Pereira & Moreira, 2019)
	In maritime transport sector	Jović, M., Tijan, E., Vidmar, D., & Pucihar, A. (2022). Factors of digital transformation in the maritime transport sector. *Sustainability, 14*(15), 9776.	
	Nonprofit and industry organizations	Vogelsang, K., Packmohr, S., & Brink, H. (2021). Challenges of the digital transformation–comparing nonprofit and industry organizations. In *Innovation Through Information Systems: Volume I: A Collection of Latest Research on Domain Issues* (pp. 297-312). Springer International Publishing.	
	In manufacturing; barriers and success factors	Cichosz, M., Wallenburg, C. M., & Knemeyer, A. M. (2020). Digital transformation at logistics service providers: barriers, success factors and leading practices. *The International Journal of Logistics Management, 31*(2), 209-238.	
	Logistics; review on technologies and implementation status	Kern, J. (2021). The digital transformation of logistics: A review about technologies and their implementation status. The digital transformation of logistics: Demystifying impacts of the fourth industrial revolution, 361-403.	
	Organizations in Portugal	Durão, N., Ferreira, M. J., Pereira, C. S., & Moreira, F. (2019). Current and future state of Portuguese organizations towards digital transformation. *Procedia Computer Science, 164*, 25-32.	
Digitalization	Intermodal transport	Vural, C. A., Roso, V., Halldórsson, Á., Ståhle, G., & Yaruta, M. (2020). Can digitalization mitigate barriers to intermodal transport? An exploratory study. *Research in Transportation Business & Management, 37*, 100525.	(Vural et al., 2020) (Nikolaeva, Rudakova, Dmitrieva, Vlasov & Morkovkin, 2020) (Bierwirth & Schocke, 2017) (Sehlin, Truedsson & Cronemyr, 2019)
	EAEU Transport and Logistics sector	Nikolaeva, I. G., Rudakova, E. N., Dmitrieva, O. A., Vlasov, A. V., & Morkovkin, D. E. (2020, March). Digitalization of the EAEU transport and logistics sector and its role in improving the Euro-Asian cargo transportation. In *4th International Conference on Culture, Education and Economic Development of Modern Society (ICCESE 2020)* (pp. 1296-1302). Atlantis Press.	
	Air cargo industry	Bierwirth, B., & Schocke, K. O. (2017). Lead-time optimization potential of digitization in Air Cargo. In Digitalization in Supply Chain Management and Logistics: Smart and Digital Solutions for an Industry 4.0 Environment. Proceedings of the Hamburg International Conference of Logistics (HICL), Vol. 23 (pp. 75-98). Berlin: epubli GmbH.	
	In small and medium organizations	Sehlin, D., Truedsson, M., & Cronemyr, P. (2019). A conceptual cooperative model designed for processes, digitalisation and innovation. *International Journal of Quality and Service Sciences, 11*(4), 504-522.	
Adopting DT	Institutional and capability barriers to smart services	Töytäri, P., Turunen, T., Klein, M., Eloranta, V., Biehl, S., Rajala, R., & Hakanen, E. (2017). Overcoming institutional and capability barriers to smart services.	(Töytäri et al., 2017) (Agrawal, Narain & Ullah, 2020)
	Digital Supply Chain (DSC) Interrelationship	Agrawal, P., Narain, R., & Ullah, I. (2020). Analysis of barriers in implementation of digital transformation of supply chain using interpretive structural modelling approach. *Journal of Modelling in Management, 15*(1), 297-317.	
Digital Innovation	Martitime industry	Gausdal, A. H., Czachorowski, K. V., & Solesvik, M. Z. (2018). Applying blockchain technology: Evidence from Norwegian companies. *Sustainability, 10*(6), 1985.	(Gausdal, Czachorowski & Solesvik, 2018) (Carlan, Sys, Vanelslander & Roumboutsos, 2016)
	In port sector for electronic data interchange	Carlan, V., Sys, C., Vanelslander, T., & Roumboutsos, A. (2016). Digital innovation in the port sector: barriers and facilitators. *The challenges of digitalization and the use of data*, 11.	

Table 19: Included literature on barriers to digitalization

Barriers Paperless Documentation	Focus	Source (APA)	
Paperless documentation/paperless trade	International trade in Asia	Larvea, E. (2005). Facilitating paperless international trade: a survey of Law and Policy in Asia. *International Review of Law, Computers & Technology*, 19(2), 121-142.	(Larvea, 2005) (Ballen Prada & Prada, 2022) (Civelek et al., 2017) (Bueno Rezende de Castro & Kornher, 2023)
	Export documents in organizaiton	Ballen Prada, J. S., & Prada, B. (2022). *Digitalization of export documents as a paperless trade strategy implementation* (Doctoral dissertation, Universidad del Rosario).	(Roman, Pietrzak & Stolarczyk, 2023) (Panos, Kapnissis & Leligou, 2020) (Ziakas, 2018) (Diefenbach et al., 2021) (Numair et al., 2021)
	Foreign trade process	Civelek, M. E., Cemberci, M., Uca, N., Celebi, Ü., & Özalp, A. (2017). Challenges of paperless trade redesign of the foreign trade processes and bundling functions of traditional documents. *International Business Research*, 10(2).	
	Trade and customs documents	Bueno Rezende de Castro, A., & Kornher, L. (2023). The effect of trade and customs digitalization on agrifood trade: A gravity approach. *Q Open*, 3(1), qoac037.	
	Transport documents	Roman, M., Pietrzak, P., & Stolarczyk, S. (2023). Digitalization in Transport: An Example of Transport Documents. In *Sustainable Logistics* (pp. 247-264). Productivity Press.	
	Transport document (BOL) in maritime industry	Panos, A., Kapnissis, G., & Leligou, H. C. (2020). The Blockchain and DLTs in the maritime industry: Potential and barriers. *European Journal of Electrical Engineering and Computer Science*, 4(5).	
	Transport document (eBOL) in maritime industry	Ziakas, V. (2018). Challenges regarding the electronic bill of lading (Ebol). *International Journal of Commerce and Finance*, 4(2), 40-45.	
	Air cargo	Diefenbach, H., Erlemann, N., Lunin, A., Grosse, E. H., Schocke, K. O., & Glock, C. H. (2021). Improving processes and ergonomics at air freight handling agents: a case study. International Journal of Logistics Research and Applications, 1-22.	
	Health information	Numair, T., Harrell, D. T., Huy, N. T., Nishimoto, F., Muthiani, Y., Nzou, S. M., ... & Kaneko, S. (2021). Barriers to the digitization of health information: a qualitative and quantitative study in Kenya and Lao PDR using a cloud-based maternal and child registration system. *International Journal of Environmental Research and Public Health*, 18(12), 6196.	

Table 20: Included literature on barriers to paperless documentation

Barriers Internal External	Focus	Source (APA)	
Innovation	Generic	Piatier, A. (1984). *Barriers to innovation*. London; Dover, NH: F. Pinter.	(Piatier, 1984)
	Barriers approach (detailed classification)	Hadjimanolis, A. (2003). The barriers approach to innovation. In *The international handbook on innovation* (pp. 559-573). Pergamon.	(Hadjimanolis, 2003) (Hölzl, W., & Janger, 2012) (Madrid-Guijarro, Garcia & Van Auken, 2009) (Reynolds & Hristov, 2009)
	External; across firms and countries	Hölzl, W., & Janger, J. (2012). *Innovation barriers across firms and countries* (No. 426). WIFO working papers.	
	In Spanish manufacturing SMEs (organizations)	Madrid-Guijarro, A., García, D., & Van Auken, H. (2009). Barriers to innovation among Spanish manufacturing SMEs. *Journal of small business management*, 47(4), 465-488.	
	In retailing/retail innovation (organizations)	Reynolds, J., & Hristov, L. (2009). Are there barriers to innovation in retailing?. *The International Review of Retail, Distribution and Consumer Research*, 19(4), 317-330.	
Adoption of innovation	Radical Innovation	Sandberg, B., & Aarikka-Stenroos, L. (2014). What makes it so difficult? A systematic review on barriers to radical innovation. *Industrial Marketing Management*, 43(8), 1293-1305.	(Sandberg and Aarikka-Stenroos, 2014) (Stornelli, Ozcan & Simms, 2021) (Töytäri et al., 2017)
	Advanced manufacturing technology; barriers, enables and types in organizations	Stornelli, A., Ozcan, S., & Simms, C. (2021). Advanced manufacturing technology adoption and innovation: A systematic literature review on barriers, enablers, and innovation types. *Research Policy*, 50(6), 104229.	
	Adopting smart services	Töytäri, P., Turunen, T., Klein, M., Eloranta, V., Biehl, S., Rajala, R., & Hakanen, E. (2017). Overcoming institutional and capability barriers to smart services.	
Adoption of sustainability innovation	Agriculture in Australia	Greenland, S., Levin, E., Dalrymple, J. F., & O'Mahony, B. (2018). Sustainable innovation adoption barriers: water sustainability, food production and drip irrigation in Australia. *Social Responsibility Journal*.	(Greenland et al., 2018) (Long, Blok & Coninx, 2016) (Kiefer, Del Rio Gonzalez & Carrillo-Hermosilla, 2010)
	Technological innovation for climate-smart agriculture in EU	Long, T. B., Blok, V., & Coninx, I. (2016). Barriers to the adoption and diffusion of technological innovations for climate-smart agriculture in Europe: evidence from the Netherlands, France, Switzerland and Italy. *Journal of cleaner production*, 112, 9-21.	
	Eco-innovation for sustainable transitions	Kiefer, C. P., Del Río Gonzalez, P., & Carrillo-Hermosilla, J. (2019). Drivers and barriers of eco-innovation types for sustainable transitions: A quantitative perspective. *Business Strategy and the Environment*, 28(1), 155-172.	

Table 21: Literature discussing and utilizing internal and external barriers

Main categories	Used by authors	#
Technical/Technological	(Gupta, Kusi-Sarpong & Rezaei, 2020) (Gupta & Barua, 2018) (Greenland et al., 2018) (Vogelsang et al., 2021) (Hölzl & Janger, 2012) (Panos, Kapnissis & Leligou, 2020) (Tijan, Jović, Aksentijević & Pucihar, 2021) (Stornelli, Ozcan & Simms, 2021) (de Jesus & Mendonca, 2018) (Kern, 2021) (Jović, Tijan, Vidmar & Pucihar, 2022) (Bueno Rezende de Castro & Kornher, 2023) (Moktadir, Ali, Rajesh & Paul, 2018)	13
Economical and financial	(Gupta, Kusi-Sarpong & Rezaei, 2020) (Gupta & Barua, 2018) (Long, Blok & Coninx, 2016) (Greenland et al., 2018) (Hölzl & Janger, 2012) (Reynolds & Hristov, 2009) (Stornelli, Ozcan & Simms, 2021) (de Jesus & Mendonca, 2018) (D'Este et al., 2012) (Moktadir, Ali, Rajesh & Paul, 2018)	9
Market	(Gupta, Kusi-Sarpong & Rezaei, 2020) (Long, Blok & Coninx, 2016) (Reynolds & Hristov, 2009) (Hadjimanolis, 2003) (Hölzl & Janger, 2012) (de Jesus & Mendonca, 2018) (D'Este et al., 2012)	7
Organizational	(Gupta, Kusi-Sarpong & Rezaei, 2020) (Long, Blok & Coninx, 2016) (Vogelsang et al., 2021) (Tijan, Jović, Aksentijević & Pucihar, 2021) (Stornelli, Ozcan & Simms, 2021) (Jović, Tijan, Vidmar & Pucihar, 2022)	6
Social and Cultural	(Gupta, Kusi-Sarpong & Rezaei, 2020) (Greenland et al., 2018) (de Jesus & Mendonca, 2018) (Bueno Rezende de Castro & Kornher, 2023) (Stewart, Bey & Boks, 2016)	5
Regulatory and Institutional	(Gupta, Kusi-Sarpong & Rezaei, 2020) (Long, Blok & Coninx, 2016) (Stornelli, Ozcan & Simms, 2021) (de Jesus & Mendonca, 2018) (D'Este et al., 2012)	5
External, External environment, Environment	(Vogelsang et al., 2021) (Piatier, 1984) (Tijan, Jović, Aksentijević & Pucihar, 2021) (Moktadir, Ali, Rajesh & Paul, 2018)	4
Political, Government	(Greenland et al., 2018) (Hadjimanolis, 2003) (Stewart, Bey & Boks, 2016)	3
Knowledge, Skill, Support	(Hölzl & Janger, 2012) (D'Este et al., 2012) (Moktadir, Ali, Rajesh & Paul, 2018)	3
Individual, Personnel-related	(Vogelsang et al., 2021) (Stornelli, Ozcan & Simms, 2021)	2
Legal	(Laryea, 2005) (Panos, Kapnissis & Leligou, 2020)	2
Operational	(Laryea, 2005)	1
Trade	(Bueno Rezende de Castro & Kornher, 2023)	1
Behavioural/psychological	(Long, Blok & Coninx, 2016)	1
Managerial	(Gupta & Barua, 2018)	1
External partnership/stakeholder	(Gupta & Barua, 2018)	1

Table 22: Classification of main categories from analyzed literature

Table 23: Conceptual theoretical overview

	Main category	Barriers	Sources
Internal	Organizational Barriers	Unsupportive organizational structure	(Narayanan, Sridharan & Ram Kumar, 2019) (Sandberg and Aarikka-Stenroos, 2014) (Tijan, Jović, Aksentijević & Pucihar, 2021) (Gausdal, Czachorowski & Solesvik, 2018) (Agrawal, Narain & Ullah, 2020) (Sehlin, Truedsson & Cronemyr, 2019) (Durão, Ferreira, Pereira & Moreira, 2019) (Gupta, Kusi-Sarpong, Rezaei, 2020) (Stewart, Bey & Boks, 2016) (Vural et al., 2020)
		Lack of training, education or guidance	(Senyolo, Long, Blok & Omta, 2018) (De Jesus & Mendonca, 2018) (Al Zaabi, Dhaheri & Diabat, 2013) (Vogelsang et al., 2021) (Moktadir, Ali, Rajesh & Paul, 2018) (Narayanan, Sridharan & Ram Kumar, 2019) (Gupta, Kusi-Sarpong, Rezaei, 2020)
		Lack of functional cooperation (organizational silos)	(Gupta, Kusi-Sarpong, Rezaei, 2020) (Stornelli, Ozcan & Simms, 2021) (Kiefer et al., 2019) (Vural et al., 2020) (Tijan, Jović, Aksentijević & Pucihar, 2021) (Stewart, Bey & Boks, 2016)
		Project vision and strategy deficiency	(Stornelli, Ozcan & Simms, 2021) (Vogelsang et al., 2021) (Bierwirth & Schocke, 2017) (Tijan, Jović, Aksentijević & Pucihar, 2021) (Agrawal, Narain & Ullah, 2020)
		Lack of employee empowerment	(Gupta, Kusi-Sarpong, Rezaei, 2020) (Senyolo, Long, Blok & Omta, 2018) (Long, Blok & Coninx, 2016) (Stewart, Bey & Boks, 2016)
		Performance measurement gap	(Gupta, Kusi-Sarpong, Rezaei, 2020) (Narayanan, Sridharan & Ram Kumar, 2019) (Al Zaabi, Dhaheri & Diabat, 2013) (Stewart, Bey & Boks, 2016)
		Inadequate or lack of resources	(Töytäri et al., 2017) (Sehlin, Truedsson & Cronemyr, 2019) (Tijan, Jović, Aksentijević & Pucihar, 2021)
	Social & Cultural Barriers	Lack of qualified personnel	(Stornelli, Ozcan & Simms, 2021) (Madrid-Guijarro, Garcia & Van Auken, 2009) (Hölzl & Janger, 2012) (Sandberg and Aarikka-Stenroos, 2014) (de Jesus Pacheco et al., 2018) (Luthra et al., 2014) (Long, Blok & Coninx, 2016) (Moktadir, Ali, Rajesh & Paul, 2018) (Cichosz, Wallenburg & Knemeyer, 2020) (Vogelsang et al., 2021) (Töytäri et al., 2017) (Bierwirth & Schocke, 2017) (Tijan, Jović, Aksentijević & Pucihar, 2021) (Agrawal, Narain & Ullah, 2020) (Durão, Ferreira, Pereira & Moreira, 2019) (Diefenbach et al., 2021)
		Resistance to change	(Stornelli, Ozcan & Simms, 2021) (Moktadir, Ali, Rajesh & Paul, 2018) (Madrid-Guijarro, Garcia & Van Auken, 2009) (Hölzl, W., & Janger, 2012) (Long, Blok & Coninx, 2016) (Moktadir, Ali, Rajesh & Paul, 2018) (Cichosz, Wallenburg & Knemeyer, 2020) (Vogelsang et al., 2021) (Tijan, Jović, Aksentijević & Pucihar, 2021) (Sehlin, Truedsson & Cronemyr, 2019) (Durão, Ferreira, Pereira & Moreira, 2019) (Civelek et al., 2017) (Diefenbach et al., 2021)
		Lack of knowledge or information	(Tijan, Jović, Aksentijević & Pucihar, 2021) (Stornelli, Ozcan & Simms, 2021) (Moktadir, Ali, Rajesh & Paul, 2018) (Narayanan, Sridharan & Ram Kumar, 2019) (Hölzl, W., & Janger, 2012) (Reynolds & Hristov, 2009) (Long, Blok & Coninx, 2016) (Vural et al., 2020) (Sehlin, Truedsson & Cronemyr, 2019) (Greenland et al., 2018) (Senyolo, Long, Blok & Omta, 2018) (Stewart, Bey & Boks, 2016)
		Lack of commitment from top management	(Moktadir, Ali, Rajesh & Paul, 2018) (Narayanan, Sridharan & Ram Kumar, 2019) (Gupta, Kusi-Sarpong & Rezaei, 2020) (Movahedipour et al., 2017) (Madrid-Guijarro, Garcia & Van Auken, 2009) (Al Zaabi, Dhaheri & Diabat, 2013) (Long, Blok & Coninx, 2016) (Gausdal Czachorowski & Solesvik, 2018) (Agrawal, Narain & Ullah, 2020) (Sehlin, Truedsson & Cronemyr, 2019) (Durão, Ferreira, Pereira & Moreira, 2019)
		Lack of awareness	(de Jesus Pacheco et al., 2018) (Tijan, Jović, Aksentijević & Pucihar, 2021) (Stewart, Bey & Boks, 2016)
Internal/ External	Economical & Financial Barriers	High initial investment / cost	(De Jesus & Mendonca, 2018) (Luthra et al., 2014) (Kern, 2021) (Tijan, Jović, Aksentijević & Pucihar, 2021) (Narayanan, Sridharan & Ram Kumar, 2019) (Agrawal, Narain & Ullah, 2020)
		Lack of budget	(Narayanan, Sridharan & Ram Kumar, 2019) (De Jesus & Mendonca, 2018) (Senyolo, Long, Blok & Omta, 2018) (Luthra et al., 2014) (Vogelsang et al., 2021)
		Difficult access to financial resources	(Stornelli, Ozcan & Simms, 2021) (Madrid-Guijarro, Garcia & Van Auken, 2009) (Moktadir, Ali, Rajesh & Paul, 2018)
		Investment aversion	(Long, Blok & Coninx, 2016) (Tijan, Jović, Aksentijević & Pucihar, 2021)
	Technical/ Technological Barriers	Lack of technological integration	(Stornelli, Ozcan & Simms, 2021) (Kern, 2021)(Vural et al., 2020) (Jović, Tijan, Vidmar & Pucihar, 2022) (Agrawal, Narain & Ullah, 2020) (Civelek et al., 2017) (Vogelsang et al., 2021) (Tijan, Jović, Aksentijević & Pucihar, 2021) (Ballen Prada & Prada, 2022) (Laryea, 2005) (Ziakas, 2018)
		Lack of infrastructure facilities	(Narayanan, Sridharan & Ram Kumar, 2019) (Madrid-Guijarro, Garcia & Van Auken, 2009) (Sandberg and Aarikka-Stenroos, 2014) (Luthra et al., 2014) (Vural et al., 2020) (Carlan et al., 2016) (Vogelsang et al., 2021) (Gausdal, Czachorowski & Solesvik, 2018) (Agrawal, Narain & Ullah, 2020)
		Data security risks	(Vogelsang et al., 2021) (Agrawal, Narain & Ullah, 2020) (Jović, Tijan, Vidmar & Pucihar, 2022)
		IT implementation gap	(Al Zaabi, Dhaheri & Diabat, 2013) (Cichosz, Wallenburg & Knemeyer, 2020)
		Misaligned technology solution	(De Jesus & Mendonca, 2018) (Luthra et al., 2014)
External	Market Barriers	Customer resistance to change	(Carlan et al., 2016) (Stewart, Bey & Boks, 2016) (Long, Blok & Coninx, 2016) (Moktadir, Ali, Rajesh & Paul, 2018) (Narayanan, Sridharan & Ram Kumar, 2019) (Gupta, Kusi-Sarpong & Rezaei, 2020) (Vogelsang et al., 2021)
		No collaboration with external partners	(Gupta, Kusi-Sarpong & Rezaei, 2020) (Stewart et al., 2016) (Gupta & Barua, 2018) (Madrid-Guijarro, Garcia & Van Auken, 2009)
		Lack of industry specific guidelines	(Tijan, Jović, Aksentijević & Pucihar, 2021) (Agrawal, Narain & Ullah, 2020) (Carlan et al., 2016) (Stewart, Bey & Boks, 2016)
		Conservative industry	(Luthra et al., 2014) (Vural et al., 2020) (Gausdal Czachorowski & Solesvik, 2018) (Ziakas, 2018)
		Lack of customer performance	(Moktadir, Ali, Rajesh & Paul, 2018) (Narayanan, Sridharan & Ram Kumar, 2019)
		Lack of competitiveness	(Stewart, Bey & Boks, 2016) (Gupta, Kusi-Sarpong & Rezaei, 2020)
	Regulatory Barriers	Lack of government support	(Stornelli, Ozcan & Simms, 2021) (Moktadir, Ali, Rajesh & Paul, 2018) (Narayanan, Sridharan & Ram Kumar, 2019) (Madrid-Guijarro, Garcia & Van Auken, 2009) (Sandberg and Aarikka-Stenroos, 2014) (Greenland et al., 2018) (Al Zaabi, Dhaheri & Diabat, 2013) (Long, Blok & Coninx, 2016) (Narayanan, Sridharan & Ram Kumar, 2019)
		Missing or inadequate regulations	(Tijan, Jović, Aksentijević & Pucihar, 2021) (Carlan et al., 2016) (Panos, Kapnissis & Leligou, 2020) (Laryea, 2005) (Civelek et al., 2017) (Ziakas, 2018)
		Restricting regulations	(Laryea, 2005) (Stewart, Bey & Boks, 2016) (Vural et al., 2020) (Ballen Prada & Prada, 2022)

So for example in the dashboard:
1. % e-AWB contracted customers.

Focus is on numbers from dashboard on % e-AWB customers, but not on the actual situation. The first step to get towards paperless: get the customers on board by signing the e-AWB contract. After this first step, there is a check from the e-Freight team on the first couple of FWBs whether they are correct. BUT, afterwards it is not monitored anymore whether the customers follows the process and delivers quality. The main goal is lost out of sight.
- Perception: when e-AWB contracted customer, customer delivers correct e-AWBs conform quality.
- Reality: e-AWB contracted customer delivers 2 documents: paper hardcopy & e-AWB, where e-AWB is not useful and contains errors/lack of quality. OPS needs to manually adjust, but because the system receives the FWB, it thinks the customer did well. So the non-performance is not captured by the system and the customer does not get the paper fee, while the system thinks that the customer delivered an FWB conform quality. So customers do not get a paper fee, while:
  o Delivering hardcopy
  o Submitting incorrect FWB and manual adjustments are being done
  o Make the process more complex for OPS

- 100% e-AWB push (MT from SIN), but no check at operational level.
- After target of 100% e-AWB; no attention anymore towards 100% e-Freight (need for extra incentive and insights in data)
- Lars: 80% e-AWB at that time etc. But what does it really mean? Is the paper still banned from the process? Is it working?

2. % e-AWBs received
That contain the code: ECC/ECP at RCS.
- Perception: e-AWB contracted customer, customer delivers correct e-AWBs conform quality
- Reality: some GHA does not even look at ECC or ECP code

3. Tool to check FWB quality
Only checks whether fields are filled or selected. What do we perceive as quality in the definition?
- Perception: correct FWB
- Reality: no correct content.
  o Stripes and dots to get the amount of characters in the field. Or a lot of different characters, without purpose. We need specific information that has to be correct.
  o Special cargo selected, while general cargo
  o Restricted options to select commodity (no option for the correct description)

Initiative is there, but lack of follow up

4. Captured in GCC: e-AWB is always leading over paper AWB when customer is e-AWB contracted.
- Perception: everybody lives conform new paragraph and statement in GCC.
- Reality: captured in GCC and only send one e-mail, but not in policy, communication properly and executed/implemented. So the intention is there, but the follow-up lacks.

APPENDIX H: TRANSFERABILITY OF RESEARCH RESULTS

This analysis will examine the specific characteristics of the research setting and their potential influence on the research results. Additionally, variations of these characteristics across the air cargo industry will be explored to determine the conditions under which the results remain applicable

- Stakeholder interaction and dependency
- Organizational structure and network (national/international)
- Size of the organization
- Financial situation of organization
- Documentation handling process
- Documentation content
- Currently implemented technology for digital documentation
- Regulatory field
- Industry practices

Stakeholder interaction and dependency
AFKLMP Cargo operates within a network of stakeholders, primarily involving business-to-business (B2B) relationships. The company's success depends on direct dependencies and interactions with customers, suppliers, service providers, and regulatory authorities. Customers (FF) play a vital role in driving demand for AFKLMP Cargo's services, and effective communication and collaboration with them are crucial for meeting their specific needs and ensuring satisfaction. Suppliers and service providers, including ground handling agents and logistics partners, are essential for facilitating smooth operations and providing value-added services. The efficiency of these interactions directly impacts AFKLMP Cargo's overall performance. Compliance with regulatory authorities and industry bodies is crucial for secure and efficient cargo movement. AFKLMP Cargo must adhere to safety protocols and maintain necessary certifications, requiring collaboration and alignment with regulatory requirements. By effectively managing stakeholder relationships, AFKLMP Cargo can enhance operational efficiency, customer satisfaction, and overall competitiveness in the air cargo industry.

Organizational structure and network (national/international)
First, the organizational structure and network of AFKLMP Cargo plays a significant role. The organization operates within an international decentralized multi-unit network and consists of a hub-and-spoke network. The decision-making authority is concentrated at the top-level management. This structure implies a certain degree of dependency on top-level decisions for the implementation of new initiatives, such as e-Freight. The bureaucratic elements within the organization also influence the decision-making process and the speed of implementation.

Size of the organization

AFKLMP Cargo is characterized by its extensive network of outstations and international dependency. With a significant presence in numerous locations worldwide, AFKLMP Cargo operates in a large number of outstations. This extensive network allows them to provide global coverage and reach a wide customer base. The international dependency of AFKLMP Cargo is a crucial aspect of its operations. As an international cargo carrier, the company heavily relies on cross-border trade and international logistics flows. The success of AFKLMP Cargo is closely tied to the movement of goods between countries, making it essential for the company to adapt to international regulations, customs requirements, and industry standards. By leveraging their extensive outstation network and effectively managing international dependencies, AFKLMP Cargo can efficiently serve customers globally and maintain a strong presence in the international air cargo market.

Financial situation of organization

AFKLMP Cargo boasts a strong financial position in the air cargo industry. The company demonstrates financial stability and robust performance, allowing it to navigate market fluctuations and maintain a competitive edge. With a solid financial foundation, AFKLMP Cargo is well-equipped to invest in innovative technologies, infrastructure development, and service enhancements to meet the evolving needs of customers. The financial strength of AFKLMP Cargo underpins its ability to deliver reliable and efficient air cargo solutions while ensuring long-term sustainability and growth in the industry.

Documentation handling process

The documentation process is a critical aspect of the case. The study considered the state-of-the-art documentation practices within Air-France KLM Martinair Cargo, including the presence of both paper-based and digital documents. This variation reflects the ongoing transition from traditional paper-based documentation to digital solutions. The level of digitalization across the organization's network of airports varies, with some locations already fully utilizing electronic documentation (e-AWB) and others still reliant on paper-based documents. This diversity in documentation practices highlights the complexity of implementing e-Freight across different locations.

Documentation content

Cargo documentation content refers to the information and paperwork associated with shipping packages or goods rather than individuals. In the context of AFKLMP Cargo, this characteristic implies a strong focus on accurately capturing and managing documentation related to cargo shipments. This includes essential details such as product descriptions, quantity, weight, dimensions, handling instructions, customs declarations, and other relevant information. By maintaining precise cargo documentation content, AFKLMP Cargo ensures transparency, compliance with regulations, and smooth coordination throughout the logistics chain. It enables efficient tracking, handling, and delivery of packages, reducing errors, minimizing delays, and enhancing overall operational effectiveness.

Currently implemented technology for digital documentation

AFKLMP Cargo, the cargo division of Air France-KLM-Martinair Cargo, has embraced messaging technology for e-Freight, prioritizing it over API one record implementation. This

strategic choice reflects their commitment to streamlining and optimizing cargo operations in a simple and efficient manner.

Regulatory field

There are no international macro level industry specific standards on the digital document versions. Therefore, the regulations within the different countries apply. These differ across all outstations due to the international context.

The regulatory environment, both within the air cargo industry and in relation to other industries, also influences e-Freight implementation. Compliance with regulations and standards is crucial in the transportation and logistics sector. The regulatory framework, including rules and requirements related to electronic documentation, affects the adoption and integration of e-Freight practices within the organization.

Industry characteristics

Industry practices provide additional context for e-Freight adoption. The air cargo industry has established practices and standards that influence operational procedures and documentation requirements. These industry practices may vary across different regions and organizations, affecting the implementation of e-Freight initiatives. Understanding and aligning with these practices is crucial for successful adoption and integration. Furthermore, the industry is a conservative industry.

Overall, the characteristics of AFKLMP Cargo are:
- International context
- Multi-stakeholder dependencies
  - Input dependency
  - Regulatory dependency
- Business to Business (B2B) interaction
- Organizational structure; multi-unit organization with 150 outstations internationally scattered
- Non-unified documentation process
- Non personal-related information
- Currently implemented technology for digital documentation: messaging
- Regulatory field; lack of macro regulation, leads to dependency on = internationally different regulations
- Industry practices: conservative industry

For top management:
- Restore the e-Freight team by focusing on recruiting innovative change makers and increasing the number of full-time employees (FTEs).
- Include e-freight as a key performance indicator (KPI) in the main program to emphasize its importance.
- Restore and ensure the reliability of tools, dashboards, and other necessary systems for e-Freight implementation (paperless dashboard, MIP tool).
- Further develop a solution for customers without a system, as the current solution (CPS extern) is not functioning effectively. Provide training for internal local teams (CSO) to support this solution.
- Invest in research and development (R&D) to pioneer and establish an API standard specific to the organization.

For e-Freight overall:
- Utilize successful examples, such as AOP for setup and Singapore for implementation, as references.
- Facilitate regular webinars between local teams to share success stories and encourage mutual support. Establish effective communication channels between local teams.

For the e-Freight project design:
- Assign clear responsibilities to each local team and the management team (MT) to ensure clarity and accountability.
- Follow a similar setup to AOP and establish a global implementation program with guiding principles.
- Actively use dashboards for data-driven decision-making and steering, with the e-freight team providing regular updates on the project's status to outstations.
- Begin with stations that have shown the best performance. Conduct assessments of all stations based on regulations (local compliance), economic development (network connection feasibility), and existing systems.
- Start with a station assessment to determine the current state of paper-based processes and identify reasons for their usage.
- Divide the project into building blocks, including internal and external aspects such as documentation processes (VSM), e-AWB status, e-freight status, IT, customers, and customs.
- Ensure regular follow-ups between the e-freight team and local teams for structural support and progress monitoring.
- Provide clear and straightforward instructions, using plain language and a handbook format, to guide local teams in their actions.
- Develop a customer approach strategy:
    - Utilize a combination of incentives and consequences, starting with persuasive storytelling and persuasion techniques. If these methods are not effective, implement stricter measures.
    - Emphasize the benefits of e-freight implementation, including feedback mechanisms.

- o Offer guidance and support to customers, providing step-by-step plans tailored to different customer categories (self-system vs. non-self-system) based on the innovation diffusion theory.
- o Consider options for stricter measures, such as implementing paper fees or accepting e-AWBs only from contracted customers.