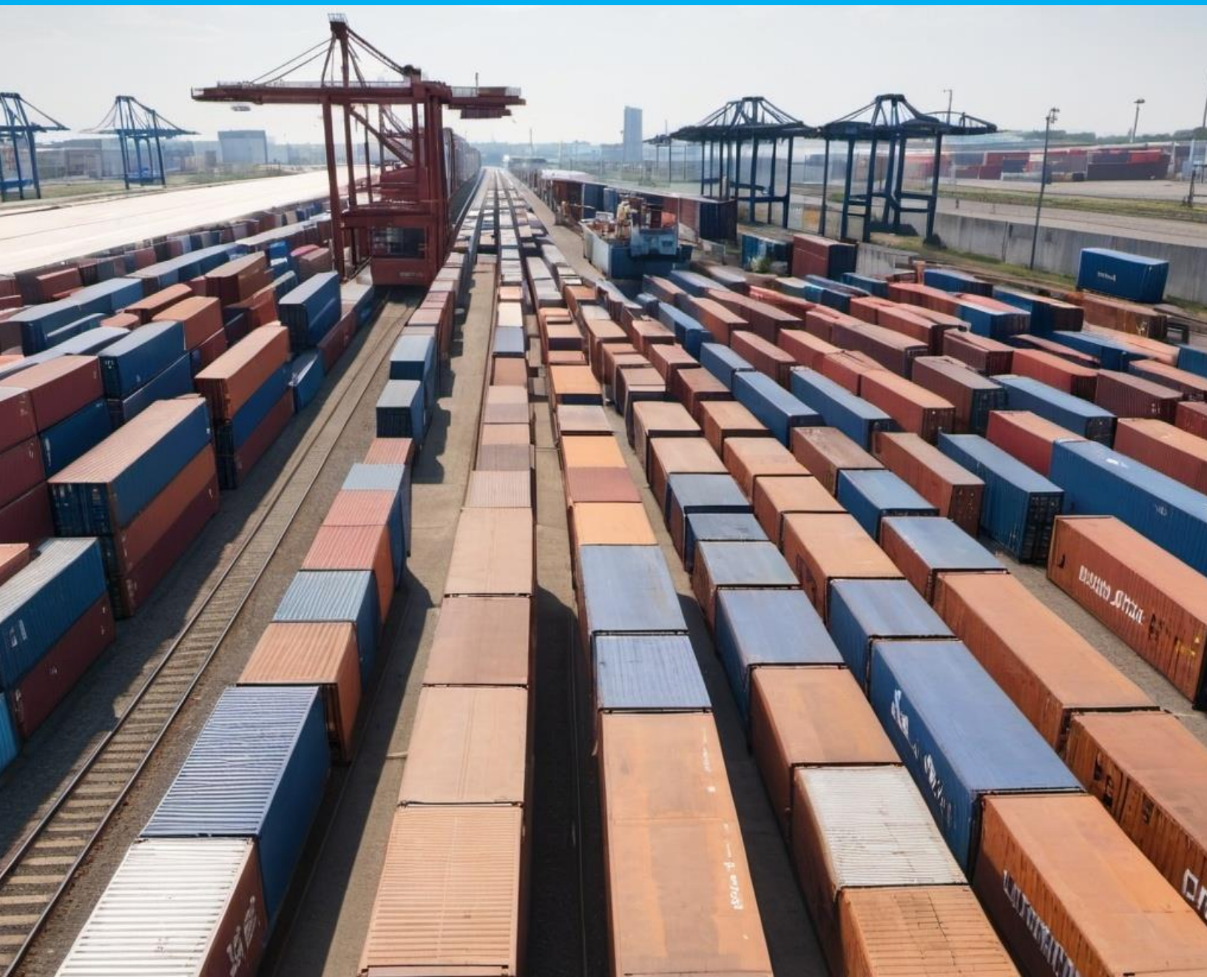
Master Thesis Project

A Maturity Model for Dry Port Development with a Case Study on Indonesian Dry Port

M.R. Ziarieputra



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A Maturity Model for Dry Port Development with a Case Study on Indonesian Dry Port

Master Thesis Project

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Preface

Coming from Indonesia, a country struggling to improve its logistics performance as a developing nation, I always aspire to be able to contribute my part in helping my country. This thesis, as a final part of my two-year journey in obtaining my master's degree in Transport, Infrastructure, and Logistics (TIL) at TU Delft, I hope could be the start of my endeavor in advancing the logistic sector, especially in Indonesia. Though this work must be acknowledged for its limitations in quality, I sincerely hope that it serves its purpose and pushes the agenda on hinterland transport improvements, more specifically in developing economies such as Indonesia.

First, I would like to offer my highest gratitude to the almighty, Allah SWT, as He has always been my strength in everything that I am doing.

Second, I would like to offer my gratitude to my thesis committee members, Lori, Arjan, Ron, and Erik. I am forever grateful to have chosen this topic and to have every one of you as a member of my thesis committee. Everyone has been very positive in directing me on my thesis journey. Each of the discussions that I have had with each of you has been nothing short of enlightening and insightful. I sincerely thank you for that. I wish all of you good health and a great career in academia so that more students may have the positive experience that I have gone through.

Thirdly, I would like to offer my gratitude to the dry port company back in Indonesia for their open arms to connect with the kind and insightful individuals in the dry port and logistic sector that provided me with the best and most useful of inputs.

Lastly, I would like to thank all my family members, friends, and colleagues, especially those I interacted with in my master study. Everyone has been a support for me since day one, and I am forever grateful to be able to interact with you on my best and worst days. A special shout out to Mamah Ina, Uni Nisa, Bang Farhan, Abi Imran, Lala, Dewo, Daffa, Helmi, Poc, Panji, Inez, and Acin. I wish everyone good health and the best in life!

Summary

Introduction

As container transport volumes continue to grow, seaport hinterland access becomes a critical factor for the competitive advantage of ports (Roso & Lumsden, 2010). Challenges such as congestion, delays, and inefficiencies often plague the hinterland transport system, leading to disruptions in supply chains and increased costs for businesses. Dry ports have emerged as a promising solution to these challenges. This study aims to fill the research gap in dry port studies by considering dry port stakeholders' perspectives to create a maturity model that helps dry port develop. To meet this gap, the study is approached with the definition of a research question as follows:

"How to utilize dry port stakeholders' perspectives to construct a dry port maturity model that will help dry port develop?"

To answer this question and structure the research, several sub-questions are formulated:

1. What are the criteria relevant to represent dry port stakeholders' perspectives?
2. What are the development steps for Dry Port considering the dry port stakeholders' perspective?
3. How can the dry port maturity model be operationalized to ensure its relevance and integration with dry port development plan decision-making processes?

Dry Port Stakeholders and Criteria

In this study, the dry port stakeholders being considered are limited to only the dry port customer and dry port operator. Specifically for the dry port customer, two main customer groups are being further considered, which are the cargo owner and shipping lines. The selection of these stakeholders is justified by the argument that these actors are the ones that are most relevant in dry port service development. In order to capture the dry port stakeholders' perspective, a set of criteria is being utilized. This approach is similar to that done by Khaslavskaya et al. (2021), where stakeholders' objectives are translated into indicators that are of importance to stakeholders when using dry port services. The dry port customer criteria are being formulated using the dry port customer logistic performance attributes, as the use of dry port is argued to help improve the customer's logistic performance. A total of seven criteria, ranging from reduction of logistic cost to improvement of environmental sustainability, were obtained through a literature study and interviews with relevant stakeholders. As for the dry port operator criteria, a set of dry port innovation factors is formulated to capture the dry port operator perspective regarding the implementability of the dry port service. The innovation factor covers the three

main aspects of innovation success factors as laid out by Planing (2017), which are feasibility, viability, and acceptability.

Dry Port Development Steps

The study then proceeds to analyze the dry port, specifically the services it offers, using the dry port stakeholders' criteria. The analysis is being done using an Indonesian dry port as its case bed to demonstrate and evaluate the approach. This analysis is argued to provide an understanding of how the service at Dry Port could be developed while considering the stakeholders' objectives. The dry port services are first formalized, with a total of twelve dry port functions making up the dry port operation. A flow process diagram is also created in order to provide an understanding of the relationship between each of the dry port functions. The dry port functions are then ranked using MAMCA by considering the dry port stakeholders' criteria. Relative to the dry port customer criteria, the functions are ranked in order of how they contribute to improving the customer's logistic performance. This approach is backed by the customer value theory. As for the dry port operator criteria, the functions are ranked in order of how challenging it is to implement the specific dry port functions. It is argued using the path dependency theory that dry port operators will favor functions that are easier to implement in their development process.

The result of the MAMCA is analyzed and used as an insight, along with the dry port operation flow process, to create the maturity model. also, hence enables the creation of the maturity model to not only consider the dry port stakeholders' perspective but also the technical relationship between each of the functions. The maturity model along with the accompanying table of function description can be found in Figure 1 and Table 1. The dry port maturity model has four levels in its maturity progression. At each stage, functions are positioned accordingly to guide the progression of development for dry port service. The first maturity level consists of basic functions such as transshipment. As the maturity level progressed, the service gradually evolved into a more specific service to meet customers' unique demands. The maturity model also provides a description of each of the functions to be considered present in the dry port, along with information regarding the focus customer, main benefit, and main implementation challenge of each of the dry port functions.

Dry Port Maturity Model Operability and Performance

In order to answer the last sub-research question, the constructed maturity model is being evaluated. This evaluation process is aimed at both showcasing the model's operability and assessing the model's performance. The evaluation is first conducted with a focus on the model construct via a domain expert interview. This evaluation revealed that the model quality is arguably acceptable in terms of its understandability, ease of use, usefulness, maturity levels, and process-wise aspects. Lastly, the model is being put to use in a series of case studies with the Indonesian dry port operator in order to demonstrate its operability within three objectives, which are to assess the current dry port maturity level, compare the past development process, and to guide further development.

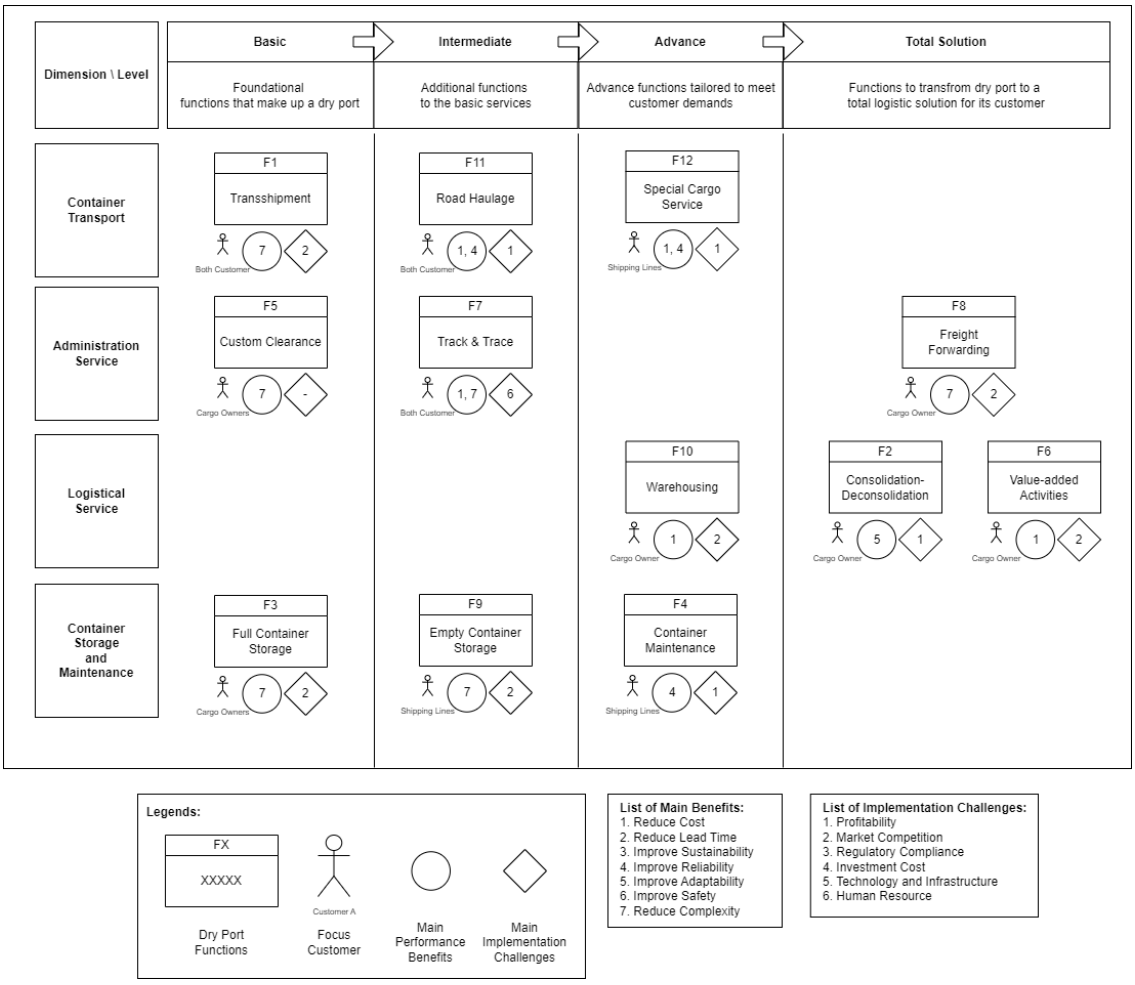

Figure 1 Dry Port Maturity Model – Case: Indonesia

Table 1 Dry Port Functions Description

No	Functions	Description
F1	Transshipment	High frequency intermodal transport between the dry port and the seaport.
F2	Consol-Deconsolidation	Sufficient capability of consolidation and deconsolidation of various cargos.
F3	Full Container Storage	Sufficient capacity of storage yard for full containers to meet the logistic flow demand.
F4	Container Maintenance	Operational container maintenance facility with ample capacity to meet customer demand.
F5	Custom Clearance	Sufficient capability to assist customer demand on custom clearance activity with service such as inspection, quarantine, etc.
F6	Value-added Activities	Sufficient capability of value-added activities for various cargos such as packaging and labelling.
F7	Track & Trace	Real-time operational and accessible data of container location and condition.

No	Functions	Description
F8	Freight Forwarding	Functioning forwarding services to support export-import activity.
F9	Empty Container Storage	Sufficient capacity of storage yard for empty containers to meet the logistic flow demand.
F10	Warehousing	Functioning warehousing services to support export-import activity.
F11	Road Haulage	Sufficient capacity of trucking to meet the logistic flow.
F12	Special Cargo Service	Sufficient capability of handling of various special type cargos such as DG and Reefer.

1 Introduction

This chapter introduces the thesis project starting with an overview of the research context and problem. It will then be followed by an explanation of the research objective and its scope.

1.1 Research Context and Problem

In today's economy, efficient hinterland transport is crucial for the smooth flow of goods between ports and the goods' origins or destinations. Hinterland transport networks connect ports with inland areas, enabling the distribution of cargo to various regions. As container transport volumes continue to grow, seaport hinterland access becomes a critical factor for the competitive advantage of ports (Roso & Lumsden, 2010). Challenges such as congestion, delays, and inefficiencies often plague the hinterland transport system, leading to disruptions in supply chains and increased costs for businesses. Dry ports have emerged as a promising solution to these challenges. Roso and Lumsden (2010) describe a dry port as an inland intermodal terminal directly connected to seaports, with high-capacity transport means, preferably rail, where customers can leave or pick up their units as if directly to or from a seaport. By serving as logistical hubs, dry ports play a vital role in enhancing the efficiency and reliability of hinterland transport networks.

For dry port operators, it may be argued that the adoption of their multimodal service by cargo owners who choose to move their goods via dry port over other unimodal options is one of the indicators of a successful dry port. It is important to acknowledge that there may be some level of aspired utilization in order to maximize profit for the dryport operator, especially in regard to the dry port capacity. Still, it is sensible to have a level of attractiveness to the customer that is competitive to gain market share as a legitimate objective for dry port operators. In terms of objective, other entities, such as the government, may have had their own aspirations in relation to dry port. The government may aspire to have the whole logistic network be as environmentally friendly as possible. This aspiration can again be related to the use of a dry port.

In the process of developing a dry port, it is essential to consider the perspectives and needs of relevant stakeholders. However, from the current body of literature, it is found that the study on dry port still lacks this consideration of stakeholders' perspectives. With regard to dry port customers, such as cargo owners and shipping lines in particular, it is recognized that there are numerous factors, such as the extensive range of logistic performance attributes, that can motivate logistic players to use a dry port. Understanding the customer's requirements, priorities, and challenges, as well as the service that a dry port could provide to meet these demands, is crucial for designing development strategies that effectively address the diverse needs of the dry port ecosystem. In line with this statement, this project hence targets to conduct an analysis of Dry Port, specifically on the services that it offered, to meet

customer preferences. This analysis is targeted to help Dry Port focus on developing services that maximize its value to the customer. Additionally, the perspective of another stakeholder, the dry port operator, will also be considered in analyzing the dry port services. The dry port operator sees the development of dry port services as an innovative endeavor and hence requires careful consideration in designing service development strategies. With these considerations of the two dry port stakeholders in the approach of analyzing the dry port services, the result of the analysis will be further used to construct a maturity model that aims to help the dry port operator plan its service development strategies to improve its value to the customer.

A maturity model is a structured framework used to assess and guide the progression of an organization or a specific entity toward a desired level of maturity. It typically consists of a series of defined stages or levels through which an organization or process evolves as it improves over time. Such a model would provide a structured framework for assessing the 'maturity' level of a dry port across key dimensions, identifying areas for improvement, and guiding strategic decisions for enhancing its functionality and performance. The dry port maturity model is expected to help dry port operators realize and improve their value to their customers by providing guidance for a development plan that is relevant and actionable, ultimately contributing to the growth and success of dry ports as vital components of global trade networks.

1.2 Research Objectives

The objective of this research is to construct a maturity model that helps dry ports develop and improve by considering the dry port stakeholder perspective, which in this project is the dry port customers and operator. By developing a maturity model, the objective is also to provide a standardized approach to guide dry ports in developing their services. This research will also aim to explore the process of considering the stakeholder perspective in constructing the dry port maturity model. The reason for this is that this process is considered unique and, to the extent of the author's knowledge, has not been done before. The creation of a maturity model by utilizing dry port customers' and operators' perspectives will be a novel contribution to the scientific body of knowledge.

1.3 Research Scope

The project's approach encompasses three decision-making tiers: strategic, tactical, and operational, as delineated by Gunasekaran et al. (2001). At the strategic level, the focus is on broad policies, financial plans, competitiveness, and alignment with organizational goals. The developed maturity model aims to offer strategic guidance for dry port entities in the dry port's development step. Tactical planning involves resource allocation and performance evaluation against strategic objectives. During model validation, the tactical level will be rigorously assessed through benchmarking of the dry port with regard to the maturity level of the model. Operational planning deals with day-to-day port activities like cargo management, operations, and regulatory compliance.

While the project mainly centers on the strategic and tactical levels, the operational level will not be directly addressed due to the concern of focus and resource allocation in executing this thesis project. However, it is important to acknowledge that operational factors may be taken into consideration throughout the project, although this will not translate into the very specific level of the operational factors. Additionally, the creation of a monitoring and maintenance system, outlined in Figure 1.1, is excluded from the project scope to maintain focus and allocate resources primarily to the maturity model's development. It will, however, be again taken into consideration, especially in the last part of formulating the project recommendation.

1.4 Research Questions

The main research question follows the research gap as well as the suggested method as obtained from the literature review in Section 2 Literature Review. Applying the research gap and suggested methodology, the following research question is formulated:

"How to utilize dry port stakeholders' perspectives to construct a dry port maturity model that will help dry port develop?"

To answer this question and structure the research, several sub-questions are formulated:

1. What are the criteria relevant to represent dry port stakeholders' perspectives?
2. What are the development steps for Dry Port considering the dry port stakeholders' perspective?
3. How can the dry port maturity model be operationalized to ensure its relevance and integration with dry port development plan decision-making processes?

1.5 Research Methodology

This section further explains the methodology used to answer the main research question. An overview of the sub-questions and the corresponding used method(s) is provided in Table 1.1. The methods are further explained in the subsections.

Table 1.1 Sub-questions and corresponding method

Main research question
How to utilize dry port stakeholders' perspectives to construct a dry port maturity model that will help dry port develop?

Sub-question	**Method**
What are the criteria relevant to represent dry port stakeholders' perspectives?	Literature Study, Interview
What are the development steps for Dry Port considering the dry port stakeholders' perspective?	Literature Study, Multi-Criteria Analysis (MCA), Maturity Model Design
How can the dry port maturity model be operationalized to ensure its relevance and integration with dry port development plan decision-making processes?	Interview, Case Study

1.5.1 Maturity Model Design Approach

In order to ensure a replicable step in constructing the maturity model, a design approach is selected. The design approach will help to formalize the steps into formulating the functions by having a clear flow of process that starts with a goal definition, requirements analysis, and constructing the maturity model. The design approach will also be related to the maturity model construction process by Mettler (2010), as discussed in the literature review section 2.4 Maturity Model. The illustration of the design approach is shown in Figure 1.1.

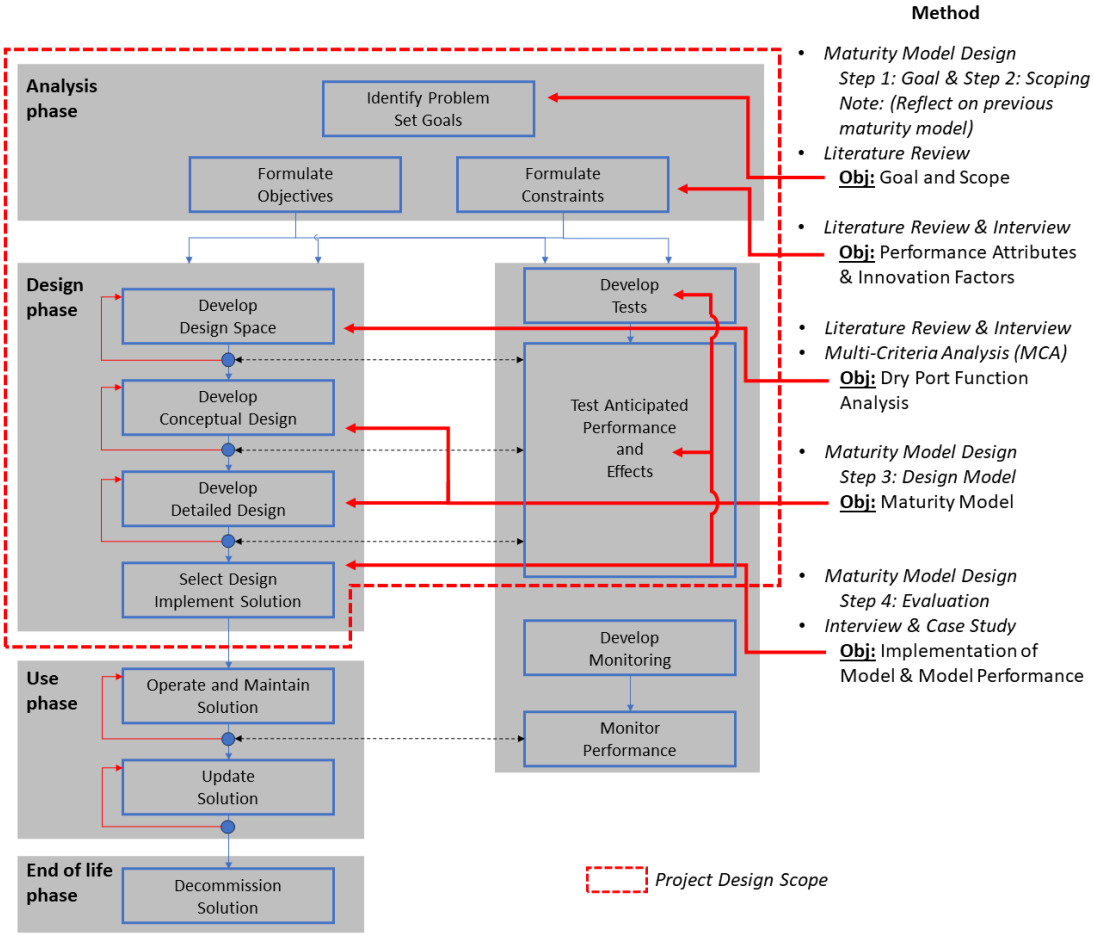

Figure 1.1 Design Approach for Maturity Model

The design approach begins with the analysis phase. The first step in the analysis will be in regard to obtaining the design goal and scoping. A formalization of the two points will be targeted. In the goal and scoping formulization, the previous maturity model from the C. Thati thesis project (2023) will be referred in order to seek a clear understanding of the existing dry port maturity model. This will help to avoid a redundant goal as well as give insights into aspects that needed to be a focus of the newly constructed model. This will be possible by acknowledging the setbacks with the previous model. The analysis phase will also cover the formalization of the dry

port stakeholder's perspective in the form of criteria, which are the dry port customer's performance attributes and the dry port operator's innovation factors.

The steps following the analysis phase are the design process and the evaluation phase. Once the dry port stakeholder perspective has been formalized in the analysis phase, the maturity model design process will start with the formalization of dry port functions. The formalization of the functions will be in relation to the dry port customer performance attributes; hence, the functions are assured to correlate with the performance attributes. Additionally, flow function diagrams will be created in order to assist in formalizing the dry port operation flow. This will assist in delineating the roles that each dry port function plays. This will also ensure avoiding superfluous functions and efficiently encapsulating the entire process inside a dry port. Lastly, the flow function diagram is expected to provide relevant insight in the later construction process of the maturity model, especially regarding the relationship between each of the functions. This function flow diagram, combined with the multi-criteria analysis discussed later, will be the basis for creating the maturity model.

1.5.2 Literature Study

A literature study is conducted in the initial planning phase of the project to find the research gap, which will also help formulate the research questions. Throughout the study, a literature review will also play an important role in gaining insight on the dry port concept, more specifically on formulating the functions within a dry port and the respective dry port stakeholder criteria. A literature study will ultimately help in the formulation of goals and scope, the listing of functions and attributes, and the construction of the model.

1.5.3 Interview

Interviews are also conducted to integrate relevant actors and expert views with the literature study process. This is to provide contemporary insights and contribute to a more comprehensive understanding of the research topic. The interviews conducted will first help to formulate the dry port functions and the dry port customer performance attributes. In the final part of the project, the interview will also help in the evaluation process of the constructed maturity model. A semi-structured interview with a clear list of interviewees and a set of questions will be formulated in order to conduct the interview.

1.5.4 Multi-Criteria Analysis (MCA)

Multi-criteria analysis (MCA) is a decision-making technique used to evaluate and prioritize alternatives or options when faced with multiple conflicting criteria or objectives. MCA is particularly useful when there are several factors to consider, each with different weights or importance. In this project, a formulation of the ranking of the elements, which in this case are the functions of dry ports, will provide the insight needed to construct the maturity model. The MCA in this project will be conducted to analyze the dry port customer performance attribute and determine its importance. In addition to the performance attributes, innovation aspects such as economic constraints and human resources will be included in the multi-criteria

analysis. This is meant to help gain more insight as well, in order to help with the later construction of the maturity model, where it is crucial to organize the development steps within the maturity model.

The MCA itself has a wide range of methods that can be utilized, such as the Analytical Hierarchy Process (AHP), the Best-Worst Method (BWM), the Multi-Attribute Value Theory (MAVT), and many others. Considering the aims of having actors coming from different backgrounds within the dry port realms, a multi-actor multi-criteria analysis (MAMCA) will be utilized to systematically consider the different objectives of each of the actors on the dry port. In this project, the MCA weighting will be done using the swing weighting method. The swing weighting method was selected due to its ability to consider the full range of attributes as well as its simplicity in the data gathering activity. For the data gathering, a questionnaire will be utilized to collect the required data from a specific list of targeted respondents. This data will later be used to calculate the weight of each performance attribute and innovation aspect.

For further analysis, performance data for each of the functions with regard to the performance attributes and innovation factors will also be gathered using a Likert questionnaire via a survey. The decision to use the Likert scale for the performance data is primarily based on considering the scale factors of the different dry ports. This will ensure that the economic scale effect can be considered accordingly. This performance data can then be combined with the weight to rank the functions with respect to both performance attributes and innovation factors.

1.5.5 Case Study

The maturity model design framework will be used in a case study with a dry port entity. This hence suggests the application of the framework with the stakeholders of the subjected dry port, which are the dry port operator as well as their customer. The MCA will be part of the case study in order to construct the maturity model using input from the stakeholders. The case study will also include the final evaluation step, which will touch on how the constructed model could be used in the dry port assessment and decision-making activity in planning their service development strategy.

1.6 Research Structure

Figure 1.2 shows the structure of the thesis report, which will be explained as follows. The introduction, which is the first chapter of the report, provides an explanation of the research's problem, objective, and scope, as well as the research questions and methods. A review of the literature on maturity models and dryports will be done in the second chapter. The dry port customer’s performance attributes and the flow of dry port functions will then be mapped out in Chapter 3. In chapter 4, the multi-criteria analysis (MCA) process will be formalized using the function and performance attributes found in the preceding stage, together with a variety of the functions' innovation factors relevant to dry port operators. This MCA will act as a basis upon which to build the dry port maturity model that follows.

The maturity model design and evaluation framework will be thoroughly discussed in the fifth chapter, while also relating to the MCA from the previous chapter. In chapter 6, the framework of analyzing the dry port functions using MCA and the construction of a maturity model is put to use in a case study to showcase the real-life application of the approach as well as to evaluate the result. Finally, the last three chapters will include a conclusion, limitation, and recommendation in which potential future works are suggested.

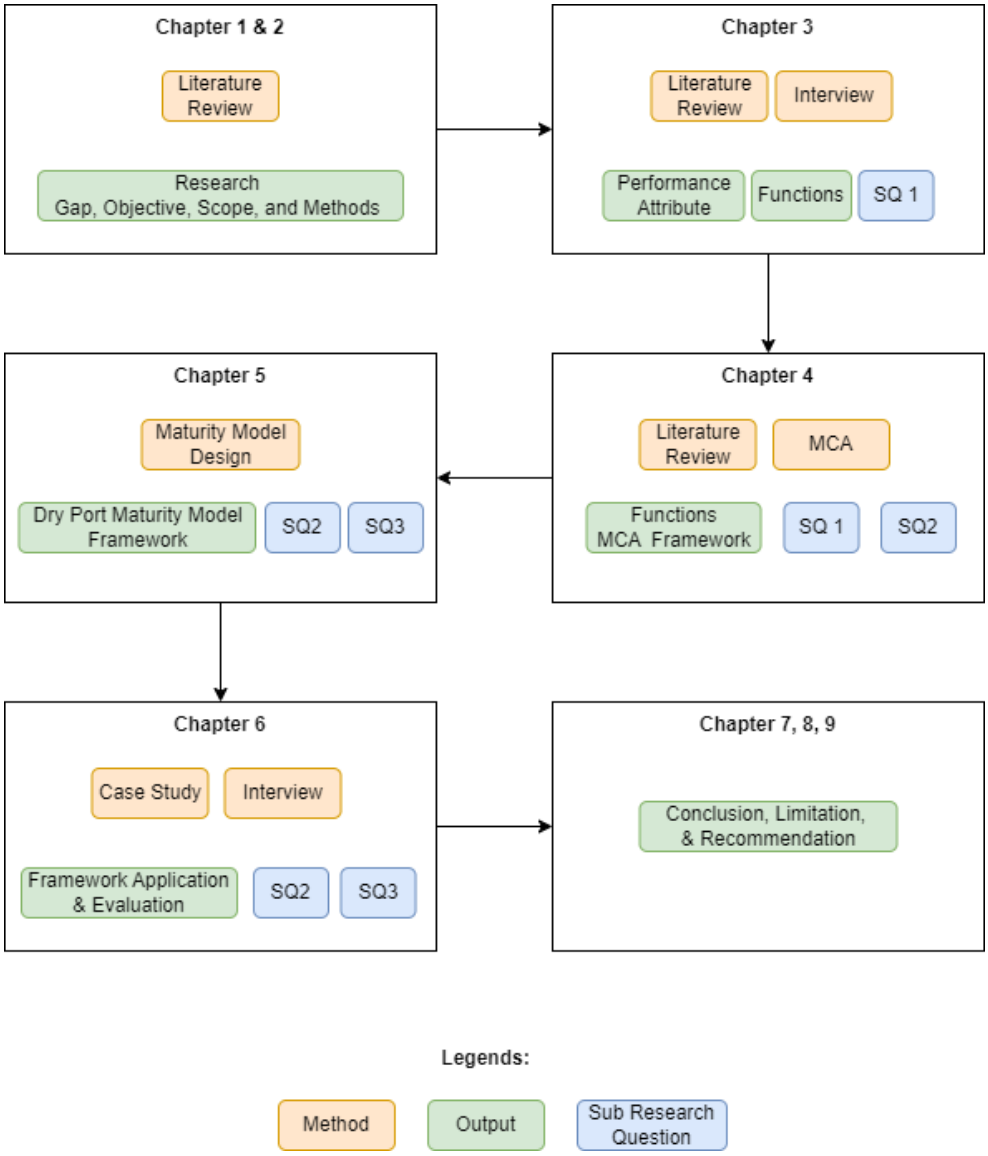

Figure 1.2 Research Structure

2 Literature Review

This chapter focuses on the literature review employed to identify a relevant research gap addressed by the research questions introduced in the preceding chapter. It commences with an elucidation of dry ports, followed by a brief overview of existing literature on the dry port's topics, culminating in the presentation of a literature overview table. Subsequently, information regarding the maturity model is provided, and the chapter concludes with a clear gap discussed in the conclusion and discussion sections.

2.1 Method of Literature Review

To conduct the literature review, a structured approach in the form of a four-step process is followed. First, to define the purpose and scope of the review; second, to seek out relevant studies; third, to narrow down the literature list to meet the conditions stipulated under step one; and fourth, to analyze and synthesize the results.

Purpose and scope: The purpose of this review is to synthesize recent research on dry ports and to have a basic understanding of a maturity model. For the purposes of this project, dry port research will be approached with a focus on the methodology of each research, important factors that contribute to increasing the number of users of a dry port, and the locations that the research is based on. As for the maturity model, the focus will be on exploring the basics of the model.

Conditionality: Literature was only included if it met the following requirements: first, published as an article in an academic (peer-reviewed) journal; second, published within the past ten years. An exception is made for much-cited landmark papers; third, the topic meets the general concepts or keywords listed in Table 2.1.

Table 2.1 Conceptual Framework for Literature Review

Concept Group	Concept; Factor			
Keywords	**Concept:**	Dry port	Maturity Model	
	Factor:	Criteria	User	Added Value

Literature Search: To identify a research gap in the literature, specific terms were employed in the Scopus search engine. Only literature meeting the criteria outlined in Table 2.1 was considered. The literature review primarily relied on the snowballing technique to identify pertinent literature using the specified keywords. Papers obtained through these processes underwent a preliminary review, including a cursory examination of the abstract, literature review, introduction, discussion/conclusion, and recommendations chapters. Less relevant articles were excluded from the literature selection. During this process, if new pertinent articles surfaced, they underwent a similar preliminary review and were added to the

collection. This iterative procedure continued until no additional sources were identified.

2.2 Dry Port Definitions

Access to seaport hinterlands becomes increasingly important for port competitiveness as container transport volumes rise. (Roso & Lumsden, 2010). The need to manage growing cargo volumes and limited seaport capacity has led to the development of new strategies to enhance capacity. Improving the infrastructure and logistics of hinterland transportation in order to move seaports inland is one such tactic (Khaslavskaya et al., 2021). Hinterland development takes the form of advanced transport infrastructure and the construction of inland intermodal facilities with high-capacity transportation links, such as dry ports. The idea of a dry port surpasses the conventional method of using rail shuttles to link seaports with their hinterlands (Roso et al., 2009). According to Roso and Lumsden (2010), a dry port is defined as an inland intermodal terminal directly connected to a seaport(s) with high-capacity transport means, preferably rail, where customers can leave or pick up their units as if directly to or from a seaport.

In order to qualify as a dry port, an intermodal inland terminal facility must meet two specific requirements (Khaslavskaya & Roso, 2020):

1. It should act as a seaport's counterpart inland, extending its operations and offering services that are normally only available at seaports.
2. It must be connected to a seaport by a "high-capacity transportation means," which is typically rail transportation, with inland waterway or barge transportation takes place occasionally.

The performance of a terminal at a dry port is heavily reliant on the quality of access and the effectiveness of the road, rail, or waterway interface. Therefore, it's imperative to guarantee reliable, planned transit to and from the seaport using high-capacity routes (Roso et al., 2009). In addition to typical transshipment services offered by conventional inland intermodal terminals, dry ports provide value-added services like storage, consolidation, depot facilities, container maintenance, track and trace capabilities, and customs clearance (Andersson & Roso, 2016). Integrating these value-added services into the service portfolio allows service providers to offer clients various benefits. However, if there are deficiencies in basic services, either in terms of quantity or quality, these services can become less important (Bask et al., 2014).

Dry ports have a lot of economic potential, which is recognized by many developing country governments (Roso & Lumsden, 2010). The concept of dry ports has attracted significant interest from scholars globally, mainly because of its ability to improve multimodal transportation in the hinterland, promote economic expansion, and lessen environmental effects (Khaslavskaya & Roso, 2020). Despite the expected benefits of establishing nearby dry ports, numerous obstacles hinder their implementation. Such projects frequently face obstacles like land usage, infrastructural development, environmental issues, and institutional constraints (Roso,

2008). Dry port development in emerging economies is another challenge. Research on dry port concepts in countries with insufficient rail networks and bureaucratic obstacles is scarce; most studies have concentrated on European and Asian nations with sophisticated railway infrastructure and robust cargo handling (Rodrigues, 2021). Finally, research highlights the critical role that users of dry ports have in the success of these facilities, stressing the significance of taking seaport-based stakeholders' and the local community's involvement into account when developing dry ports (Nguyen et al., 2021).

2.3 Past Research on Dry Port Topic

A review of past research on dry ports has been conducted in order to grasp the current knowledge gap for further research. The review is scoped down to at least three focus areas, which are the methodology, the location of the study, and the factors that contribute to leading more logistic subjects to use dry port. Each of these foci is discussed as follows:

2.3.1 Dry Port Research Methodologies

The primary objective of this review is to delve into the methodologies employed within dry port literature. While a range of methods have been utilized to study dry ports, the bulk of research predominantly consists of qualitative cases and quantitative modeling and optimization studies. Remarkably, the number of publications based on shipper or transport operator surveys is quite little (Khaslavskaya & Roso, 2020). Furthermore, most of the research examined in this literature review also tends to rely on qualitative approaches, such as literature reviews, case studies, and multi-criteria analyses. However, it is noteworthy that much of this research has primarily focused on the conceptual development of dry ports, their economic and environmental impacts, or various optimization strategies. Finally, the understanding of stakeholders' perspectives about the use of dry ports has received less attention (Khaslavskaya et al., 2021).

This emphasis on methodological approaches within the literature aligns with the broader interest within the transport industry in exploring the diverse manifestations of dry ports globally. Dry ports serve various functions for stakeholders across different contexts. To illustrate, the government focuses most on regional economic development and sustainability, while dry port operators consider profit generated as the most important factor relating to the utilization of a dry port. Thus, it is imperative that the idea be further explored, taking into account the perspectives of various stakeholders (Khaslavskaya & Roso, 2020). This is particularly crucial for projects involving dry port development, as they necessitate careful consideration of stakeholders' needs and desires. In order to improve dry port performance and achieve measurable benefits, efficient stakeholder engagement is essential (Kuncoro et al., 2021). Zanten et al. (2024), for instance, interview a range of dry port actors to verify the increased value that a dry port could offer to its clients.

Moving on to the inclusion of stakeholders, there are fundamental conceptual questions that remain unaddressed in the literature. For instance, one pertinent

question is: "Who ultimately decides whether to import or export through dry ports or seaports?". Numerous research works have investigated this matter, specifically with regard to the selection of seaports, identifying influential parties including shipping lines, freight forwarders, and shippers (Rodrigues, 2021). Furthermore, Nguyen et al. (2021) identify the user group, or dry port customer, as the most significant stakeholder group in dry port decision-making. The attainment of consensus among many stakeholders is acknowledged as a crucial factor in reducing bias and guaranteeing thorough stakeholder involvement (Nguyen & Notteboom, 2016). This underscores the importance of incorporating diverse perspectives to achieve robust and inclusive decision-making processes within the realm of dry port operations and development.

2.3.2 Factors in Attracting Dry Port User

The subsequent section of this review focuses on the factors contributing to attracting more users to the dry port. From the literature reviewed, it becomes apparent that no study specifically targets the focus on attracting more users to the dry port. While research on dry port concepts, impacts, and optimizations naturally considers the goal of improving performance and expanding user bases, it seldom prioritizes this aspect. This section will further explore the existing literature to identify related factors that are argued to contribute to attracting more dry port users.

A prominent argument in the literature is that dry ports help reduce costs for logistic players (Bergqvist, 2015; van Zanten et al., 2024). This cost reduction convinces more logistics players to divert their operations through dry ports. The components of logistic costs that are reduced include transportation (Roso & Lumsden, 2010; Khaslavskaya & Roso, 2020; Rodrigues, 2021; Nguyen & Notteboom, 2016; Nguyen et al., 2021; Khaslavskaya & Roso, 2019) and storage (Roso & Lumsden, 2010; Nguyen et al., 2021). The use of rail services by dry ports also helps lower transportation costs by avoiding toll fees (Khaslavskaya et al., 2021). Moreover, reduced logistic costs can lead to revenue improvements (Andersson & Roso, 2016). Additionally, to enhance market share, dry ports sometimes employ tailor-made pricing strategies to match specific customer characteristics (Jeevan et al., 2022).

Another argument found in the literature is that dry ports help decrease transportation time for logistics players (Roso & Lumsden, 2010; Khaslavskaya & Roso, 2020; Bergqvist, 2015; Nguyen & Notteboom, 2016; van Zanten et al., 2024; Nguyen et al., 2021). This reduction is attributed to dry ports avoiding transportation activities that would otherwise face road congestion (Andersson & Roso, 2016; Rodrigues, 2021; Roso et al., 2009; Roso, 2008; Roso, 2007). Health and environmental improvements also persuade more logistics parties to utilize dry ports (Andersson & Roso, 2016; Rodrigues, 2021; Roso et al., 2009; van Zanten et al., 2024; Khaslavskaya & Roso, 2019). Reduced emissions from consolidated transport via dry ports contribute to environmental sustainability and enhance the eco-friendly image of logistic entities (Khaslavskaya et al., 2021; Andersson & Roso, 2016; Nguyen et al., 2021). Additionally, dry ports help reduce the risk of road-related accidents by employing consolidated modes of transportation (Roso, 2008; Roso, 2007).

Enhanced cargo safety from external risks is also cited as a reason to use dry ports (Roso & Lumsden, 2010; Nguyen et al., 2021; Khaslavskaya & Roso, 2019). Simplified documentation and customs-related activities also influence dry port users (Roso & Lumsden, 2010; Nguyen et al., 2021). This bureaucratic ease is believed to reduce complexity in logistic activities by involving fewer actors in day-to-day operations (Khaslavskaya et al., 2021).

Another factor discussed in the literature that influences parties to use dry ports is their improved accessibility for logistics players. Dry ports play a significant role in improving connectivity within their geographic locations (Nguyen et al., 2021), especially benefiting the business and industrial sectors (Li et al., 2015; Nguyen & Notteboom, 2016). This accessibility improvement results from the provision of access and sufficient transport capacity to and from the dry port premises (Khaslavskaya et al., 2021; Nguyen et al., 2021). These accessibility aspects also contribute to overall service level improvements in logistic activities facilitated by dry ports, further encouraging their use by logistics players (Khaslavskaya & Roso, 2020). Additionally, dry ports enhance transport reliability (Khaslavskaya et al., 2021; Kuncoro et al., 2021; Bergqvist, 2015; van Zanten et al., 2024; Nguyen et al., 2021), offer flexibility in choosing transportation modes (Khaslavskaya et al., 2021; Bergqvist, 2015), improve transport punctuality (Kuncoro et al., 2021), and adaptability in effectively managing supply chain uncertainty (van Zanten et al., 2024; Khaslavskaya & Roso, 2019).

Lastly, all the aforementioned benefits are understood to stem from the main service offered by dry ports. Many studies also mention additional services provided by dry ports, such as container management and stripping, to further persuade logistics players to use them (Roso & Lumsden, 2010; Khaslavskaya & Roso, 2020; Kuncoro et al., 2021; Bask et al., 2014; Nguyen et al., 2021). This underscores the potential of dry ports to offer comprehensive logistical solutions for their customers (Jeevan et al., 2022). However, it is important to note that these additional services are only useful when basic services are already fairly provided (Andersson & Roso, 2016; Roso et al., 2009).

In the end, a service provider's value to its customers may stem from reducing expenses or boosting shipping revenues (by raising service levels); nevertheless, more investigation is required to completely define the implications and the locations of these shifts (Andersson & Roso, 2016). It's also critical to identify and understand the main value mechanisms that will generate value and how service providers communicate the value of what they have to provide (Andersson & Roso, 2016). One study by Khaslavskaya et al. (2021) has been done on this theme, understanding the many factors that contribute to creating the most beneficial service offerings from a dry port and contributing to the common value of the larger inland transportation chain. This study considers a very diverse stakeholder base and can be extended to a more focused analysis of services available at dry ports and their influence on stakeholders' objectives, as well as by examining different taxonomies of dry ports (Khaslavskaya et al., 2021).

2.3.3 Location of Dry Port Study

As previously mentioned, numerous governments, particularly in developing nations, acknowledge the promising potential of dry ports (Roso & Lumsden, 2010). Most dry port research was carried out in countries that have advanced logistic systems, while studies on dry ports in countries with weak intermodal networks and bureaucratic problems are scarce (Rodrigues, 2021). Additionally, the literature suggests significant differences among dry port stakeholders in various regions (Bergqvist, 2015). Additional investigation into the fundamental causes of these variations is necessary since they represent stakeholder dynamics as well as the contextual elements impacting their environment and activities (Bergqvist, 2015). Moreover, concerning the context of developing countries, unlike more developed systems where dry port development is often driven by seaport interests, the planning of inland terminals in developing nations appears to be motivated by land parties aiming to streamline cargo movement from inland areas to seaports (Nguyen & Notteboom, 2016). Furthermore, conducting dry port studies again in various geographic locations may improve knowledge of the services provided by dry ports and the advantages these services provide to stakeholders (Khaslavskaya et al., 2021). This underscores the importance of considering the geographical location of dry ports and conducting thorough studies in this regard.

2.3.4 Table of Summary of Dry Port Research

The reviewed research on dry port is summarized and shown in Table 2.2.

Table 2.2 Summary of Dry Port Research

No	Literature	Methods	Factors	Locations	Others
1	A review of dry ports (Roso & Lumsden, 2010)	Literature Review, Interview	- Customer service: lower transport costs, more value-added services at the customer's doorstep, faster transport of units to/from the seaports, faster customs clearance, simplified documentation, and lower storage rates - Safety of cargo [Tanzania] - Reduced tariffs, simplified documentation, and increased rail frequency [Nepal] - Storage service [Pakistan]	Asia, Europe, Africa	As container transport volumes increase, seaport hinterland access becomes more crucial to ports' economic advantage. A dry port is an intermodal terminal located inland that is directly connected to a seaport. It is equipped with high-capacity transportation, preferably rail, enabling customers to drop off and pick up their units just like they would if they were traveling directly to or from a seaport.
2	Evaluating the role of dry ports in the port-hinterland settings: Conceptual framework and the case of Vietnam (Nguyen et al., 2021)	Literature Review, MCA	Developers of dry ports should focus on bolstering the customs infrastructure at existing ICDs and the intermodal connectivity between ICDs and seaports in order to offer more value to the cargo owner.	Vietnam	Development of dry ports has a major impact on the progress of port-hinterland integration. The study's conclusions stressed the importance of dry port users in ensuring a port's success and cautioned other scholars not to minimize the contributions of the seaport community and other participants to the development of dry ports.
3	Dry Port Development in China: Current Status and Future Strategic Directions (Li et al., 2015)	Literature Review, Case Study	Connection between the dry ports business system and the seaports business system.	China	The design of dry port construction plans should be incorporated into the port and national integrated transport system planning to avoid unnecessary construction or reckless expenditure.

No	Literature	Methods	Factors	Locations	Others
4	Dry ports: research outcomes, trends, and future implications (Khaslavskaya & Roso, 2020)	Literature Review	- Optimized logistics (shorter time and lower costs)/lead time reduction - (Total) transportation/logistics cost minimization/decrease/reduction due to optimized design of hinterland transportation leg - Good services for shippers and transport operators - Improved customer service	-	An intermodal inland terminal facility needs to fulfill two criteria in order to be classified as a dry port: 1. the expansion of a seaport inland, serving as its interface and offering services normally provided at the ports; 2. the connection of a seaport by "high-capacity transportation means," usually meaning rail and less frequently barge/inland waterway transit. Additional research is required to fully understand the concept of a dry port from the viewpoints of multiple stakeholders.
5	Value-Added Services at Dry Ports: Balancing the Perspectives of Different Stakeholders (Khaslavskaya et al, 2021)	MCA	- Logistics costs: transport costs, storage/warehousing, avoiding tolls - Service level, to get efficient services by means of improving indicators: reliability, flexibility, and improved seaport access - Green image: positive image related to environmental performance - Reduced complexity: lower number of actors/better integration of the transport chain	Sweden	Seaport development projects must take the needs and preferences of stakeholders into account. Despite being somewhat reliant on and affecting the activities of others, the stakeholders possess the capacity to impact each other's performance and strategic choices.

No	Literature	Methods	Factors	Locations	Others
6	Developing Dry Ports Through the Use of Value-Added Services (Andersson & Roso, 2016)	Literature Review	- The switch from road to rail as a means of transportation accounts for the benefits of remote dry ports. As a result, there is less traffic at the ports entry and around it, and the environment has less of an influence as you travel. - By changing the service levels, a provider's value to a client can be expressed in terms of cost savings or increased revenue for the shipper. - The value that a supplier brings to its clients might be measured in terms of lower costs or higher shipping profits (via modifications to service standards).	-	At an inland intermodal terminal with a direct rail connection to a seaport, known as a dry port, customers can drop off and pick up their goods in intermodal loading units. A typical inland intermodal terminal provides transshipment; dry ports provide value-added services such storage, consolidation, depot, track and trace, container maintenance, and customs clearance.
					Logistics service providers have broadened the scope of services they provide to include duties that shippers used to perform. The objective is to provide services that most closely match shippers' supply chain plans.
7	Effect of Supply Chain Collaboration and Service Stakeholder Commitment on Dry Port Firm Performance (Kuncoro et al., 2021)	Questionnaire, Regression	The provision of reliability, punctuality, added value, productivity, and high performance of the supply chain	Indonesia	A stronger collaborative edge could be attained through improved supply chain coordination between port users and the port. Thus, enhanced port performance may result from this cooperative advantage.

No	Literature	Methods	Factors	Locations	Others
8	Revisiting the marketing approach between seaports and dry ports in Malaysia: current trend and strategy for improvement (Jeevan et al., 2022)	Interview	Offering made-to-order pricing based on demand and service effectiveness can draw customers to seaports. Additionally, dry port offers its customers a complete supply chain or logistical solution.	Malaysia	Businesses may look at introducing customized pricing and key locations as ways to attract customers.
9	The extended gate concept for container terminals: Expanding the notion of dry ports (Veenstra et al., 2012)	Literature Review	-	-	Seaports will be heavily dependent on dry port networks since they will primarily use barges and rail to move freight into the hinterland. This implies that truck traffic in and around seaports will be drastically decreased if political will is demonstrated to erect barriers preventing trucks from entering the port.
					Seaports will become centers for cargo handling and transshipment rather than centers for logistics. Distribution parks will no longer exist in port regions, making space available for other, more directly port-related purposes. The inspection and supervision programs of Customs and other inspection agencies would be moved into the hinterland.

No	Literature	Methods	Factors	Locations	Others
10	Determining dry port criteria that support decision making (Rodrigues, 2021)	Literature Review	Transportation expenses, the separation between a dry port and a seaport, and the effect of railroad use in the logistics integration system on CO2 emissions, traffic, and cost reduction	-	Another challenge is the expansion of dry ports in emerging economies. Most of the research was carried out in countries like Europe and Asia that have advanced rail systems and handle a lot of containers. Studies on dry port concepts in countries with weak rail networks and bureaucratic roadblocks are scarce.
11	Development of seaport–dry port dyads: two cases from Northern Europe (Bask et al., 2014)	Case Study	The expansion and development of several value-added services is a major component in the development of dry ports and the integration of multimodal transportation.	Finland	A service provider may add value-added services to broaden their service portfolio and offer a range of benefits to clients. However, these services seem useless if there are flaws in the core offerings.
12	The dry port concept: connecting container seaports with the hinterland (Roso et al., 2009)	Case Study	The concept of a dry port can assist reduce traffic in coastal towns, discover ways to shift freight quantities from road to more energy- and environmentally efficient modes of transportation, and provide shippers in the port's hinterland with better logistics options.	Europe, US, Africa, Australia	Complete Dry ports should provide more services than just transshipment, which is their primary purpose. These services include customs clearance, depot-storage of empty containers, storage, consolidation, and container upkeep and repair. It's critical to have high-capacity, regularly scheduled transportation to and from the ports. The standard of terminal performance is determined by the state of the interface between the road, rail, and canal, as well as by the accessibility of a dry port.

No	Literature	Methods	Factors	Locations	Others
13	Making hinterland transport more sustainable a multi actor multi criteria analysis (Bergqvist, 2015)	MCA	Low cost, alternatives for flexibility, performance and time quality, dependability, green image, and equity in the options offered.	Sweden, Belgium	Several regional differences were discovered among the study's stakeholders. This suggests that stakeholder context matters in addition to the stakeholders themselves, and more research into the fundamental causes is necessary. The research also outlines the governance options for greener hinterland transportation systems and clarifies the viewpoints of different stakeholders on these options.
14	A Multi-Criteria Approach to Dry Port Location in Developing Economies with Application to Vietnam (Nguyen & Notteboom, 2016)	MCA	Decrease in the cost and duration of transportation; accessibility to inland waterways, railroads, and roads; breadth of services; and closeness to the manufacturing base and other logistical platforms.	Vietnam	Unlike more established systems where dry port construction is often driven by seaport interests, planning for inland terminals appears to be originated by land parties in developing nations to facilitate the transit of freight from the interior to seaports.
15	Factors influencing implementation of a dry port (Roso, 2008)	Literature Review, Case Study	There will be less traffic at the seaport gates and in the surrounding area, and there will be less environmental influence at every turn. Additionally, there will be a lower likelihood of car accidents.	Australia	The most common barriers to the implementation of dry ports are those related to infrastructure, land use, the environment, and laws. This reduces the efficiency of freight movements on land access routes to and from seaports.

No	Literature	Methods	Factors	Locations	Others
16	Evaluation of the dry port concept from an environmental perspective: A note (Roso, 2007)	Model & Simulation	There should be less chance of traffic accidents, less CO2 emissions, and fewer ports terminal lineups.	Sweden	With a dry port in place, computed CO2 emissions are around 25% lower for chosen scenario, and terminal traffic and truck wait times are significantly reduced.
17	On the Dry port to Dry port-concept Gaining a better understanding of the added value (Zanten et al., 2024)	Literature Review, Interview	Added values such as reliability, costs, adaptability, delivery speed, environmental sustainability	Indonesia & the Netherlands	Dry Port to Dry Port (DP2DP) concept can add value from multiple perspectives Dry port maturity is a prerequisite for the DP2DP concept. Put another way, the dry ports must provide something that genuinely encourages people to consider them as an extension of the harbor. It might be advantageous to consider developing a dry port maturity model.
18	Outcome-Driven Supply Chain Perspective on Dry Ports (Khaslavskaya & Roso, 2019)	iterature Review, Interview, Site Visit	Supply-chain outcomes (SCOs): Cost, responsiveness, security, environmental performance, resilience, innovation	Sweden	All of the main SCOs are said to benefit from the dry port. The facilities' strategic position, the availability of dependable and convenient transportation, and the admissible degree of complexity of the hinterland transportation system are all necessary for this to occur. The actors' perspective influences how things are perceived as well.

2.4 Maturity Model

As discussed previously, one study by Khaslavskaya et al. (2021) has been done on this theme, understanding the many factors that contribute to creating the most beneficial service offerings from a dry port and contributing to the common value of the larger inland transportation chain. A further step can be made toward projecting the study's results as implications for improving the utilization of dry ports (Khaslavskaya et al., 2021). Referring to Section 2.3.1, Dry Port Research Methodologies, one of the methods that have not been employed in the topic of dry port research is the development of a dry port maturity model. van Zanten et al. (2024) contend in their study on the Dry Port to Dry Port (DP2DP) concept that in order to achieve the intended benefits that dry ports could provide, a certain degree of maturity on the part of the dry ports involved will be necessary. In the end, the study suggests that it would be beneficial to consider over constructing a dry port maturity model (van Zanten et al., 2024).

Conceptual frameworks known as maturity models describe how organizational skills progressively advance along a desired, expected, or logical path (Pöppelbuß & Röglinger, 2011). Initially rooted in the realm of software development, these models have gained broader applicability and are increasingly utilized across various domains. They are useful instruments for evaluating the condition of organizations, processes, or phenomena at the moment and identifying possible areas for development (Boullauazan et al., 2022). Maturity models' main goal is to provide direction along a trajectory of development by adding structure to the process of improving actions that have potential results (Mettler, 2010). Contrary to focusing solely on a linear progression toward a predetermined "end state," maturity models should prioritize understanding the drivers of evolution and change (Pöppelbuß & Röglinger, 2011). This holds great significance in the context of dry ports, where services typically evolve gradually, beginning with the most fundamental and necessary offerings and then broadening into more specialized offerings to meet the unique needs of customers (Khaslavskaya et al., 2021).

The development of a maturity model involves a systematic design process characterized by sequential steps. Prior to moving on to the next step, decisions must be taken for every activity and at every stage of design (Boullauazan et al., 2022). As maturity models articulate theories of stage-based advancement, their fundamental purpose lies in delineating stages and pathways of maturation. As a result, it is crucial to clarify each stage's distinguishing traits as well as the logical relationships between them (Pöppelbuß & Röglinger, 2011). Essential components of maturity models include (Mettler, 2010):

1. Number of levels (typically three to six),
2. Descriptor for each level (e.g initial, repeatable, defined, managed, and optimizing processes),
3. Generic description of the characteristics of each level as a whole,
4. Number of dimensions,
5. Number of elements or activities for each dimension, and

6. Description of each element or activity as it might be performed at each level of maturity.

Mettler (2010) outlined a framework comprising five distinct steps for designing maturity models. These steps encompass the following (Mettler, 2010):

Step 1: Identification of a Need or New Opportunity:

This first stage is identifying the precise opportunity or need that motivates the creation of the maturity model. Furthermore, it is recommended to carry out an extensive analysis of current models to guarantee that significant perspectives are integrated into the suggested framework (Boullauazan et al., 2022).

Step 2: Definition of Scope:

The maturity model's scope is made clear in the second stage. This involves defining the level (individual, organizational, inter-organizational, or societal) to which the model applies as well as whether it will handle a wide or specific topic.

Step 3: Model Design:

Decisions about the maturity model's design are taken at this point. One of the most important things to think about is deciding which maturity elements the model will emphasize.

Step 4: Design Evaluation:

Using a multidimensional and multimethod approach, a thorough assessment of the model's utility, validity, reliability, and generalizability is carried out.

Step 5: Reflection on Evolution:

Taking into account that maturity models are inherently dynamic, this last phase underscores the significance of continuous introspection. With the passage of time, certain model structures might become antiquated, new components might appear, and presumptions regarding various degrees of maturity might be confirmed or refuted. Thus, it is crucial to think about how to modify the model's implementation and architecture in order to account for these changes as soon as possible.

2.5 Dry Port Maturity Model by C. Thati (2023)

In regard to the construction of a maturity model, although no existing published journal has worked on the said framework, academic work in the form of a thesis project does exist as a precedent for the current project. The project in question is the thesis project of Chandusha Thati (2023), with the title “Development of maturity model for dryports in the Netherlands." In her thesis, Thati has come up with a dry port maturity model using the Netherlands as context. The motivation behind this maturity model is to help provide the framework needed by inland terminals in the Netherlands to transform into a dry port.

The approach that is used in the said thesis project utilizes first the creation of a series of functions within dry port via literature review and interviews. With the formulated functions, a morphological chart is also constructed to give insight into the means that could be employed for a specific function within a dry port. As for the construction of the maturity model, the previously formulated functions are being prioritized using a multi-criteria analysis (MCA). The function priority is used together with other qualitative reasoning to place the functions at a specific level within the dry port maturity model. The constructed dry port maturity model is shown in Figure 2.1.

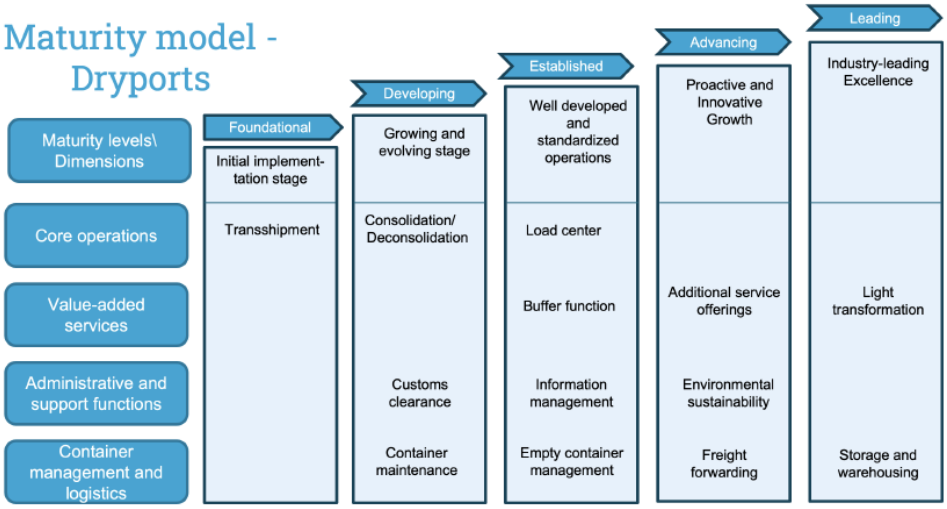

Figure 2.1 Dry Port Maturity Model by C. Thati (2023)

Finally, in her thesis project, the dry port maturity model is verified and validated using the questionnaire and interview methods. From the verification, a few notable points are highlighted. The first is that the constructed maturity model is understandable for the dry port operator. This also relates to the notion that the model is considered relatively easy to use for the benchmarking purposes of the dry port operator. Lastly, one of the strengths of the constructed model is that the level in the maturity model is considered quite distinct (mutual exclusion). However, the model itself is considered to be limited in terms of relevancy, comprehensiveness, and accuracy with regard to the level of maturity in the model.

The maturity model is also checked and operationalized at two different inland ports in the Netherlands to determine its validity via a case study. The case study revealed primarily that the use of such a maturity model must not be decisive and is to be taken virtuously. The level at which a dry port might be in the maturity levels could also not be very specific, as the dry port might have a feature of several levels within the maturity model. One of the main challenges in the project is the construction of the maturity model. It is still quite unclear how the function's priority relates to placement at a specific level of the maturity model. It is noted that other aspects, such as the implementation factors for each of the functions, are only limitedly included in

the project. Lastly, the case study conducted at the two inland ports also only focuses on the maturity model as the sole assessment framework. This argued to still open the possibility of exploring more insights related to the perspective preceding the creation of the maturity model itself that could offer more insight into the assessment process.

2.6 Conclusion and Discussion

The comprehensive analysis of existing literature underscores the pivotal role of dry ports in shaping the trajectory of the global supply chain, particularly in enhancing hinterland connectivity. Despite their undeniable significance, it is apparent that current research overlooks the incorporation of stakeholder viewpoints. Notably, dry port customers such as shippers, forwarders, and shipping lines represent crucial participants whose perspectives warrant thorough consideration. Moreover, there is a conspicuous absence of emphasis on the dry port operator objective of engaging and capturing more potential users within current research frameworks.

Literature, however, has already highlighted many attributes related to logistic performance that contribute to persuading logistic players to shift to using a dry port. It is also imperative that these attributes are thoroughly analyzed to understand their effect and from where (or what service) they can come from. These attributes also need to be communicated appropriately to the customers of dry ports. One study by Khaslavskaya et al. (2021) has tried to analyze many attributes relevant to a wide group of dry port stakeholders and their relation to the service offered at a dry port. This study further suggests a more focused analysis of services available at dry ports and their influence on stakeholders' objectives, as well as examining different taxonomies of dry ports. Additionally, the understanding of the value that a dry port's service could bring to its stakeholders can also be used as an implication to further improve a dry port's performance. In that context, one of the methods that is endorsed in the literature for dry port development is a maturity model.

To conclude, the findings in the literature imply an area of study on the topic of dry port that considers the dry port stakeholder perspective by analyzing the dry port services and their value to the stakeholder, and then continues to use this understanding to construct a maturity model that could help dry port operators strategize their dry port development plan. By leveraging the structured framework of a maturity model, Dry Port can delineate clear and actionable steps towards improving their service and bolstering stakeholder engagement. The maturity model is also very relevant to the dry port context, as services at dry ports often develop over time, starting with the most basic, essential ones before expanding into more specific services to fulfill customers' specific demands.

Finally, it is also important to note that, despite the lack of published work on the subject of dry port maturity models, there is a precedent in the form of a thesis project that developed a dry port maturity model for the Netherlands by Thati (2023). This thesis work might serve as an initial effort toward developing the dry port maturity model concept further.

3 Dry Port Functions and Performance Attributes

In this chapter, the focus will be on the conceptual understanding of a dry port. This understanding will first be acquired through the formalization of the performance attributes that are considered by the dry port users. This will also help partially answer the first research question of this thesis project, considering first the dry port customer perspective. With the performance attributes formally listed out, this chapter will follow with a formalization of the functions that constitute dry port operation. These functions will be put in relation to the performance attributes, as these functions are expected to provide the level of performance expected by the user. The functions will also be formalized using a function flow diagram to provide an understanding of the relationship between each of the dry port functions and the overall dry port operation process.

A two-step approach is applied in order to formalize the functions and performance attributes of a dry port in relation to its customer:

1. Defining an initial set of logistics performance attributes and functions using existing scientific literature.
2. Validation and further elaboration of the initial set of performance attributes and functions using interviews with dry port operator and its customer.

3.1 Interview Details

In order to validate the performance attributes as well as the dry port functions, an interview is being conducted with relevant dry port stakeholders, which consist of dry port operators and dry port customers, which are cargo owners and shipping lines, as shown in Table 3.1. The interview is being conducted with a semi-structured approach where a list of questions has been created. The semi-structured approach allows the discussion on each of the questions to be tailored to each of the interviewee responses. This, therefore, resulted in a wider knowledge of the questioned topics.

Table 3.1 List of Interviewee

Company	Designation
Dry Port Operator	General Manager in Terminal Business
Dry Port Operator	Branch Manager
Trading Company (Cargo Owner)	Logistic Manager
Main Line Operator (Shipping Lines)	Operation Manager

The brief context of the interviewee is further discussed as follows: The dry port operator is being represented by two entities. The first is a general manager-level employee of a dry port located in West Java, Indonesia. Having been with the

company since its inception, the general manager employee has experienced the development of the dry port from the conceptual level until now, offering a wide range of services. Now posted to oversee mainly the terminal side of the business, the insights from the dry port operator have been crucial in validating the performance attributes, especially the dry port functions and its operation flow process. The second entity representing the dry port operator is a branch manager with 5 years of experience working in that position at a dry port in the Netherlands. Again, this provides a good overview of the dry port operation as well as the benefits that a dry port offers to its customers.

The cargo owner is represented by a trading company with long experience in export and import activity in Indonesia. This trading company is represented by a manager-level employee who focuses on handling the logistics, which include export, import, and last-mile distribution activities. The trading company has been one of the pioneer customers to use the dry port in West Java, Indonesia. The company also has distribution infrastructure, such as the warehouse located around the said dry port. The trading company has a lot of experience working with and utilizing the wide range of services offered by the dry port. The interview with the trading company has ensured a close understanding of the performance attributes and the dry port service that helps them excel in the performance attributes.

The last interviewee is from the shipping lines. The shipping lines are represented by a main line operator that is based in Singapore and has been a global market player in the container shipping industry for many years. The shipping line company is represented by a manager-level employee who is responsible for the company's shipping operations. The company has been utilizing the service of the dry port since the early days and has been utilizing a wide range of services offered by the dry port. Again, this interview is expected to bring insights on the process of dry port operation and the relationship it had with shipping line performance. The list of interview questions and answers can be found in Appendix A.

3.2 Dry Port Performance Attributes

3.2.1 Dry Port Customer Relevance

As discussed previously in the literature review, it is imperative to try to include the perspective of stakeholders in the exploration of the concept of dry port (Khaslavskaya & Roso, 2020). In order to give a clear scope to this project, it is important to first clarify which stakeholders are being considered in the study. Numerous research works have investigated this matter, specifically with regard to the selection of seaports, identifying influential parties including shipping lines, freight forwarders, and shippers (Rodrigues, 2021). The most significant stakeholder group in dry port decision-making is the user or customer group (Nguyen et al., 2021). Furthermore, according to Khaslavskaya and Roso (2020), there are presently very few publications on dry port that are based on shipper or transport operator surveys. In dry ports, the majority of services are provided to customers according to their demands and those of shippers, based on practicality (Khaslavskaya et al., 2021). These factors make the customer or user of dry ports the chosen stakeholder

group that this study will concentrate on. Shippers and carrier companies are the subjects that a terminal operator, like Dry Port, believes most value the services provided at the terminal (Konings, 1996). As a result, in this project, these two entities are referred to as the user or customer group.

3.2.2 Formalization of Dry Port Performance Attributes

The approach to includes the dry port customer perspective is then being defined clearly. According to Andersson and Roso (2016), a dry port's value to its client may come from reducing costs or boosting shipping revenue (by raising service levels). Additionally, several factors have already been identified in persuading logistic players to utilize a dry port in the previous literature review section. Hence, it is decided that to include the dry port customer perspective in this project, a series of performance attributes that are relevant to the dry port customer will be utilized. In a way, dry port stakeholder objectives are translated into indicators that are of importance to stakeholders when selecting or using dry port services (similar to Khaslavskaya et al., 2021).

In his study, Beamon (1999) identified the use of resources, the desired output, and flexibility (how well the system reacts to uncertainty) as vital components of supply chain success. His study further argues that a supply chain measurement system therefore must place emphasis on three separate types of performance measures: resource measures, output measures, and flexibility measures. In order to formalize the dry port performance attributes, these three types of performance measures are then considered the initial group of the dry port performance attributes. Beamon (1999) also suggests that a supply chain performance measurement system must contain at least one individual measure from each of the three identified types. As for the individual measures chosen from each type, they must coincide with the organization's strategic goals (Beamon, 1999). Hence, from the three initial groups of performance attributes, a more specific individual measure will be explored, bearing in mind the dry port context from the existing literature. The formal list of the performance attributes is illustrated in Figure 3.1, followed with the detailed discussion on each of the selected logistic performance attributes.

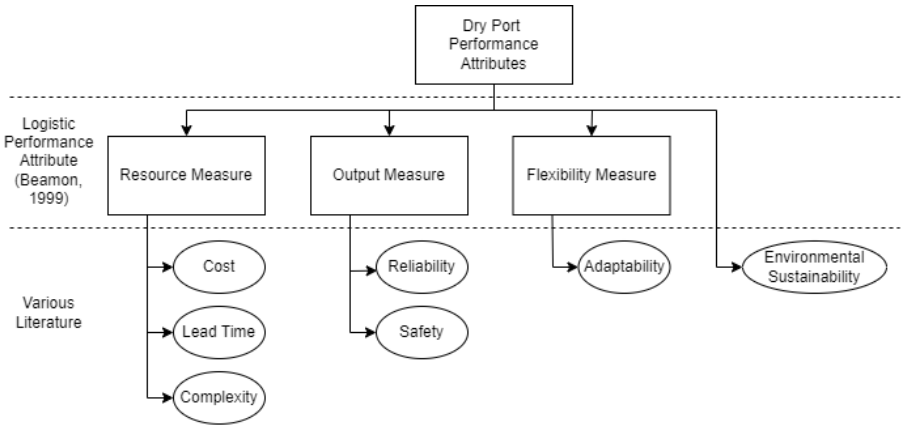

Figure 3.1 Identified Dry Port Performance Attributes from Literature

Cost

First, the focus is to identify performance attributes within the resource group. Resources are generally measured in terms of the minimum requirements (quantity) or a composite efficiency measure, with efficiency measuring the utilization of the resources in the system that are used to meet the system's objectives (Beamon, 1999). As suggested in his study, Beamon (1999) puts cost as the central measure of resource efficiency. Literature suggests that dry ports help reduce costs for logistic players (Bergqvist, 2015). This cost reduction convinces more logistics players to divert their operations through dry ports. The components of logistic costs that are reduced include transportation (Roso & Lumsden, 2010; Khaslavskaya & Roso, 2020; Rodrigues, 2021; Nguyen & Notteboom, 2016; Nguyen et al., 2021) and storage (Roso & Lumsden, 2010; Nguyen et al., 2021).

From the interview (Appendix B. Interview Details Question 5), the cost factor was found to be more significant on the cargo owner side and not on shipping lines. In the Netherlands, it is argued that the cost savings come from both intermodal transport and storage for the cargo owner. In Indonesia, storage is more significant for reasons such as cheaper storage costs compared to those on seaports, and customers could avoid additional penalties that are only relevant in seaports due to differences in regulations. Lastly, in both countries, the avoidance of demurrage and detention charges from the use of dry port is also one of the important factors in choosing to use dry port. In line with this, the first performance attribute for dry port in the resource group will be the logistic cost.

Lead Time

The second dry port performance attribute in the resource efficiency theme is the lead time. In line with the topic of the lead time in serving the customer, SCOR measurement uses the term responsiveness to refer to the speed at which tasks are performed or at which a supply chain provides products to the customer (APICS, 2017). The argument found in the literature to support this selection is that dry ports help decrease the transportation time for logistics players (Roso & Lumsden, 2010; Khaslavskaya & Roso, 2020; Bergqvist, 2015; Nguyen & Notteboom, 2016; van Zanten et al., 2024; Nguyen et al., 2021).

To this end, there are some mixed responses in the interview (Appendix B. Interview Details Question 6). From the Netherlands, it is believed that the direct lead time in the customer supply chain actually increased due to the use of dry ports. However, if we look at the bigger picture, due to the efficiency of the decoupling effect from using a dry port, the overall supply chain time might be decreasing. As for the Indonesian context, the lead time for cargo owners does significantly decrease due to the faster customs clearance. This is possible with a better custom clearance system in the dry port than in the seaport. As for shipping lines, it is believed that a dry port indirectly helps to ensure a low level of yard occupancy ratio (YOR), hence making the overall stevedoring or loading-unloading activity in the seaport much faster.

Complexity

As for the last performance attribute in the resource efficiency context, it is selected to be complexity in the supply chain. A supply chain's growing complexity reduces visibility and control, which raises risks and costs. (Musa, 2012). Dry port, on the other hand, is found to simplify documentation and customs-related activities for its users (Roso & Lumsden, 2010; Nguyen et al., 2021). This bureaucratic ease is believed to reduce complexity in logistic activities by involving fewer actors in day-to-day operations (Khaslavskaya et al., 2021). In the interview (Appendix A. Question 11), it is revealed that in the Netherlands, the complexity is not that much affected by the utilization of a dry port. However, in Indonesia, it is believed that complexity does reduce as customers do not have to coordinate with the many seaports that have their own systems and only need to coordinate with one entity, which is the dry port that is close to them. Additionally, the dry port has the potential to offer a wide range of services, helping customers avoid the trouble of working with too many parties that offer the specific services needed.

Reliability

Moving on, the focus is to identify performance attributes under the output group. The output measures can be regarded as the output of a logistics system, with customer satisfaction as the overall objective (van Zanten et al., 2024). In this study, the output measures are deemed closely related to the reliability that is offered by a dry port. Referring to APICS (2017), reliability focuses on the predictability of the outcome of a process, with typical metrics for the reliability attribute including: on-time, the right quantity, and the right quality. Relating to this, literature suggests that, firstly, dry ports improve accessibility for logistics players. Accessibility improvement results from the provision of access and sufficient transport capacity to and from the dry port premises (Khaslavskaya et al., 2021; Nguyen et al., 2021). The accessibility aspect contributes to overall service level improvements in logistic activities facilitated by dry ports (Khaslavskaya & Roso, 2020). This ultimately relates to the role of dry ports in improving supply chain reliability as previously defined (Khaslavskaya et al., 2021; Kuncoro et al., 2021; Bergqvist, 2015; van Zanten et al., 2024; Nguyen et al., 2021). From the interview (Appendix B. Interview Details Question 8), it was learned that the wide range of services that a dry port could offer helps to improve reliability. With the example of empty container storage and container maintenance services that enable shipping lines to serve their customers for their export activities, Moreover, services such as warehouses also help with the improvement of reliability. We then conclude with the selection of reliability as the first performance attribute in the output group.

Safety and Security

Literature also suggests that dry ports help reduce the risk of road-related accidents by employing consolidated modes of transportation (Roso, 2007). Enhanced cargo safety from external risks is also cited as a reason for the use of dry ports by its customers (Roso & Lumsden, 2010; Nguyen et al., 2021). From the interview

(Appendix B. Interview Details Question 10), since it is considered already safe overall in the Netherlands, the dry port only contributes slightly to this aspect. However, in Indonesia, the use of e-seal as a tool to keep track of the container location and condition, along with a security measure in the customs area, does improve safety and security significantly. The use of intermodal transport by rail also helps since it avoids the risk coming from road transport. This foundation hence motivates the selection of another performance attribute, which is cargo and equipment safety, in the output group.

Adaptability

Next up, the focus is to identify performance attributes under the flexibility group. Flexibility refers to the ability to respond to a changing environment. In an uncertain environment, supply chains are able to respond to change (Beamon, 1999). In line with the term flexibility, SCOR measurement uses the term agility to refer to the ability to respond to external influences and the ability to respond to marketplace changes to gain or maintain competitive advantage (APICS, 2017). From the literature, it is found that dry ports offer flexibility in choosing transportation modes (Khaslavskaya et al., 2021; Bergqvist, 2015), improve transport punctuality (Kuncoro et al., 2021), and adaptability in effectively managing supply chain uncertainty (van Zanten et al., 2024). The later term of adaptability is considered in this project to encapsulate the idea of the dry port's ability to cope adequately with supply chain uncertainties. This term is argued to cover a wider topic than that of flexibility, as indicated by Beamon (1999). However, for the purpose of this study, the performance attribute selected in the flexibility group was decided to be adaptability in order to generalize the ability of customers to adapt to dynamic conditions in the supply chain.

In the interview (Appendix A. Question 9), this has been one of the major benefits argued to be experienced in the Netherlands context. The customer can adapt their logistic plan more flexibly due to the decoupling ability that comes from utilizing a dry port. Similarly, in the Indonesian context, the cargo owner can also buffer their container at the location of the dry port in order to meet their efficiency plan. The option of intermodal transport also helps in the transport aspect since cargo owners have more options in their planning to cope with disruptive conditions such as road congestion.

Environmental Sustainability

Lastly, when exploring performance attributes beyond the three- groups identified by Beamon, the environmental aspect is being considered. Over the past decade, environmental issues have drawn more attention, and with them, logistics systems may play a role a role in lessening environmental effects (Roso & Lumsden, 2010). According to Roso's (2007), the advantages of remote dry ports stem from the switch from road to rail modalities, which lessens traffic at the seaport gates and neighboring areas as well as the negative effects of the environment on the route. Literature also suggests that health and environmental improvements also persuade more logistics parties to utilize dry ports (Andersson & Roso, 2016; Rodrigues, 2021; Roso et al.,

2009; van Zanten et al., 2024). Reduced emissions from consolidated transport via dry ports contribute to environmental sustainability and enhance the eco-friendly image of logistic entities (Khaslavskaya et al., 2021; Andersson & Roso, 2016; Nguyen et al., 2021).

In the interviews (Appendix B. Interview Details Question 7), all discussions lead to the common notion that the use of dry port and its intermodal transport enables a more sustainable supply chain for the logistic player. This comes from the use of intermodal transport as opposed to unimodal trucking. In Indonesia however, this care on sustainability has not been too significant. On the contrary, the Netherland has seen this as one of the critical aspects and even going so far to have the argument that if a logistic company wants to reduce their carbon emissions by 40%, then using a dry port is surely the way. This hence motivates the final dry port performance attributes of environmental sustainability.

A summary of the set of performance dimensions can be found in Table 3.2

Table 3.2 Set of Dry Port Customer Performance Attributes

Performance Attributes	Definition
Costs	(Total) logistic cost i.e transport, storage, etc.
Lead Time	(Total) delivery time
Environmental Sustainability	Environmental impact, relates to company green image
Reliability	Meeting customer expectations; i.e providing reliable access to the right service, at the right time, with the right quantity and quality
Adaptability	The ability to adequately adapt or respond to uncertainty in supply chain
Safety	Cargo and equipment safety throughout logistic activity
Complexity	The numbers of actor involved and bureaucratic easiness in managing the supply-chain

3.3 Dry Port Functions

3.3.1 List of Dry Port Functions

In essence, a dry port is a freight terminal that has certain unique characteristics that set it apart from other ports. According to Slack (1999), modern freight terminals perform four essential functions. First, the actual movement of the goods between two modes (usually in a unitized form). The second function involves the assembly of the cargo before transferring it. Third, the storage of freight in anticipation of delivery and pickup. The fourth function that results from the latter is the logistical distribution and control of products. Thus, these four functions are initially considered to be part of a dry port.

The literature is further consulted in order to define the specific dry port functions. In line with the first functions of a modern freight terminal by Slack (1999) of the moving of goods between two modes, it is found that transshipment service is one of the critical functions of a dry port (Khaslavskaya & Roso, 2020; Andersson & Roso,

2016; Roso et al., 2009; Rodrigue & Notteboom, 2011; Rodrigue et al., 2010; Roso, 2008; Khaslavskaya et al., 2021). A dry port should offer a high-capacity transport connection with the seaport, which implies the presence of infrastructure that facilitates the efficient, frequent, and reliable transport of consolidated cargo on a regular schedule, be it railway or inland waterway (Khaslavskaya et al., 2021). The transshipment services relate to several performance attributes, as has been discussed in section 3.2.2 especially to reduce cost, improve sustainability, and helps on firm adaptability in the supply chain. Furthermore, dry port could also offer a road haulage service with trucking, for example, as an additional service to accommodate roadside transportation (Khaslavskaya et al., 2021). From the interview, it is understood that this function relates closely to the adaptability and reliability attributes, as this service meets the needs of customers and offers alternatives in their day-to-day operation.

As for the second function of cargo assembly activities before the transportation phase, several specific dry port functions have been identified from the literature. The first function is the function of breaking down and/or combining smaller items to be transported, usually called the consolidation/deconsolidation function (Khaslavskaya & Roso, 2020; Rodrigues, 2021; Roso et al., 2009; Rodrigue et al., 2010; Roso, 2008; Khaslavskaya et al., 2021). Value-added services could also be considered as services to offer at a dry port, such as packaging, sorting, labeling, assembly operations, sequencing, and light manufacturing (Andersson & Roso, 2016; Rodrigue et al., 2010; Khaslavskaya et al., 2021). These functions have been found in interviews to relate to improving the reliability aspect since it helps to meet customer needs. Furthermore, in literature, shipment consolidation is argued to be able to help mitigate carbon and energy waste, hence reducing environmental damage (Ulku, 2012).

With the third function of storing freight, several functions have been identified from the literature. The first one is the storage of full or loaded containers, as this is an essential part of the intermodal transport taking place in a dry port (Khaslavskaya & Roso, 2020; Andersson & Roso, 2016; Kuncoro et al., 2021; Rodrigues, 2021; Roso et al., 2009; Khaslavskaya et al., 2021). A warehousing service could also be offered at a dry port to store raw or complete items and stuff (Rodrigue & Notteboom, 2011; Khaslavskaya et al., 2021). The warehouse service could also further develop to support the bonded logistic area (Li et al., 2015). Both the full container storage and warehouse have been found to help decrease costs, according to the interview. This is because the storage fee is arguably significantly cheaper than that in the seaport area.

Lastly, a dry port could also offer a storage facility for empty containers, usually called an empty container depot, to store empty containers that support the overall export and import activity of the location (Rodrigues, 2021; Roso et al., 2009; Roso, 2007; Rodrigue & Notteboom, 2011; Roso, 2008; Khaslavskaya et al., 2021). From the interview, this service is heavily related to improving reliability as it brings the empty container closer to the customer. The fourth function of a freight terminal by Slack (1999) is mostly considered to be the buffer functions that could be offered at a dry port to strategically postpone shipments in order to meet a certain requirement of

the shipment (Rodrigue et al., 2010). This can be part of the storage of full containers, and from the interview, it was revealed that this function has a significant impact on the adaptability of the customer supply chain.

Moving further from the four functions group as delineated by Slack (1999), several other logistical services are identified in the literature as relevant in a dry port setting. First, a customs clearance service could be offered at a dry port to assist customers in completing their customs duty for export import activity with services such as customs inspection, quarantine, and other customs-related activity (Khaslavskaya & Roso, 2020; Andersson & Roso, 2016; Kuncoro et al., 2021; Rodrigues, 2021; Roso et al., 2009; Rodrigue & Notteboom, 2011; Roso, 2008; Khaslavskaya et al., 2021). It was learned from the interview that this service may reduce customer lead time due to faster clearance and reduce complexity since the process is centralized in one entity, which is the dry port. Additionally, dry port could also offer container maintenance service as part of their functions, with maintenance activities consisting of inspection, washing, and repair (Khaslavskaya & Roso, 2020; Andersson & Roso, 2016; Kuncoro et al., 2021; Rodrigues, 2021; Roso et al., 2009; Roso, 2008; Khaslavskaya et al., 2021). Again, similar to empty container storage, this service also improves reliability for the same reason of making sure empty containers are available for customer export activities.

Along the transportation of the container using a dry port, customers can also be provided with accurate information about the container's whereabouts with the service of track and trace as another function of a dry port (Khaslavskaya & Roso, 2020; Andersson & Roso, 2016; Rodrigues, 2021; Roso, 2007; Roso, 2008; Khaslavskaya et al., 2021). This significantly improves safety and security due to the ability to track a container's whereabouts in real time, as revealed in the interview. A dry port could also expand their service to not only handle general cargo but to also include special cargo service in their functionality (Khaslavskaya et al., 2021; Roso, 2008). The special cargo services can range from reefer handling, out-of-gauge cargo handling, fumigation, and other special cargo services. Lastly, dry port could also act as a freight forwarder to offer customers a single gateway for their shipment (Khaslavskaya & Roso, 2020; Khaslavskaya et al., 2021). From the interview, it was learned that this special cargo service relates heavily to reliability attributes since it entertains a wide array of customer requirements.

All identified services hence show the dry port’s role as a seaport’s interface with its hinterland, which implies that customers have the opportunity to handle their cargo at the dry port just as they would at the seaport (Khaslavskaya et al., 2021). The list of identified dry port functions can be found in Table 3.3.

Table 3.3 List of Dry Port Functions/Services

No	Functions	Definition
F1	Transshipment	Transfer of cargo, mostly unitized, between two modes. In dry port, this relates to the availability of railway service or inland waterway.

No	Functions	Definition
F2	Consol-Deconsolidation	Breaking down and/or combining smaller item to be transported
F3	Full Container Storage	Storage for full/laden container. This includes the option to strategically postpone shipment for adapting to shipment requirement.
F4	Container Maintenance	Damage inspection, cleaning, and repair of container
F5	Custom Clearance	Custom inspection, quarantine, and other custom related activity
F6	Value-added Activities	Value-added services including things such as packaging, sorting, labelling, assembly operations, sequencing, and light manufacturing
F7	Track & Trace	Real-time information of container location. This also includes EDI (Electronic-data Interchange) to relevant partners such as shipping lines and seaport
F8	Freight Forwarding	Freight forwarding service that help to offer a single gateway for a shipment
F9	Empty Container Storage	Storage for empty container
F10	Warehousing	Storage for raw and/or processed goods and items. This includes the bonded warehouse service.
F11	Road Haulage	Road transport for full and/or empty container
F12	Special Cargo Service	Special cargo services such as reefer handling, OOG handling, DG, fumigation, etc.

3.3.2 Dry Port Functions Flow Diagram

To further analyze the dry port functions, a process flow diagram is created using the dry port functions. This process flow diagram is aimed at helping provide further understanding of the dry port functions, especially the relationship between each of the functions. This dry process flow diagram will be used later in the project to help with the creation of the maturity model since it is argued that it will require a clear understanding of the dry port-function relationship. The dry port flow process will be created for two processes, which are outbound and inbound of the dry port. The dry port flow process diagram for outbound flow is shown in Figure 3.2, and the diagram for inbound flow is shown in Figure 3.3. The dry port flow process diagram is defined from two main actor perspectives, which are the cargo owner (shipper/consignee) and the shipping lines. Some functions lie mainly on the cargo owner side and some on the shipping line side. The flow process diagram is created on the assumption that the customer is utilizing all the functions that are being offered by a dry port.

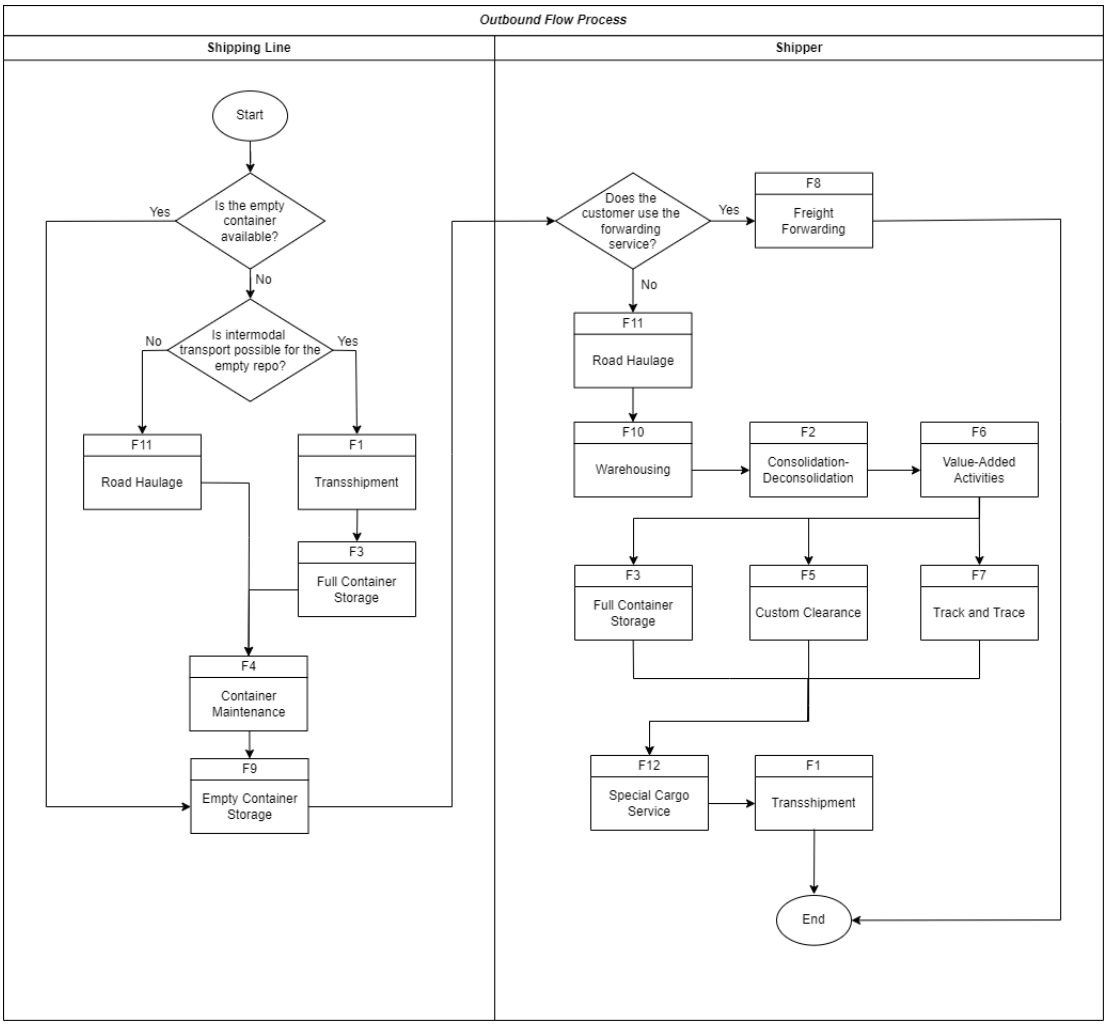

Figure 3.2 Dry Port Flow Process - Outbound

For outbound flow, the process starts from the shipping line side. The shipping line needs to ensure the availability of empty containers at the location around the dry port in order to support the export activity of the customer. These empty containers that are subject to being used for export will be stored in the empty container storage or empty container depot. In the event that the empty container meant to be used by the shipper is not available, the shipping line will need to support it by doing an empty container reposition. This meant moving the empty container from another location to the depot at the dry port. Two options are available for empty container repositioning: via land transport using the road haulage service or intermodal transport using the transshipment service at the dry port. It is important to note that the transshipment service for empty repositioning means the movement of the empty container will go through the full container storage service at the dry port. Once the empty container arrives at the dry port depot, the empty container will go through inspection in the container maintenance function. This will ensure the condition of the empty

container, and in case the empty container is damaged, a repair activity can be executed in the depot.

Moving on, once the empty container is available at the dry port depot, the customer, which is the shipper, can pick up the empty container for their stuffing activity to start their export. Additionally, a shipper can also utilize a freight forwarding service from the dry port operator that offers a total logistic solution; hence, the customer can leave all the technicalities of the outbound process to them. If the customer does not utilize the freight forwarding service, they can use the road haulage service to assist with the empty container pick-up and movement for stuffing activities. The storing and stuffing of products can also be assisted by the warehousing service offered by the dry port. Additionally, the assembling of the cargo can also be assisted in the warehouse with services such as consolidation and deconsolidation, as well as value-adding activities such as packaging, labeling, etc.

Once the stuffing activities have been completed in the warehouse, the shipper can continue to bring the full container to the dry port for further transportation to the seaport. Once they arrive at the dry port, the shipper can complete their customs duties with the customs clearance service. Once that has been completed, the full container will be stacked in the full container storage at the dry port. This will also mean that the container will be available for tracking in the track and trace system, and information about its location will also be shared with relevant parties, such as the shipping lines and seaport. If the containers are of a special cargo type, such as reefer or out-of-gauge commodities, the special cargo service can also be utilized, such as using the reefer plug and monitoring while still stacked at full container storage. The container can also be strategically postponed for shipment and kept in full container storage if needed to comply with any special requirements. Finally, the cargo can embark on the intermodal transport of railway or inland waterways using the transshipment function for their journey to the seaport.

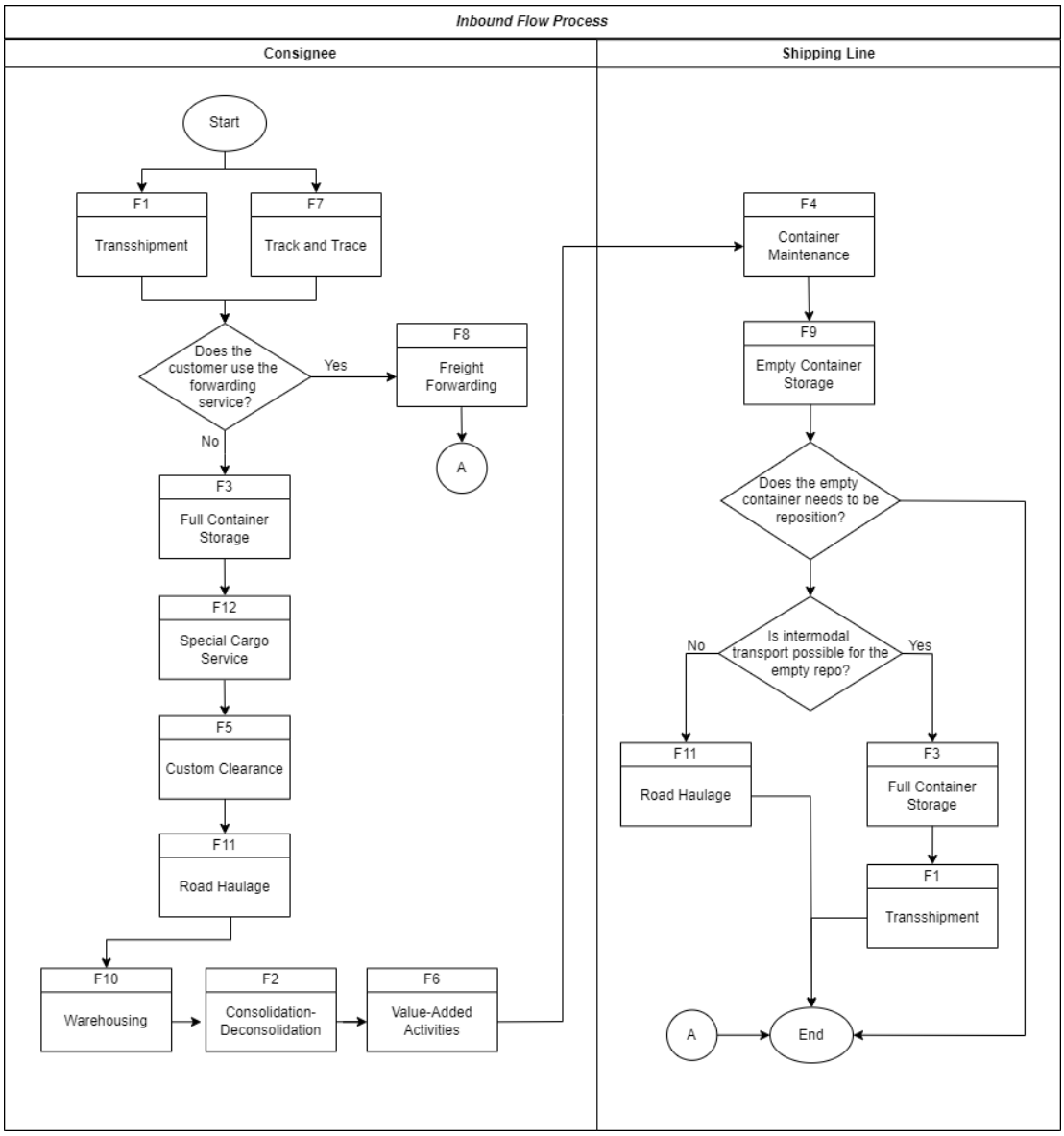

Figure 3.3 Dry Port Flow Process - Inbound

As for the inbound flow (Figure 3.3), the actor that is now involved is the consignee at the dry port area. The overall flow process stays the same with Outbond, although now the flow is reversed. The process starts when the container arrives at the dry port after using intermodal transport and will be assisted by the transshipment service at the dry port. The consignee can again utilize the forwarding service or choose to execute the inbound cargo themselves. They will use the services at the dry port, along with utilizing the warehouse service and the other service for unstuffing purposes. The consignee will then also bring the empty container once they have finished the unstuffing activity to the empty container depot, where the empty

container can again be repositioned using either road haulage or intermodal transport relative to the shipping line requirement.

3.4 Chapter Conclusion

In this chapter, a conceptual understanding of what a dry port looks like as well as the benefits that it brings to the customer has been obtained through a thorough analysis of current literature combined with a rigorous interview to further validate the findings from the literature. A list of customer performance attributes that are relevant to the use of dry port has been formalized, as shown in Table 3.2. Furthermore, the functions or services that make up a dry port have also been listed, as shown in Table 3.3. These services have also been further connected to the performance attributes and discussed how each of the functions could bring benefits relative to each of the attributes. Lastly, a process flow diagram has also been developed using the obtained dry port functions for two flow processes, the outbound and inbound flows. The outbound flow diagram is shown in Figure 3.2, and the inbound flow diagram is shown in Figure 3.3. These flow diagrams help to improve the understanding of the processes happening in a dry port further and are expected to be beneficial for the next stages in the study, which are the dry port function analysis and the creation of the dry port maturity model.

4 Dry Port Functions Analysis

In this chapter, the focus will be on further analyzing each of the dry port functions in relation to the direction of the dry port development. The analysis will use the dry port customer perspective in the form of the performance attributes as laid out in the previous chapter. Additionally, another stakeholder's perspective, which is the dry port operator, will also be part of the analysis. Hence, this chapter will again partially answer the first sub-research question, this time considering the dry port operator perspective. It then follows to partially answer the second sub-research question on the development step for dry ports.

4.1 Function Analysis Method

4.1.1 Customer Value Theory

Little is known about the basis of the services dry ports develop and provide, while they frequently start with the most fundamental and necessary services before branching out into more specialized ones to meet the needs of individual customers (Khaslavskaya et al., 2021). Khaslavskaya et al. (2021) hence have this as a motivation for their study that resulted in having dry port stakeholder objectives translated into criteria and indicators that are of importance to stakeholders when selecting or using dry port services. The conclusion of the research makes the case that this kind of evaluation is crucial since it offers essential information on which dry port services should receive priority development or investment in order to meet the expectations of various stakeholder groups.

The previously discussed study by Khaslavskaya et al. (2021) is argued to center heavily on considering stakeholder interests and objectives. This is compatible with the stakeholder theory, which holds that companies should take stakeholders' interests into account, and deontology provides a moral foundation for this strategy (Gibson, 2000). As has been clearly defined in the previous chapter, the selected group of stakeholders that will be the focus of this study is the customer of a dry port, which consists of the cargo owner and shipping lines. This is understood as the contrast between the study by Khaslavskaya et al. (2021), which takes a bigger diversity of stakeholders and not only the customer group into account when analyzing the dry port service.

It is imperative to take consumer interest into account when building a service since this results in customer-serving techniques that are more profitable, efficient, and effective (Zeithaml et al., 2001). In order for businesses to compete in a market where customer centricity and self-service skills are on the rise, it is imperative that they take customer interests into account while building services (Brohman et al., 2009). In addition, customer satisfaction assessment plays a critical role in the design of product-service systems by assisting in the identification of strategies for improvement and in understanding how qualities affect the realization of customer

value (Geng & Chu, 2012). As laid out in the previous chapter, a series of performance attributes relevant to the dry port customer have been formalized. These performance attributes will hence be utilized in order to consider customer interest in analyzing dry port functions, as it is argued to be able to measure the benefits that customers can obtain by utilizing a service from a dry port. This approach is based on theories found in literature and will be discussed as follows.

One theory contends that customer value is essential to a company's ability to compete and to its long-term performance, which makes it crucial to consider when developing and researching service offerings (Khalifa, 2004). There are mechanisms that are thought to contribute to customer value; Khalifa (2004) has expanded on two of these theories. The first one is explained in the value exchange model (Khalifa, 2004). In essence, the value exchange model is a benefits-costs model where the client agrees to forgo a specific amount of money, time, effort, and risk in exchange for anticipated advantages that exceed the total amount of sacrifices. Net customer value is the outcome of the difference between total benefits and total sacrifices; a purchase decision is only made if this value is zero or higher. The second one is the value build up model (Khalifa, 2004). The benefits side of the value equation is highlighted in this model, and the customer value accumulation model is derived from the implicit assumption that total customer benefits surpass total customer costs.

These models of customer value are used as the reasoning for utilizing the dry port performance attribute in analyzing the dry port functions, as these attributes are expected to be maximized in order to improve the dry port customer value. The value that a service company offers to its clients might come from raising service standards to increase revenue or reducing costs., and there is a need to fully characterize the impacts and the locations of these shifts in order to determine and comprehend the value mechanisms via which value will be created (Andersson & Roso, 2016). In the context of this project, the value that each of the dry port functions brings, as well as how the customer values these functions, will be understood from the function analysis using the performance attributes.

4.1.2 Consideration of Innovation Factors in the Analysis

Next to analyzing the functions based on customer value creation using the performance attributes, the analysis will also be expanded to include the innovation factors of the dry port services from the dry port operator perspective. This is done in order to obtain knowledge of how challenging it is for a dry port operator to implement a certain service. This approach is in line with the limitations of the study by Khaslavskaya et al. (2021), which did not consider other characteristics of the dry port system that could have some effect on the availability of services. Future research is advised to examine other dry port system elements that can affect dry port service design (Khaslavskaya et al., 2021). In order to look for the other aspects within a dry port, this study again considers the relevant dry port stakeholders, and one way to find relevant stakeholders is to see if there is a demand and supply side of the problem at stake (Macharis et al., 2012). As the dry port customer is considered to answer the demand side, the dry port operator needs to be taken into consideration in

order to fulfill the supply side. Therefore, this study will include the dry port operator perspective by using the dry port functions' innovation factor as an additional factor.

This approach is further contextualized with the innovation theory in transport and logistics, as the implementation and improvement of services could be considered a form of innovation in a dry port by the operator. The core challenge of improving customer service quality while lowering delivery costs is at the center of innovations in logistics services (Zenezini & Tavasszy, 2022). The servitization of product offers or the addition of service aspects to a product, like in this study's context with services that could be provided at a dry port, has caused a change in the quality of logistical services and hence could be considered as an innovative endevour.

The inclusion of innovation factors will aim to add another perspective to that of customer value that has been discussed previously. It is not only that dry port operators will want to implement services that maximize the benefit to the customer, but they will also need to consider the feasibility of implementing such services and how it relates to the overall state of the dry port. Additionally, the inclusion of innovation factors will aim to be holistic in the sense that it will allow the analysis of the dry port services to be not limited to technical feasibility but to a broad range of factors. As the goal of this analysis is to provide guidance in the later construction of the maturity model, a clear approach to the inclusion of these innovation factors must also be defined, similar to the performance attributes that have the goal of maximizing the benefit to the customer. In that sense, the service will be analyzed to understand which service is the least challenging to implement by a dry port and hence more attractive to the dry port operator. The reason behind this choice is again rooted in literature.

In multi-level perspective theory, or MLP for innovations, there is a basic assumption that, due to the stabilizing character of the current socio-technical regime, radical innovations will not happen in this regime (Annema, 2022). Thus, stability and continuity have generally been emphasized in analyses of regime change (Berkhout, 2002). This is closely related to the condition in firms, which can be further explained by the path dependency theory. If initial actions in one direction result in more actions in the same direction, then the process is path-dependent (Kay, 2005). Path dependency thus suggests that industries tend to focus on reproduction and smaller stages of progress rather than developing something entirely new because the "new thing" does not correspond with their routines, their existing knowledge, or their established technologies, among other reasons (Annema, 2022). This is hence used as the reasoning behind the approach to analyzing the dry port functions that aims to obtain the least challenging to implement. Nonetheless, there is an instance where significant innovations could be made. To achieve this, the best possible incentive program that rewards long-term success and tolerates early failure will need to be implemented (Manso, 2010).

4.1.3 Multi-Actor Multi-Criteria Analysis (MAMCA)

Conducting a MAMCA would be suitable to address the inclusion of multiple stakeholder perspectives in dry port evaluations (Khaslavskaya et al., 2021). Hence, this study will use MAMCA in order to analyze the customer perspective in the form of the diverse performance attributes as well as the dry port operator perspective in the form of the innovation factors in relation to the dry port functions or services. The MAMCA will help rank the functions relative to their performance in helping bring benefits to customers (attractiveness to customers) as well as ranking the functions relative to how challenging they are as innovations (attractiveness to dry port operators).

4.2 Dry Port Innovation Factors

As previously discussed, in order to obtain an understanding of how challenging each of the dry port services is to be implemented by the dry port operator, a set of innovation factors is first being formulated for later analysis. Literature is consulted in order to find the innovation factors. First, the theory of innovations is used as inspiration in order to look for implementation factors. In his theory of the opportunity vacuum for innovations, Planing (2017) argues that there are three aspects that need to be focused on in order to have a successful innovation. The first aspect concerns how possible it is to implement the innovations. According to Planing (2017), every invention is built upon earlier ideas that were built upon earlier ones. This could be interpreted as meaning that an innovation cannot be implemented unless it has a proper and functional precedent. This primarily has to do with innovation's technological component. The second aspect concerns how viable it is to implement the innovation. The viability aspects stem from an economic point of view. According to Planing (2017), it is more precise when describing how the innovation is anticipated to result in cost savings for realization within a predetermined time frame. This is logical, as profit-oriented entities will avoid doing something such as innovation that only further decreases their financial performance.

Lastly, the third aspect concerns how acceptable innovation is to the current edges of socially accepted behavior, which currently only innovators embrace but will soon reach the early majority of technology adopters. It can be seen that an innovation must also be accepted by the public, not just from the innovator side. It is again sensible, as an innovation is expected to help the community at large, not just a very limited part of society. In conclusion, an innovation can only be considered successful when it is both financially and technically feasible to implement the idea and when the majority of society is ready to accept it (Annema, 2022). From here, literature is further consulted in order to find more specific factors that could help define the three aspects of a successful innovation as laid out previously. The innovation factors obtained from the literature are illustrated in Figure 4.1

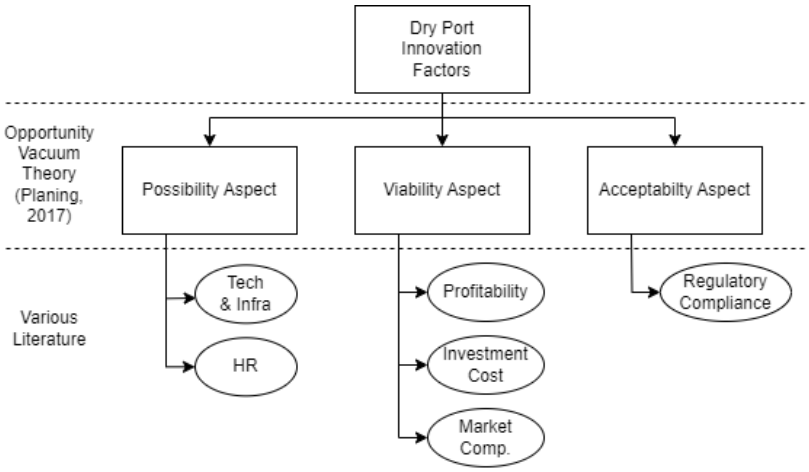

Figure 4.1 Identified Dry Port Innovation Factors from Literature

First, the aspect of possibility is being further considered. In line with the technological perspective as proposed by Planing (2017), the first innovation factor selected is technology and infrastructure. According to Richey et al. (2007), supply chain companies need to be technologically ready and technologically complementary in order to provide superior logistics services, which is why the aforementioned innovation factor was chosen. Moreover, the technology used in delivering the service will likely depend on human control to operate it. Human capital is essential to economic growth because it creates new kinds of physical capital (Schultz, 1993). In the service sector, such as dry port, human capital planning is especially important for businesses to stay competitive in a market that is driven by services (Zula & Chermack, 2007). A freight terminal also remains very dependent on its human capital. In addition to helping transhipment maritime container terminals achieve high levels of productivity and offer shipping companies high-quality services, optimal human resource allocation can significantly reduce personnel shortages and operational delays (Di Francesco et al., 2015). This hence motivates the second innovation factor of human resources.

Moving on to the second aspect of viability, the focus is on the financial perspective, as laid out in the literature. Straightforwardly, the first selection of innovation factor in this aspect is profitability. Planning for the construction of a new terminal or the expansion of an existing facility calls for careful consideration of the topic of overall profitability (Ferreira & Sigut, 1993). Moreover, in the context of dry port, it has been learned that profit is indeed one of the most important considerations for a dry port operator (Khaslavskaya et al., 2021). The second innovation factor in the viability aspect is investment cost. This aspect is crucial in the dry port setting. Policies for infrastructure investment are a significant component of terminal performance measurement (Ferreira & Sigut, 1993). Freight terminal investments are crucial because they can result in large cost reductions over the existing goods movement system (Clark & Ashton, 1977).

The third and last innovation factor in the viability aspect is market competitiveness. It will be quite challenging to implement a service that is hard to acquire in the market. In a dry port setting, consideration of market competitiveness is crucial for terminal operators to address the strategic importance, location, and network configuration of freight terminals (Wiegmans et al., 1999). In particular, while creating a new service, it is critical to take market competitiveness into account when developing plans for frequency, mode, route, and staffing in order to provide dependable, superior services at reasonable costs (Wieberneit, 2007). The market competitiveness factor can therefore be argued to be very closely related to the dry port customer perspective with the performance attributes. Hence, for the purposes of this study, since the service advantage will be mostly covered by the performance attributes, this factor from the dry port operator perspective will only consider other aspects of market competition, such as market saturation and the company's experience and reputation.

The last aspect of social acceptability will be covered by a single innovation factor, which is regulatory compliance. In a way, the government regulation already summarizes the social acceptability of a service being offered, as it will already consider the community norms and practices. According to Lopez et al. (2020), legal compliance is crucial for verifying that a business process is operating correctly. Legal compliance is essential in the logistics sector because non-compliance can put workers, the environment, and one's finances and reputation at risk (Perez & Korth, 2020). Logistics compliance checking is crucial because it guarantees that operational procedures meet established legal criteria and minimize significant risk (Ramezani et al., 2013). An overview of the selected innovation factors can be found in Table 4.1.

Table 4.1 Set of Dry Port Innovation Factors

Innovation Factors	Definition
Technology and Infrastructure	Technology and infrastructure capital refers to the technological assets and physical infrastructure to support and enhance their operations, processes, and capabilities.
Human Resource	Human resource refers to the skills, knowledge, experience, and abilities possessed by individuals in the dry port, which can be viewed as assets that contribute to the success of implementing a service.
Profitability	Profitability refers to the ability of the dry port service to generate profit or financial gain over a specific period.
Investment Cost	Investment cost refers to the total amount of money that dry port operator spends to implement a service. This cost includes the purchase price of the investment itself, as well as any associated fees, commissions, taxes, and other expenses.

Innovation Factors	Definition
Market Competition	Market competitiveness refers to the ability of the dry port service to effectively compete with other entities in the marketplace. This is limited to the market's saturation and the company's experience and reputation.
Regulatory Compliance	Regulatory compliance refers to the adherence to laws, regulations, guidelines, and specifications relevant for a dry port to implement a specific service.

4.3 MAMCA-Swing for Dry Port Functions Analysis

In order to analyze the dry port functions using the dry port operator and customer perspectives, the multi-actor multi-criteria analysis method, or MAMCA, will be utilized. In this methodology, which can be seen as an extension of the traditional multi-criteria decision analysis, or MCDA, the stakeholders are explicitly considered (Macharis et al., 2012). As discussed in the previous chapters, the dry port function analysis includes several stakeholders. Multi-criteria decision analysis (MCDA) also allows the analyst to involve the objectives of different interest groups or stakeholders (Macharis et al., 2012). However, as mentioned beforehand, MAMCA allows for more explicit ways of including the differences in perspective of different stakeholders in its method; hence, MAMCA is considered to be used in this paper. Due to the fact that MAMCA evaluates different alternatives based on the objectives of the stakeholders, decision-makers can increase their support for the alternative they choose. The MAMCA methodology specifically focuses on the inclusion of the different actors that are involved in a project, or the so-called stakeholders. In the traditional multi-criteria decision analysis (MCDA), it allows the inclusion of qualitative as well as quantitative criteria with their relative importance, but in the MAMCA, criteria further represent the goals and objectives of the multiple stakeholders. As such, the stakeholders are incorporated into the decision-making process. The MAMCA method includes sequential steps, and the overall process is described in Figure 4.2.

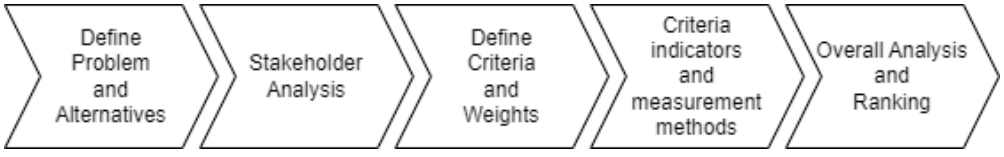

Figure 4.2 MAMCA Flow Process (as adapted from Macharis et al., 2008)

The details on each of the stages of the MAMCA that is outlined for this project can be found in Appendix C. MAMCA-Swing Process Details. The following section will discuss more closely some aspects of the MAMCA process, two of which are the criteria weighting method and the process of the final overall analysis of the dry port functions.

Firstly, regarding the weighting method, in the third stage of the MAMCA, it includes the process of defining the criteria's weight of importance. In this project, the weighting will be done using the swing weighting method (von Winterfeldt & Edwards, 1986). The swing weighting method was selected due to its ability to consider the full range of attributes as well as its simplicity in the data gathering activity. However, it is also important to critically acknowledge the potential setbacks of this chosen approach with the swing weighting method. One of the main concerns regarding the potential setbacks is about biases. Subjective assessments used to determine weights in MCA situations have the risk of introducing cognitive biases and skewing the best potential results (Rezaei et al., 2022). Rezaei et al. (2022) discovered in their study that stakeholders in Swing often underestimated the less significant (sub)attributes, and as a result, this could naturally have an impact on the analysis's outcome because it both overweighs and underweighs the more crucial traits. This potential setback will be taken into consideration for the analysis of the result.

Secondly, the focus is on the final overall analysis. As there will be three stakeholders in the analysis, there will be three final values for each of the dry port functions for each of the dry port stakeholders. To show and further analyze these final values, a graph with two axes will be used for better illustration, as can be seen in Figure 4.3. As there are two actors representing the dry port customer group, the analysis will result in two graphs for each cargo owner and shipping line. From the two graphs, a diagonal direction of prioritizing the functions within the two graphs is being conducted. This diagonal direction of prioritizing is based on the reasoning of the analysis to find the dry port services that maximize the benefit in relation to the performance attribute that is based on the customer value theory and minimize the effort for implementation in relation to the innovation factors based on the path dependency theory. This approach hence ranks the functions in a pareto interpretation based on the two stakeholders' perspectives. Ultimately, this analysis is expected to provide the relevant information needed in the later dry port maturity model construction phase, which mainly centers on the need for direction for service development.

From the illustration, it is also implied that the importance of each of the actors from the supply and demand sides is quite even in the analysis since this study aims to have this balance of considerations between the two arguably relevant stakeholders. Lastly, it is important to acknowledge that the MAMCA in this project does not resemble the typical MAMCA analysis. Usually, MAMCA considers a wider and more opaque range of stakeholders. However, in this project, it is more limited by using the market perspective of supply and demand, with direct suppliers and customers being considered. This is done due to the limited focus of the study, which aims to solely consider the development steps of the services of a dry port and only consider the two arguably most relevant actors without prioritizing one over the other.

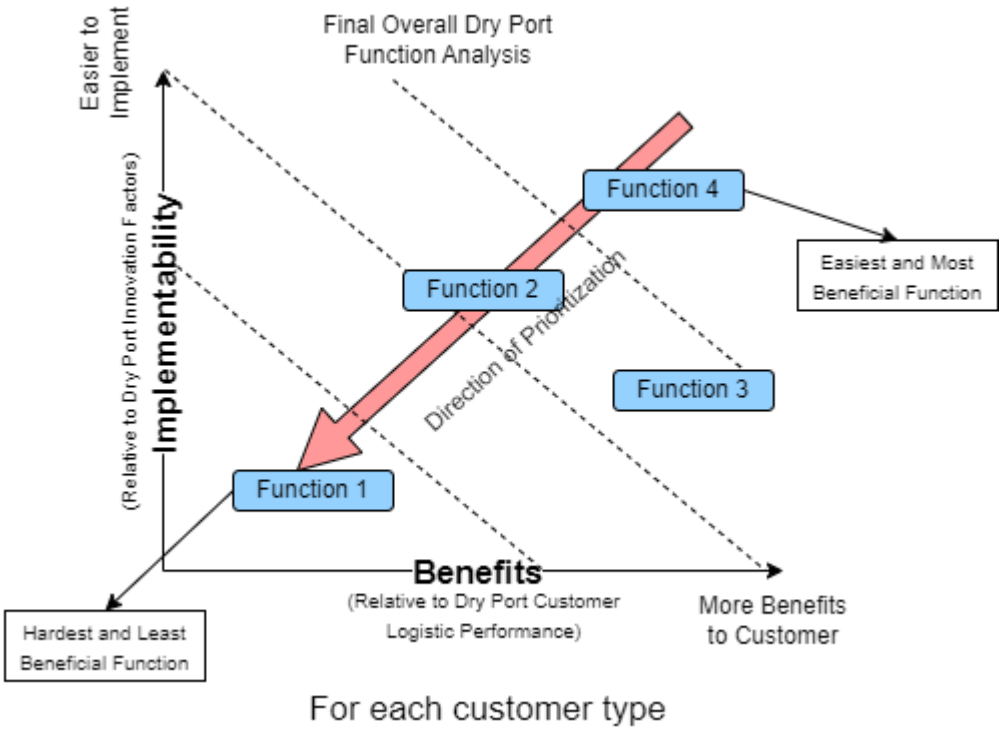

Figure 4.3 Dry Port Function MAMCA-Swing Final Overall Analysis Illustration

4.4 Chapter Conclusion

A framework for analyzing dry port functions has been developed in this chapter. The Multi-Actor Multi-Criteria Method is being utilized in the framework due to its suitability to consider the diverse perspectives coming from different actors related to dry port. The stakeholders and actors that are considered in the analysis are the dry port customer and the dry port operator. For the dry port customer, their perspective is being considered using the dry port customer performance attributes as have been formalized in the previous chapter. The MAMCA analysis will rank the dry functions by aiming to maximize the benefits that the customer received from using dry ports relative to the performance attributes. This approach is backed by the customer value theory to improve service utilization.

As for the dry port operator, their perspective is being considered using innovation factors that explain how challenging it is for the operator to have a specific function or service offered at the dry port. These innovation factors have been obtained from analyzing existing literature, especially in the context of logistic innovation, and can be found in Table 4.1. Using the innovation factors as criteria, the MAMCA analysis will rank the dry port functions by aiming to minimize the effort for the dry port operator to implement the services. This approach is backed by the innovation's

theory, which is path dependency and the motivation for a company to take a bigger risk if there are equally strong incentives.

The MAMCA framework has been constructed to conduct the analysis explained previously. The independence of each of the criteria in the analysis has been rigorously evaluated in order to ensure independent criteria. The weighting method used in the MAMCA has also been discussed with the selection of the swing method. The function indicator and measurement will rely on a survey based on the actors, and the final part of the MAMCA analysis will utilize the additive value functions to rank the functions.

5 Dry Port Maturity Model

From the dry port function analysis that has been covered in the previous chapter, many factors that contribute to creating the most beneficial service offerings for the customer from a dry port operator have been covered and thoroughly analyzed. One recommendation from the Khaslavskaya et al. (2021) study is to take additional steps to project this knowledge in order to increase the use of dry ports. Referring to Section 1.5.1, that a maturity model has not been employed in the current literature and that it is suggested by a study from van Zanten et al. (2024) to create a dry port maturity model in order to optimize the benefits of using a dry port to the user, a maturity model is chosen as the next step forward from the analysis of dry port services.

Conceptual frameworks known as maturity models explain how organizational capacities develop gradually along anticipated, desirable, or logical paths (Pöppelbuß & Röglinger, 2011). This is especially relevant to the setting of dry ports because those services frequently evolve over time, beginning with the most basic and essential services and then growing into more specialized offerings to meet the unique needs of customers (Khaslavskaya et al., 2021). Furthermore, it is as important for a service provider like a dryport to communicate the value of what they have to offer (Andersson & Roso, 2016). The maturity model is then aimed at helping Dry Port communicate their service value to their customers. This section will then ultimately help to answer the second and third sub-research questions of this study with the dry port maturity model creation framework.

The knowledge of the services from the previous analysis will be put to use in order to construct a dry port maturity model that will help dry ports plan their development. This approach is therefore expected to produce a very specific maturity model since it will heavily rely on the context-specific dry port stakeholders' perspective. This is justifiable referring to literature since it is suggested that a maturity model could consider either the two different focuses, general and domain-specific, that determine the specificity and extensibility of the maturity mode (Mettler, 2010). By choosing to build a model to meet a specific domain, this presents the process to address the demand for maturity assessment to cover very specific requirements involving specific factors such as functional areas, economic sectors, and countries (de Jesus & Lima, 2020). The approach using the dry port stakeholder's perspective will consider these various factors in relation to the stakeholder-specific context. It can be argued that specific maturity models can provide detailed, actionable guidance tailored to their intended context, which leads to efficient and targeted improvements in addressing domain-specific challenges. However, its narrow focus can limit the maturity model's applicability outside of specialized areas, making it less useful for organizations in different contexts.

The creation of maturity models is also considered to be a topic for design research studies (Pöppelbuß & Röglinger, 2011). Hence, it is decided that the steps on constructing a dry port maturity model will follow the generic design step as laid out in Figure 1.1 that integrates the system engineering design approach and the maturity model design framework by Mettler (2010). The following section will first discuss the design goal and scope, followed by the design step, and lastly talk about the evaluation process of the constructed model.

5.1 Maturity Model: Analysis Phase

The process of designing the maturity model for a dry port starts with the definition of the goal as well as the scope of work. As thoroughly discussed in Section 1.2 Research Objectives, the goal is to have a maturity model that helps a dry port operator develop its service in order to improve its performance by considering the dry port stakeholder perspective. As for the scope of the design, it will be a combination of the many aspects of the design framework that have been laid out in the previous chapters. There are five items in the scope of the maturity model design, as follows:

1. Limited to only strategic and tactical level of planning for dry port development (Refer to Section 1.3 Research Scope)

The developed maturity model aims to offer strategic guidance for dry port entities in the dry port's development step. During model validation, the tactical level will be rigorously assessed through benchmarking of the dry port with regard to the maturity level of the model. While the model mainly centers on the strategic and tactical levels, the operational level will not be directly addressed due to concerns about focus and resource allocation.

2. Utilize the formulated functions within a dry port (Refer to Section 3.3 Dry Port Functions)

The service offered at a dry port is expected to grow over time; hence, in the maturity model, the dimensions that will be used in order to assess and improve the dry port will be the dry port functions, as have been formalized previously. Additionally, the relationship between each of the functions will also be taken into consideration, as this relationship can be observed from the dry port function flow diagram.

3. Maximized the customer value in respect to the dry port customer performance attributes (Refer to Section 4.1.1)

In order to improve dry port performance, the performance benefits that have been formalized previously will be maximized in the development process in the maturity model. This is to improve the customer value that relates to the further improvement of customer-oriented service at the dry port.

4. Minimized the effort to implement the wide range of services on a dry port (Refer to Section 4.1.2)

From the perspective of the dry port operator, the innovation factors will also be taken into account in the creation of the maturity model. This will be done by ensuring that the process of dry port development will be feasible for the dry port operator without taking too much risk in innovating, in line with the path dependency theory.

5. The maturity model must follow the components of a maturity model as suggested in the literature (Refer to Section 2.4)

The constructed maturity model must follow the general concept of a maturity model and aim to have the suggested components as laid out by Mettler (2010) and mentioned in section 2.4 Maturity Model.

Additionally, in the analysis phase, the formalization of dry port stakeholders' perspectives is carried out. The formalization will be based on the results of the literature review and interview to formulate the dry port stakeholder's criteria, which can be found in Table 3.2 for dry port customers and Table 4.1 for dry port operators. The next section will cover the design phase of the maturity model, with further discussion on the details of the dry port maturity model and the process to construct it following the scope of work as detailed previously.

5.2 Maturity Model: Design Phase

In line with Mettler's outline on creating a maturity model (2010), the subsequent step, which is the design phase, will provide more details of the maturity model construct. This design process of the maturity model is in line with answering the second sub-research question of the study of understanding the steps of the development of a dry port. In order to construct the maturity model, a design space will be utilized in order to direct the design process.

In his study, Mettler (2010) identified that, from the literature, there are at least two approaches to the design phase of a maturity model. One of the approaches is argued to be more of a top-down approach that starts with the identification of aspects within the focus domain (similar to the process categories and process areas in CMMI) and then follows with the design of maturity levels relative to the domain's aspects. This approach is argued to be the one chosen in this project to construct the maturity model. In his work, Mettler (2010) found that this top-down approach is able to be materialized using a wide array of research methods, such as the Delphi method, literature review, and creativity techniques. It is argued that the approach to this project will be more on the creative side and will be further discussed as follows.

Firstly, the insights for the creation of the maturity model will be based on the result of the function analysis, as previously discussed in Chapter 4. This result will be put in context with the design scope, especially points 3 and 4. To utilize the function analysis results in constructing a maturity model, a clear approach is being formulated. The analysis results consist of two graphs, one for each of the dry port customer groups: the cargo owner and shipping lines. The graph shows how each of the dry port functions is located relative to the benefit it brings to the customer and

how challenging it is to implement. As has been clearly defined in the previous chapter, the functions will be ranked with pareto interpretation to look for the ones that bring the most benefit as well as being less challenging to implement first. With those goals, the analysis result can be analyzed in a diagonal direction to group up the functions into a priority list for the dry port operator. This pareto interpretation is in line with the general view in which companies prioritize service improvements by considering both the increase in revenue through the increased customer value and the increase in cost from the implementation of the improvement (Srinivasan et al., 2015). The illustration for this approach can be found in Figure 5.1 Dry Port Function Analysis for the Maturity Model.

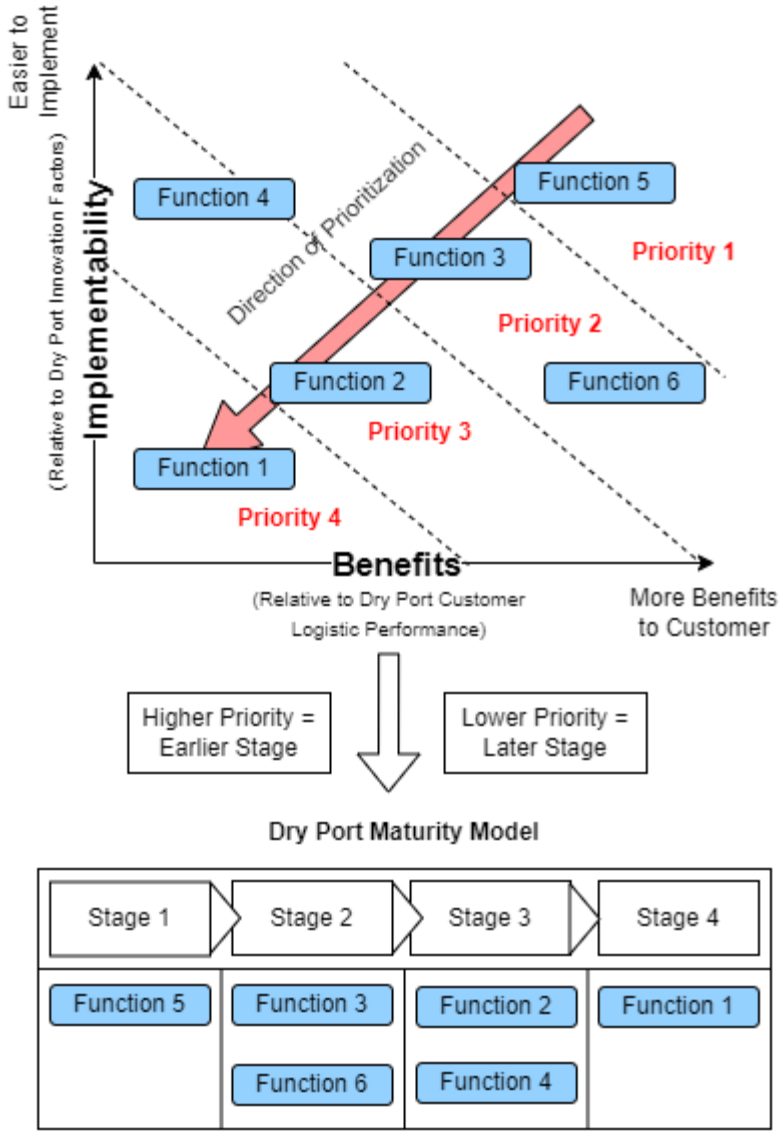

Figure 5.1 Dry Port Function Analysis for the Maturity Model Construction

From this approach, it can be concluded that the distribution of the dry port functions prioritization is based on the benefits and implementation rules for both the cargo owner perspective and the shipping line perspective. The functions' priority will relate to their later position in the maturity model, with higher-priority functions likely being positioned in the early stages of the maturity model. It is important to also note that not only the priority group of the specific function will be taken into account, but the specific position in the graph will also be considered in the maturity model construction. Additionally, the relationship between the dry port functions as illustrated in the dry port process flow diagram (Figure 3.2 and Figure 3.3) will also be taken into account, as some services may require other services to exist first before the later can be implemented.

The other thing that is important to highlight concerns the two customer groups that resulted in the two different final analysis results. In the construction of the maturity model, both results from the two customer groups will be considered equally, meaning that no customer group is being prioritized over the other. This decision needs to be put in the more specific context of each of the customer groups being considered in the project. The two customer groups are perceived to utilize the specific and different aspects of a dry port. The cargo owner customer group is taken to represent the group of companies that own the cargo that is being traded through international trade activities. This means that this customer group is mainly focusing on arranging the transportation plan for the movement of the cargo while also handling all the administrative necessities. This activity could be assisted by another party in reality, for example, by cooperating with a freight forwarding company. However, in this project, the cargo owner is solely considered due to its hierarchy in the final decision-making process.

As for the shipping lines, they are perceived as the party that provides the transportation services for the cargo owners to make their trade. Shipping lines mainly focus on supporting cargo owners with the right equipment and a reliable transportation schedule. From these specific descriptions of the two customer groups, it is inferred that both customer groups utilize dry port services with different agendas and objectives. To illustrate, cargo owners may heavily rely on the customs clearance service to handle their customs duties, while shipping lines may focus more on the empty container storage service to store their equipment. This ultimately motivates the choice to evenly consider both customer group analysis results in the maturity model construction process since each customer group may concern different aspects of the dry port.

Next up in the design space, the construct of the maturity model components is being formalized. The maturity model will have the essential components of a maturity model, as mapped out by Mettler (2010). The details of the maturity model are discussed as follows. First, the maturity model will consist of four levels: basic level, intermediate level, advanced level, and total solution level. This leveling is consistent with the argument made by Khaslavskaya et al. (2021) that the development of

services at dry ports frequently begins with the most fundamental, necessary ones before branching out into more specialized ones to meet the unique needs of clients. Each of the level descriptors is as follows:

1. **Basic level**
   The basic level encompasses the foundational functions that make up a dry port. The functions at the basic level are the ones that enable an inland terminal to at least be considered a dry port. This shows the high importance of the basic level since it helps define the identity of the terminal as a dry port.
2. **Intermediate level**
   Moving one step higher from the basic level, the maturity model has a second level, which is the intermediate level. This level shows a condition in which a dry port is starting to offer more functions to its customers as an addition to the basic services. The services here help provide the basic services needed to thrive even more in meeting customer needs.
3. **Advanced level**
   At the third level, the maturity model has an advanced level that shows a quite significant advancement in dry port services, although there is still room for improvement. Here, again, more services are offered and tailored to the unique requirements of the dry port customer.
4. **Total solution level**
   In the last level, a total solution level is introduced in the maturity model. A dry port can aspire to offer a total logistic solution to its client (Jeevan et al., 2022). This level hence represents the condition where a dry port offers the whole end-to-end service of logistics to its customers with the introduction of a very wide range of services that meet customer demand.

After clearly defining the levels that make up the dry port maturity model, the next part is the dimension that makes up the maturity model. Since the idea is to utilize the formalized functions to construct the maturity model, it is then decided that the functions will be grouped up to make up the dimensions of the maturity model. The functions will be grouped into four groups, which are: container transport, administration service, logistical service, and container storage and maintenance. Each of the dimension's groups is then further discussed as follows:

1. **Container transport**
   The first group of dimensions is the container transport group. This dimension consists of functions that relate to the movement of containers to and from a dry port. There are three dry port services in this dimension, which are transshipment, road haulage, and special cargo service. Transshipment relates to intermodal transport, and road haulage relates to road transport. As for special cargo service, it is a crucial part of the movement of special cargo.
2. **Administration service**
   The second group of dimensions is the administration service. This dimension consists of functions that relate to the administrative aspects of container logistics, such as information and documentation. There are three dry port

services in this dimension, which are custom clearance, track and trace, and freight forwarding. The customs clearance service helps with the customs administrative work of customers. Tracking and tracing help provide information on container locations. Freight forwarding offers a total solution for the administrative activities of the cargo owner.

3. **Logistical service**
   The third group of dimensions is the logistical service. This dimension consists of functions that relate more closely to the wider logistical activities, apart from container logistics. There are three dry port services in this dimension, which are warehousing, consolidation-deconsolidation, and value-added activities. These services relate to the logistical activities prior to and after the containerization part.
4. **Container storage and maintenance**
   The last group of dimensions is container storage and maintenance. This dimension consists of functions that relate to container storage and its maintenance. There are three dry port services in this dimension, which are full/laden container storage, empty container storage, and container maintenance.

The last detail of the maturity model is the description of each of the elements in each of the dimensions. As has been clearly defined, the dimension will have specific dry port functions as its elements. In order to describe each of the dry port functions in the maturity model, a few pieces of information will be provided to better explain each of the functions. This way, the assessment process of the dry port relative to the dry port maturity model will be clear. The first piece of information that will be provided to describe the functions concerns the focus customer. This will hence highlight the customer group (cargo owners or shipping lines) that is most benefited by the existence of those specific dry port functions. Hence, it will be known which group of customers must be paid attention to in considering the specific dry port functions.

The second piece of information to describe the functions is the main performance benefit that the dry port functions offer to their customers. This, therefore, relates to the customer logistic performance attribute that the specific dry port functions help improve. This helps to understand the focus of the benefits that a specific dry port function could offer. The third piece of information that will be provided is the main challenge for the specific dry port function implementation. Hence, this will heavily relate to the innovation factor that is most challenging to overcome in order to implement a specific dry port function. All this information will come from the prior function analysis process. Lastly, a generic description of the functions will also be provided in order to measure whether the function is available in the dry port. This description will only be on the strategic and tactical level, as has been determined in the maturity model scope. The design of the maturity model is illustrated in Figure 5.2.

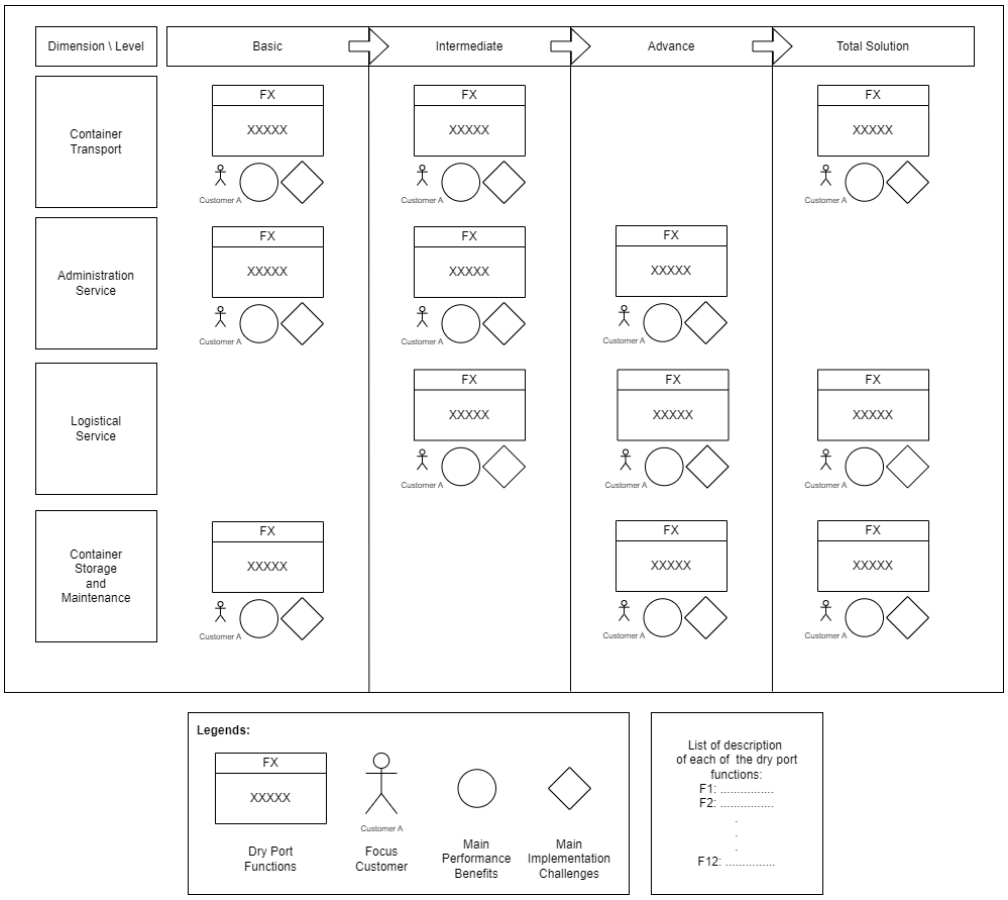

Figure 5.2 Dry Port Maturity Model Outlook

5.3 Maturity Model: Evaluation Phase

As suggested by Mettler (2010) on the process of designing a maturity model, the next part of the design process is evaluation. Although maturity models represent assessment tools, they are also subject to evaluation and improvement activities. The assessment of the maturity model concentrates on understanding and improving the process that is being studied, whereas the evaluation concentrates on understanding and improving the maturity model itself (Salah et al., 2014). According to Salah et al. (2014), there are several types of maturity model evaluation, two of which are domain expert evaluation and practical setting evaluation. Domain expert evaluation, which is typically conducted through surveys or interviews, is an assessment carried out by experts in the kind of process that the maturity model aims to enhance but who were not involved in its development. In terms of practical setting evaluation, it entails analyzing and enhancing both the maturity model and the process under examination by applying the maturity model in a more realistic context. In terms of practical evaluation, the maturity model's usefulness will be evaluated based on user feedback (Mettler, 2010). For this type of evaluation, case studies, field studies, surveys, and longitudinal analyses are some suggested approaches. (Mettler, 2010).

Maturity model testing should focus on aspects such as the model's construct and the model's instruments (Salah et al., 2014). The completeness, clarity, understandability, operationality, efficiency, and user impact of maturity model constructs should all be evaluated. (Salah et al., 2014; March & Smith, 1995; Mettler, 2010). In contrast, validity and reliability tests for the model instruments must be conducted (Salah et al., 2014). In this case, validity aims to accurately depict the real world from the standpoint of the model's intended applications (Conwell et al., 2000). Thus, this has to do with how well the maturity model performs when it comes to enhancing decision-making through recommended practices that boost a process's efficacy and efficiency (Mettler, 2010).

In this project, the two foci of model evaluation will be assessed. The model's construct will be evaluated using the domain expert evaluation approach, and the model instrument, which is closely related to the model's operability, will be evaluated using the practical setting evaluation. The following sub-sections will discuss each of the evaluation processes more closely.

5.3.1 Evaluation – Model Construct

For this project, the model construct will be assessed with a domain expert evaluation by selected experts in the dry port/container logistic field. The evaluation will be conducted using a semi-structured interview with selected experts in the dry port/container logistic field to check on how the model meets the quality of a fair maturity model, as has been discussed previously. The list of questions used for the domain expert evaluation is carefully designed based on the maturity model expert evaluation template by Salah et al. (2014), as follows:

1. **Topic: Understandability** – Is the maturity model understandable for evaluating dry ports maturity?
2. **Topic**: **Ease of use** – Is the maturity model easy to be used as assessment tool and in helping development of a dry port?
3. **Topic**: **Usefulness** – Will the maturity model be useful for use as an assessment tool and in helping development of a dry port?
4. **Topic: Maturity Levels** - Is the maturity model have sufficient level or does it need more or maybe less level? Please also explain the reasoning for the answer. [Sufficiency & Accuracy]
5. **Topic: Processes** – Are there any functions that needed to be added or removed in the maturity model? Please also explain the reasoning for the answer. [Relevance, Comprehensiveness, & Mutual Exclusiveness]
6. **Topic: Processes** – Is there any need for a change on any of the function's description? Please also explain the reasoning for the answer. [Accuracy]
7. **Topic: Processes** – Are there any suggestions for updates related to the position of the functions on the maturity level? Please also explain the reasoning for the answer. [Accuracy]

After the interview has been conducted, the result of the interview will be used as an input for further improving the quality of the maturity model as directed by the feedback received.

5.3.2 Evaluation – Model Operability

The next step is to conduct the model operability evaluation using the practical setting evaluation, which aims to determine the extent to which a maturity model is an effective representation of the real world. This, therefore, relates to the role of the maturity model in improving the decision-making process of planning the service development strategy at a dry port. This improvement may show up in the organization's economic evaluation as a result of applying the designated maturity model; examples of this include cost savings, increased productivity, improved quality, improved reputation, etc. (Mettler, 2010). The practical setting evaluation will be conducted via a case study with a dry port operator. This process will ultimately help to show the maturity model's operability with the use of case scenarios relevant to the development plan and help to answer the last sub-research question of this study. The practical setting evaluation's case study will consist of three parts. Each part is meant to assess one of the three application-specific purposes of a maturity model, as pointed out by Pöppelbuß & Röglinger (2011), which are descriptive, comparative, and prescriptive purposes. The three parts of the case study, along with their context for the application-specific purpose, are discussed as follows:

Part 1: Assessment of the dry port maturity level

This part aims to assess the existing conditions of the dry port and relate them to the maturity model (to conclude its maturity level). This will be done by thoroughly going through one by one of the model dimensions and assessing their condition (existing or non-existing) relative to the maturity model function description. Because it is used for as-is assessments, where the existing capabilities of the item under examination are evaluated in relation to the model's specified criteria, this phase thus connects to the descriptive goal of a maturity model as described by Pöppelbuß & Röglinger (2011).

Part 2: Reflection on past development process

This part will focus on reflecting on the past process of developing the dry port to reach its current state. This part aims to compare the reality of past development processes to the process suggested in the maturity model. This part aims to help the study assess the relevance of the maturity model as well as its performance. Either one of the two scenarios is to be expected. The first scenario is that the past process is in line with the one suggested in the maturity model, and the other scenario is that it is not in line. If scenario one is to be found, this may suggest a high relevance of the development process suggested by the maturity model. If the second scenario is to be found, it can be put to further analysis on whether the suggested process from the maturity model may offer a better or worse approach to development. This step hence relates to the comparative purpose of a maturity model, as it allows for internal or external benchmarking (Pöppelbuß & Röglinger, 2011).

Part 3: Further development

This part will aim to utilize the maturity model to help provide insights on the dry port service's further development process. This, therefore, will be on either the dry port plan to add non-existing functions to its service portfolio or the plan to further improve the quality of existing services. To this end, the focus customer, main benefits, and main challenges that are attributed to each of the dry port functions in the maturity model will be put to use. The focus of customer information will be to provide an appropriate approach that is tailored to the customer profile. The main benefits can either help to provide focus on which attributes the service needs to focus on or even highlight the need to put focus on other attributes. Lastly, the information on the main challenging factors will be helpful to give a heads-up to the dry port operator on their implementation strategy, as they could expect the main problem that could occur. Thus, this action is related to the prescriptive function of a maturity model, which aids organizations in determining appropriate degrees of maturity and offers recommendations for improvements (Pöppelbuß & Röglinger, 2011). The process for utilizing the maturity model to plan further dry port service development is illustrated and shown in Figure 5.3.

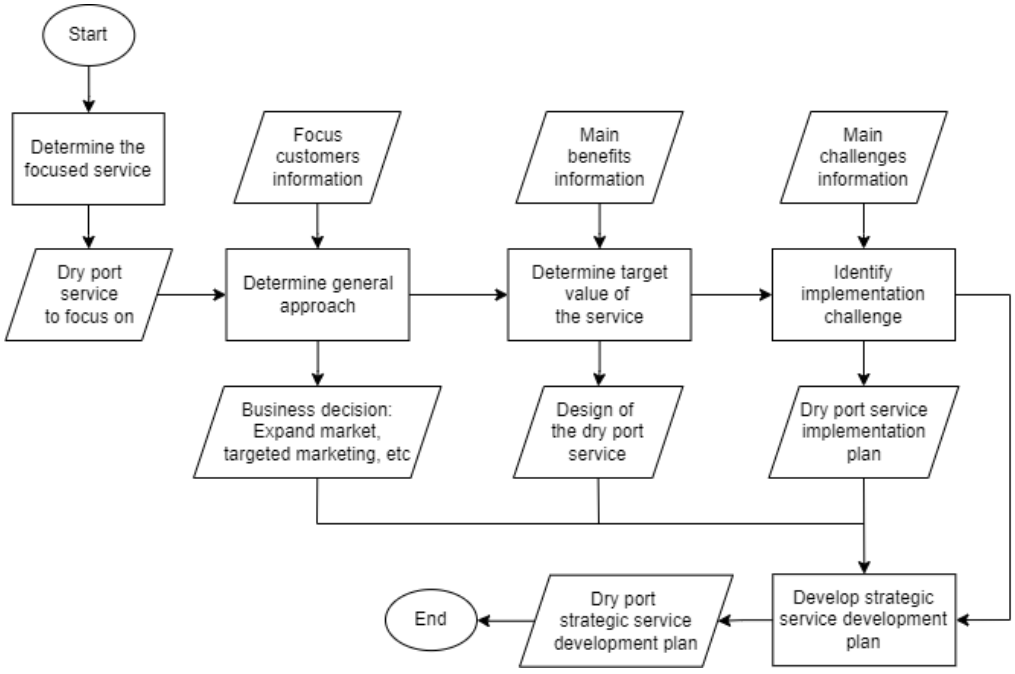

Figure 5.3 Further Development Planning Process

With the three parts of the case study, it could then be possible to analyze further the maturity model's overall performance in helping dry ports develop. This will also provide knowledge for recommendations that could be made regarding the further advancement of the maturity model.

5.4 Chapter Conclusion

In chapter 5, the process of designing the dry port maturity model has been formalized, starting with the analysis phase until the model evaluation steps. The analysis phase provides the corridor for designing the dry port maturity model with the use of clear design goals and scope. Moving on to the next step, the design phase, a clear design space has been formulated. Starting with the transparent approach, with rules on how to utilize the result of the dry port function analysis to construct the maturity model as well as an outlook on what the maturity model will look like, this design space has been clearly laid out in accordance with the goal and scope of the design. Finally, the last phase, which is the evaluation phase, will consist of two evaluation processes on the constructed maturity model to assess the model's construct as well as its operability in achieving the goals of the maturity model.

6 Case Study

6.1 Case Study Outlook

The case study is being conducted with a dry port located in Indonesia with the aim of utilizing the previously formulated framework to design the dry port maturity model. The studied dry port is located in the province of West Java, Indonesia, approximately 50 kilometers east of the nation's capital city of Jakarta. The dry port is designated to support the industrial estate located in the Cikarang area by connecting the industry to the seaports, mainly the one located in Tanjung Priok, Jakarta, for their trade activity. The dry port company argued that they offer an integrated port and logistic facilities that consist of terminals, transportation infrastructure, and logistic properties. The dry port is connected to the seaport via highway roads as well as railways for multimodal transport. As of 2023, the dry port has a throughput of around 400.000 TEUs of containers annually. The dry port has also established partnerships with around 20 shipping lines, both serving national and international trade. Lastly, the dry port company has integrated the various stakeholders to work together with the dry port to streamline the logistic flow. This is specifically highlighted with the establishment of partnerships with the Indonesian customs authority, which resulted in the dry port's integrated customs system.

The case study starts with the function analysis, where a survey is being conducted to gain input for the analysis. Each of the stakeholders related to the studied dry port in Indonesia that are part of the MCA is asked to fill out the survey, which consists of input for criteria weighting (the swing method) and the assessment of the dry port function performance relative to each of the criteria as can be seen in Appendix D. MAMCA-Swing Survey Details. The stakeholders are represented in the survey by individuals that were previously involved in the interview process, as detailed in Section 3.1, meaning that the dry port operator is represented by a general manager in terminal business, the shipping lines are represented by an operation manager, and the cargo owner is represented by a logistic manager of a trading company. Once the survey has been completed, it is used to do the MCA analysis and come up with the designated final analysis outcome, as outlined in Figure 5.1.

The result is then used to provide insights into constructing the dry port maturity model. A systematic approach is taken in order to use these insights accordingly in the construction of the maturity model. Once the dry port maturity model has been created, it will be first evaluated through an interview with selected experts in order to evaluate the model construct. The details of the experts involved will be discussed in the specific sections discussing the model's construct evaluation result. Then, the constructed maturity will go through the next evaluation process with the dry port operator. This evaluation will be conducted together with the general manager employee from the Indonesian dry port, which is the same individual involved in the previous interview and survey for the MCA. A case study with the dry port operator

will be done not only to demonstrate the model's use but also to evaluate the model's operability and determine the effectiveness of the maturity model in helping the dry port operator plan their development strategy. A series of case studies will be utilized with the aim of grasping a complete approach to demonstrate the use of the model as well as evaluate its performance.

6.2 Function Analysis

The function analysis starts with a discussion of the weight of importance for each of the stakeholder criteria. It will then be followed by the overall analysis by combining the weight of importance with each of the function's performance values in each criteria using the additive value function.

6.2.1 Importance of the Criteria

Shipping Lines

From the shipping lines survey result, using the swing weighting method, the importance of the criteria (performance attributes) has been obtained, as shown in Figure 6.1. It can be seen that the most important performance attributes from the perspective of shipping lines are the reduction of cost with a weight of 0.2, and the least important attribute is environmental sustainability with a weight of 0.1. From the previous interview, this finding is not surprising, as shipping lines in Indonesia admit that their concern over environmental sustainability is still relatively low. As for the high importance of cost, it can be understood to stem from the relatively high cost of logistics in Indonesia, which resulted in services that could help reduce this high cost with high regard to the shipping lines.

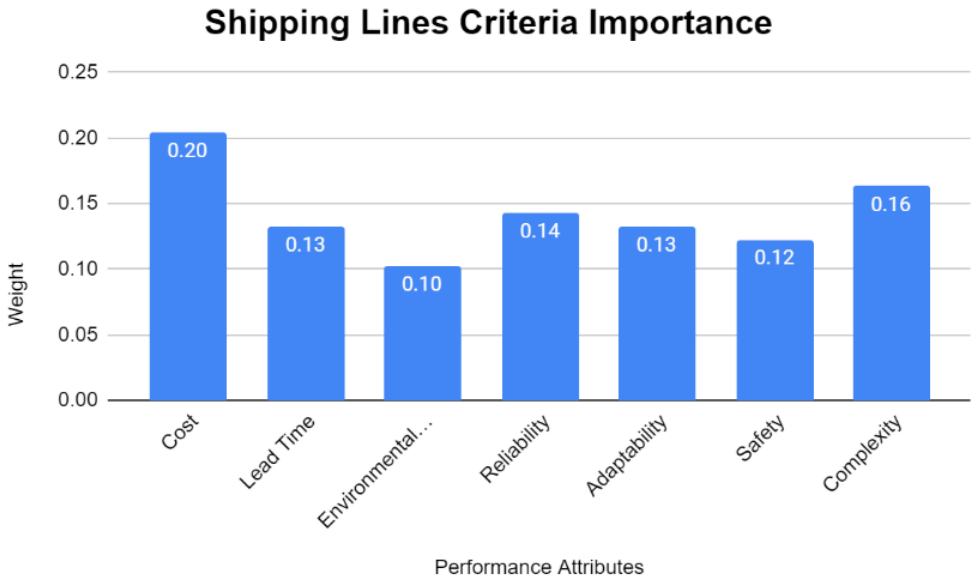

Figure 6.1 Shipping Lines – Criteria Importance

Cargo Owner

For cargo owners, the importance of their criteria, which are again the performance attribute, is shown in Figure 6.2. As can be seen from the figure, the most important performance attribute from the cargo owner's perspective is the reduction of complexity, with a weight of 0.18, and the least important attribute is environmental sustainability, with a weight of 0.12. The least important attribute being environmental sustainability is similar to what is found from the shipping line perspective and may suggest the overall low level of concern regarding sustainability in Indonesia. However, the most important attribute, complexity, may show how complex it is for the current state of the Indonesian logistic environment, and services that may help to reduce this complexity will be highly regarded in that sense.

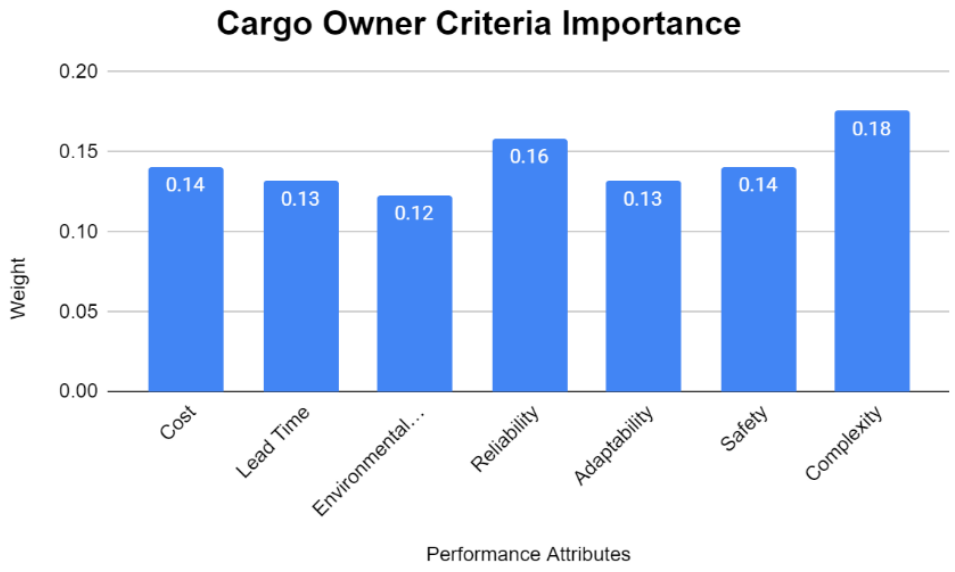

Figure 6.2 Cargo Owner – Criteria Importance

Dry Port Operator

Lastly, for the dry port operator, again using the swing method, the importance of the criteria, which are the innovation factors, can be obtained and shown in Figure 6.3. It can be seen that profitability is the most important factor in implementing a specific service within a dry port, with a weight of 0.22. This is sensible considering Dry Port, as a profit-oriented entity, should have prioritized profitability in their actions. As for the least important criteria, it is human resources, with a weight of 0.11. This may be understood due to the fact that the services offered at Dry Port do not require a complex task to be operational, resulting in a low challenge in order to get the necessary individuals and/or train the existing individuals.

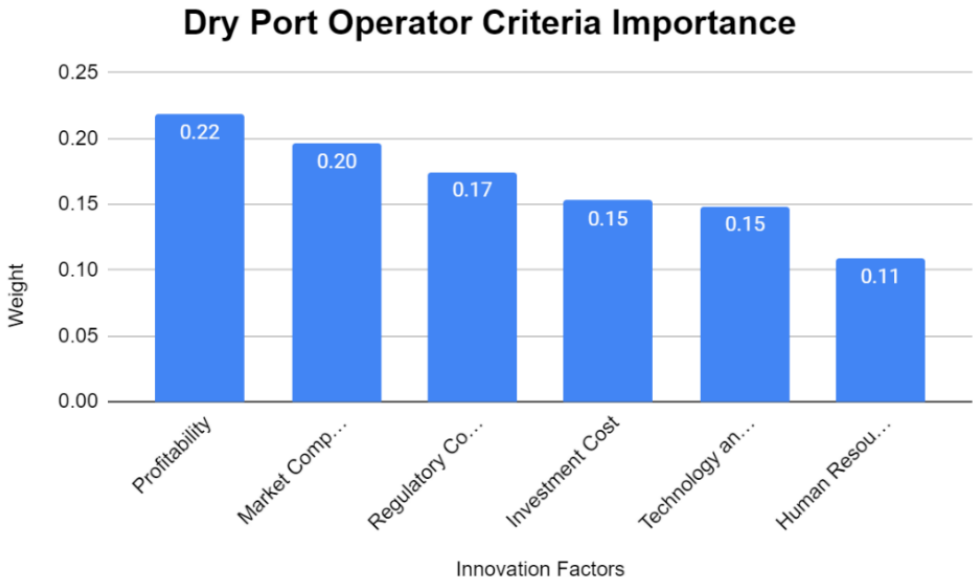

Figure 6.3 Dry Port Operator – Criteria Importance

6.2.2 Overall Analysis

In order to conduct the overall analysis, in addition to the weight of importance, the performance value of each of the dry port services is also needed. By using the additive value function, the ranking can be done for the services relative to their final value. The service performance value obtained from the survey, along with the final value and the ranking for each of the actors's analyses, can be found in Appendix E. MAMCA-Swing Data. Combining the final value from each actor's analysis, a final graph, as planned before, can be obtained. The final analysis using the shipping line final value and the dry port operator final value can be found in Figure 6.4 and the final analysis using cargo owners final value and dry port operator final value can be found in Figure 6.5.

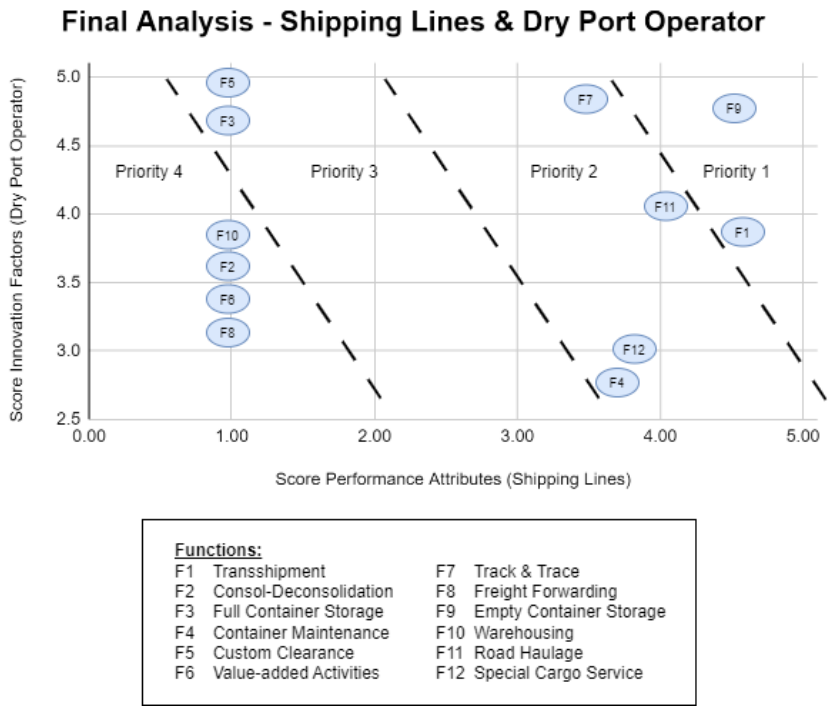

Figure 6.4 Final Analysis 1 – Shipping Lines & Dry Port Operator

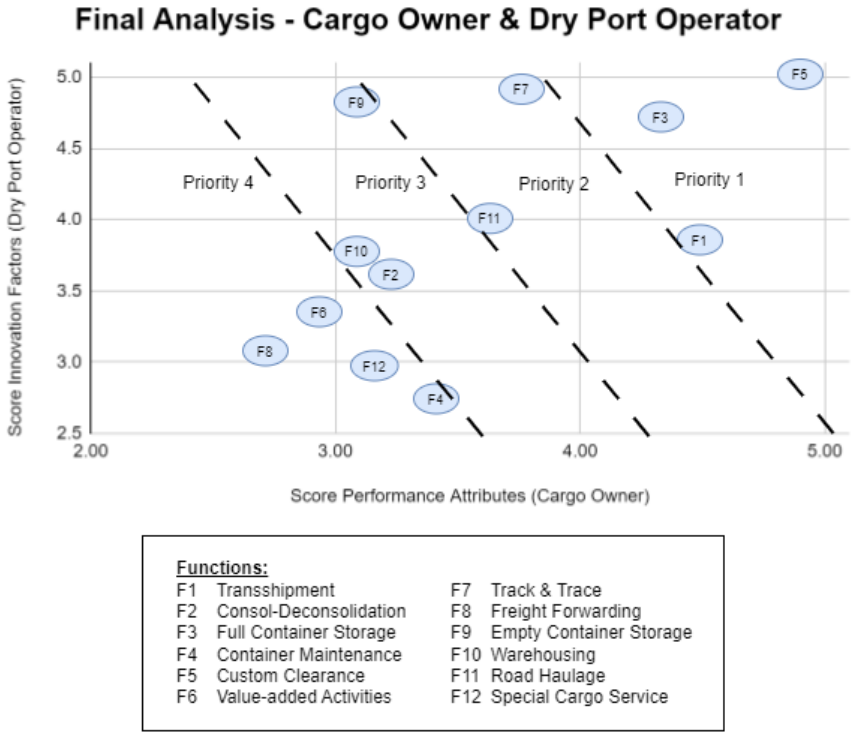

Figure 6.5 Final Analysis 2 – Cargo Owner & Dry Port Operator

To start the discussion on the MCA final analysis result, first the focus is on the possibility of having a correlation between the performance attribute and the implementation factors. In the MCA, it has been made clear on the independence of the criteria within each of the criteria groups (both performance attributes and implementation factors). However, it is argued that there may be a risk of correlation between the two groups of criteria from different actors. This risk may come from the criteria 'profitability' in implementation factors and the criteria 'reduce cost' in performance attributes. To check this, the score of each of the functions is analyzed further. From this analysis, it is only found that the risk of correlation is low and may only be the case for several functions. To illustrate, the container maintenance function scores quite low in profitability but scores quite high in reduction of cost; hence, this may imply a correlation between the two criteria. However, looking at functions such as full container storage, although it scores a maximum in profitability, it also scores a maximum in helping cargo owners reduce their costs. Hence, the correlation between the two criteria cannot be generalized to the overall analysis.

From the two graphs, a diagonal direction of prioritizing the functions within the two graphs is being conducted. Prioritization is being done to obtain four priority groups. This number of priority groups is based on the level that the aspired dry port maturity model had of 4 levels; hence, this grouping is expected to help in the later construction of the maturity model, especially for placing the specific functions on a specific maturity level. This prioritization also shows which customer group is more relevant to which dry port functions. However, in the later construction of the maturity model, the specific position where each of the functions is located in the graph is taken into consideration, hence not limiting the positioning of each of the function's priority groups. The priority group is summarized and shown in Table 6.1.

Table 6.1 Priority Group – Dry Port Functions

Dry Port Functions	Priority Group Analysis - Shipping Line	Priority Group Analysis - Cargo Owner
Transshipment	1	1
Consol-Deconsolidation	4	3
Full Container Storage	3	1
Container Maintenance	2	4
Custom Clearance	3	1
Value-added Activities	4	4
Track & Trace	2	2
Freight Forwarding	4	4

Dry Port Functions	Priority Group Analysis - Shipping Line	Priority Group Analysis - Cargo Owner
Empty Container Storage	1	3
Warehousing	4	3
Road Haulage	2	2
Special Cargo Service	2	4

From the priority grouping of the dry port functions, some aspects can be learned. Focusing on the shipping line analysis result, only transshipment and empty container storage lie in priority group 1. This is understandable as transshipment is a core service of a dry port, and for shipping lines specifically, their ability to bring empty containers to their customers is a key aspect of their business, as previously shown in the dry port function flow diagram. As for the result from the cargo owner analysis, functions that are considered in the first group are transshipment, full container storage, and customs clearance. For transshipment again, it is clear that this is a core part of a dry port operation. As for full container storage, it was learned from the interview that there are many great benefits coming from the availability of the full container storage function within a dry port, such as reducing storage costs, which are relatively more expensive in the seaport. This is also found to be the case in the Netherlands, based on the previous. interview result. Lastly, for customs clearance, as learned from the interview, this function relates to an overall reduction in complexity and cost due to the transparent and integrated system of customs clearance in the dry port, especially when compared to that in the seaport. This is also found to be quite unique for the Indonesian context, as the high impact of customs clearance services offered by a dry port is not suggested from the interview in the Netherlands. This may be due to the difference in the customs clearance system at the seaport compared to the two countries, where a dry port may not contribute as much to the Netherlands as it does in Indonesia on the customs clearance side.

6.3 Dry Port Maturity Model

6.3.1 Constructed Maturity Model

Using the result from the function analysis as has been thoroughly discussed in the previous sections, the dry port maturity model can then be constructed. The result of the constructed maturity model can be found in Figure 6.6 and Table 6.2.

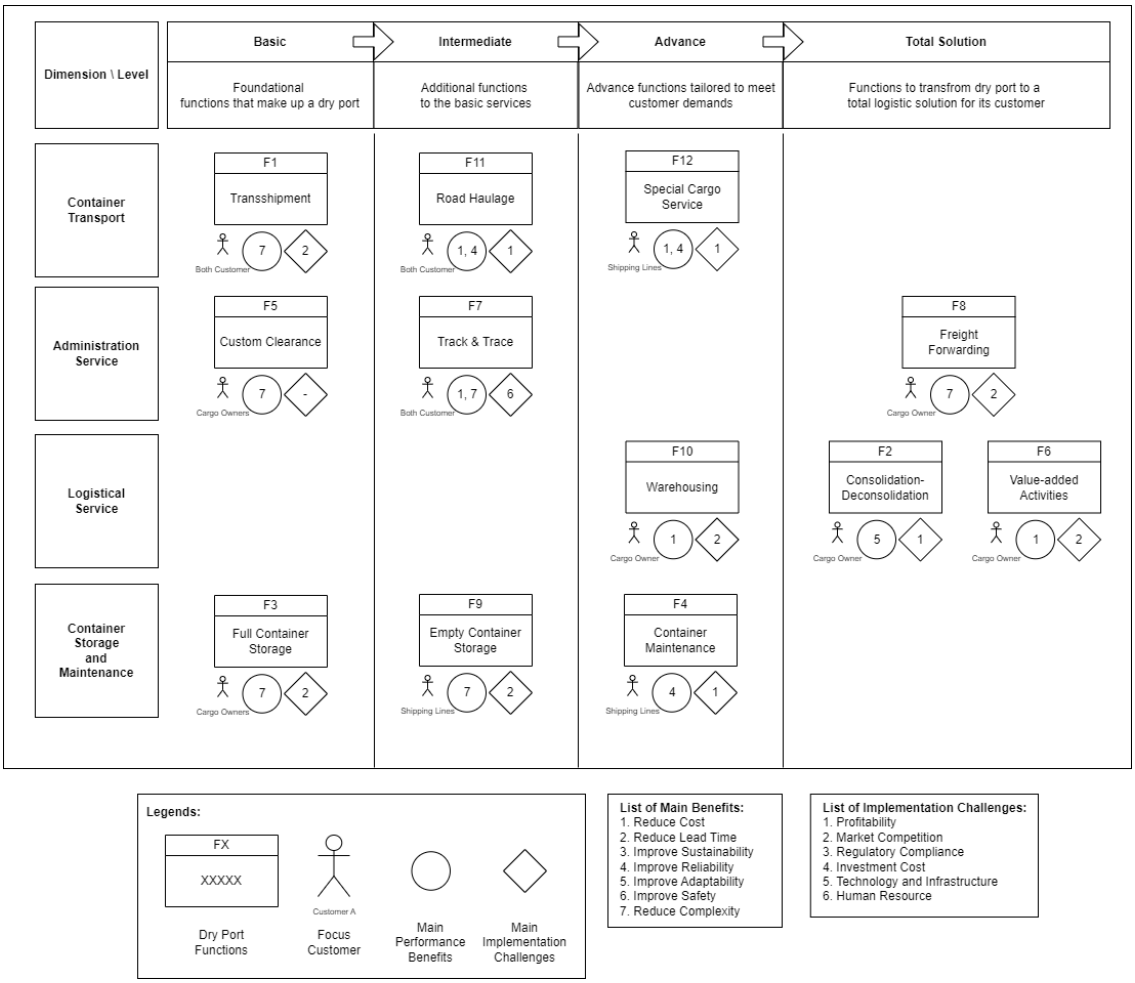

Figure 6.6 Dry Port Maturity Model – Case: Indonesia

Table 6.2 Dry Port Functions Description

No	Functions	Description
F1	Transshipment	High frequency intermodal transport between the dry port and the seaport.
F2	Consol-Deconsolidation	Sufficient capability of consolidation and deconsolidation of various cargos.
F3	Full Container Storage	Sufficient capacity of storage yard for full containers to meet the logistic flow demand.
F4	Container Maintenance	Operational container maintenance facility with ample capacity to meet customer demand.
F5	Custom Clearance	Sufficient capability to assist customer demand on custom clearance activity with service such as inspection, quarantine, etc.
F6	Value-added Activities	Sufficient capability of value-added activities for various cargos such as packaging and labelling.
F7	Track & Trace	Real-time operational and accessible data of container location and condition.

No	Functions	Description
F8	Freight Forwarding	Functioning forwarding services to support export-import activity.
F9	Empty Container Storage	Sufficient capacity of storage yard for empty containers to meet the logistic flow demand.
F10	Warehousing	Functioning warehousing services to support export-import activity.
F11	Road Haulage	Sufficient capacity of trucking to meet the logistic flow.
F12	Special Cargo Service	Sufficient capability of handling of various special type cargos such as DG and Reefer.

The construction of the maturity model is using the result of the function analysis and is accordance with the scope of the design as formalized previously. Transshipment service is positioned at level 1 as it is pretty clear that from the literature, interview, and the analysis (having priority group 1 in both analysis) that transshipment is the core service in a dry port. Custom clearance is also put in level 1 with similar reason, although with slight difference since on priority analysis with shipping line perspective, the priority group is not priority 1. However, it is made the case that the impact it has on cargo owner is very critical motivating its position in level 1. For the last function in level 1, the full container storage is also placed in level 1 with similar reasoning with custom clearance. Additionally, from the dry port operation flow diagram, it can be argued that a full container storage is central in supporting a transshipment function hence the two must be offered at the same stage.

At level 2, the maturity model first has the road haulage as the function from the container movement dimension. It is pretty clear from the analysis that road haulage is prioritized quite highly from both customer groups (both analysis shows priority group 2) since this service is bringing significant benefits to both customers. The second function at level 2 is track and trace from administration service dimensions. Again, the reasoning is pretty similar to that of road haulage. The last function at level 2 is from the container storage dimension which is the empty container storage. This function lies on priority group 1 in the shipping line analysis and is argued to bring quite significant impact as well to the shipping lines. However, as full container storage is understood to be critical in order to operate the transshipment service (the full container will require a stacking yard and storage space prior to and after the transshipment activity), hence the full storage service is placed in the first level and empty storage service is being placed in the second level.

At level 3, first, the special cargo service of the container transport dimension is being placed at this level. This is due to being on priority group 2 for shipping lines and priority group 4 for cargo owners, hence making it appropriate to put it at level 3. Warehousing service will be the first logistical service placed in the maturity model at level 3, having lies on priority group 4 for shipping lines and priority group 3 for cargo owners. The last function at level 3 is container maintenance having lies on priority group 2 for shipping lines and priority group 4 for cargo owners. Additionally, it is learned from the dry port flow process that a container maintenance

service is usually is offered at the empty container storage facility hence making it crucial to first offer the empty storage facility before having the maintenance service.

At the last level, level 4, freight forwarding function of the administration service dimension is placed at this level. This is due to having lies on priority group 4 on both analyses hence it is reasonable to put this function at the last level. Two functions from logistical service dimensions, which are the consolidation-deconsolidation and added-value functions, also lie low on priority analysis hence it is reasonable to put them on level 4 as well. It is also understood from the flow process that both these logistical service functions usually are conducted within the warehouse hence making them reasonable to be placed after the warehousing service.

The main customer information at the maturity model is also based on priority analysis where if a function lies on high priority it is understood as the main concerned customer to the specific dry port functions. Transshipment, Road Haulage, and Track & Trace are of concern to both customer groups and this is sensible as these functions are both heavily utilized by both customers. Empty container storage and container maintenance is primarily concerned by the shipping line. This is to be expected since these functions are more closely related to dry port operation on the shipping line side as can be learned from the dry port operation flow diagram. Another function that has been primarily concerned by shipping line is the special cargo service and this might be due to their aim to provide services for a wide range of customers with various types of cargo. As for the rest, the main concerned customer group is the cargo owners as these functions primarily relate to the cargo owner side of dry port operation as shown in the dry port process flow diagram.

Lastly, the main benefit and challenges information on the maturity is based on the score and weight of importance as a result of the MCA. The search for main benefit is by looking at each of the service's highest scoring attribute and then focusing on the one that has the highest weight of importance. As for the main challenge, the search is by looking at each of the service lowest scoring attributes and then focusing on the one that again has the highest weight of importance. Reduction of cost, reduction of complexity and improvement of reliability are found to be the three main benefits from the dry port functions. As for the main implementation challenges, many of the dry port functions have profitability and market competition as the main challenge.

6.3.2 Maturity Model Evaluation Result – Model Construct

The first evaluation conducted on the constructed maturity model is on the model construct. As laid out in section 5.3.1 Evaluation – Model Construct, an expert evaluation interview is employed in order to assess the maturity model construct with focus on aspects such as completeness, simplicity, understandability, ease of use, efficiency and impact on the users. The expert evaluation interviews are done with two different selected experts that both possess extensive experience in both the academic and professional realm of logistics. Both experts are also selected due to their familiarity with dry port concepts as well as the logistics context of Indonesia in

which this project case study is based on. The details on the interview question and answer could be found in Appendix F. Model Evaluation - Expert Interview. The following sub-sections will discuss the overall result of the model construct evaluation.

Understandability

The first aspect of the model construct being assessed is its understandability (Appendix F. Model Evaluation - Expert Interview Question 1). Both experts argued that the model is relatively simple to understand. One expert pointed out that the legends and information are clearly presented. The other expert argued that it is easy to understand the model since it is intuitively in line with the concept of dry port service that is expected to progress from the most basic to the integrated solution level as prescribed in the model.

Ease of use

On to the second aspect, which is ease of use (Appendix F. Model Evaluation - Expert Interview Question 2). Similar to the first aspect, both experts argued that the model will be easy to use. It has been learned that both experts view the model as easy to use as a tool to assess the condition of the dry port as well as to help plan the dry port's future development.

Usefulness

The third aspect of the model construct is its usefulness (Appendix F. Model Evaluation - Expert Interview Question 3). Both experts view the constructed dry port maturity model as useful, although it has different focus aspects. One expert argues that the model is particularly useful for the dry port operator's internal discussion and can later be used to make a more detailed plan for improvement, such as the creation of KPIs. This model, therefore, is more of a tool to guide the thinking and discussion process. The other expert argues that the model will be useful for dry port operators, especially to help them point out the benefits of using a dry port to prospective customers. This is to persuade the customer to use dry port so that they will eventually experience the benefits themselves.

Maturity Levels

The maturity level in the maturity model is next assessed (Appendix F. Model Evaluation - Expert Interview Question 4). The model currently has four levels in its maturity progression. The two experts view four levels (basic, intermediate, advanced, and total solution) as sufficient. One expert argued that adding more levels will not add much value to the model, while the other expert views the 4 levels as sufficient as they show the gradual level of the service challenge and knowledge needed from the dry port operator.

Processes

The last aspect of concern in assessing the maturity model construct is the process within the maturity model. To assess the process, first the functions are being focused on, specifically its relevancy, comprehensiveness, and mutual exclusiveness (Appendix F. Model Evaluation - Expert Interview Question 5). Both experts argue that the twelve functions used in the maturity model are currently accurate, and there is no pressing need to add or remove any more functions. One expert further commented that if there are any more detailed or more specific functions that are to be added to the model, they could be part of the freight forwarding or the value-added services functions, as both could cover a wide range of specific services. The other expert further focuses on the freight forwarding service being offered at a dry port, as it serves as an additional concern, especially about data sharing as it might relate to sensitive data. As an example, the expert argued that, from an advanced level, the data collected by the dry port operator could already be a lot, and this could lead to problems if a freight forwarding service is being offered (such as conflicts of interest). To put more context into it, freight forwarding will help cargo owners select which shipping line to use, and since a lot of information has already been obtained on various shipping lines, this might cause concern.

The next focus on assessing the process within the maturity model is its accuracy, specifically addressing the description being used to describe each of the dry port functions (Appendix F. Model Evaluation - Expert Interview Question 6). Both experts view the qualitative approach in the description as sufficient, although improvement could also be beneficial. The first expert argues that the qualitative description could be improved by acknowledging parameters that could help define the qualitative performance. The other expert suggests adding more details regarding regulatory aspects to the qualitative description.

The last focus in assessing the process within the maturity model is again regarding its accuracy, but this time more on the positioning of each of the functions at the specific maturity level (Appendix F. Model Evaluation - Expert Interview Question 7). Both experts agree that the positioning of all the functions in the maturity level is sensible. The first expert views the positioning of all the functions at the maturity level as showing the gradual process of dry port service development. The other expert views the function’s positioning as showing the level of customer demand and the challenge of implementing progress in the right direction in the maturity model.

6.3.3 Maturity Model Evaluation Result – Model Operability

The result of the evaluation conducted to assess the maturity model's operability is next discussed. The evaluation is executed using a case study with a dry port entity in Indonesia that previously helped with the input of the dry port function analysis. The case study is being done as laid out in the previous chapter, with a representative of the dry port operator represented by a general manager-level employee of the company. The case study result will be discussed in the following sub-sections to

show the model's operability as well as its performance in helping Dry Port plan their development strategy.

Part 1: Assessment of the dry port maturity level

In order to assess the maturity level of the dry port in the case study, each function at each level of maturity in the model is being assessed relative to the dry port existing condition. The result of each of the levels of maturity from the dry port is shown in Table 6.3, Table 6.4, Table 6.5, and Table 6.6.

Table 6.3 Assessment of Level 1 - Basic

Level 1 - Basic			
No	**Functions**	**Description**	**Assessment Result**
F1	Transshipment	High frequency intermodal transport between the dry port and the seaport	**Available**, there is a daily call of 2 trains every day between the dry port and seaport that has a capacity of 60 TEUs each (a total of 240 TEUs/day). In the high season such as the muslim holiday and christmas, the call can be up to 3 or even 4 calls daily to meet the high demand. The stacker capacity employed also is sufficient to meet the high season demand.
F3	Full Container Storage	Sufficient capacity of storage yard for full containers to meet the logistic flow demand	**Available**, there are stacking yard ready to meet with the estimated potential throughput as analyzed from the industry around the dry port area
F5	Custom Clearance	Sufficient capability to assist customer demand on custom clearance activity	**Available**, the service complies with the custom duties related regulation on dry port in Indonesia

Table 6.4 Assessment of Level 2 - Intermediate

Level 2 - Intermediate			
No	**Functions**	**Description**	**Assessment Result**
F7	Track & Trace	Real-time operational and accessible data of container location and condition	**Available,** the tracking now utilizes e-seal on each container that is equiped with GPS technology to provide real-time data on the container location.
F9	Empty Container Storage	Sufficient capacity of storage yard for empty containers to meet the logistic flow demand	**Available**, there is currently more than 5 acres of area designated for empty container storage with an average occupancy rate of around 40%. This hence serves as more than enough capacity to meet the empy container storage. Moreover, other stuffs such as vehicle could also utilize this area.

Level 2 - Intermediate			
No	**Functions**	**Description**	**Assessment Result**
F11	Road Haulage	Sufficient capacity of trucking to meet the logistic flow	**Available**, there is a fleet of trucks available to support the demand. This fleet could also be added at any time with the cooperation established with several third-party trucking provider.

Table 6.5 Assessment of Level 3 - Advance

Level 3 - Advance			
No	**Functions**	**Description**	**Assessment Result**
F4	Container Maintenance	Operational container maintenance facility with ample capacity to meet customer demand	**Available with a note**, the service for container maintenance is available at the empty container depo at the dry port but is being done by the depo operator which is an entity that works with the dry port operator. The maintenance service is also only limted to minor damages and not for major heavy damages such as structural issue of containers
F10	Warehousing	Functioning warehousing services to support export-import activity	**Available**, for both bonded (with special ceritification) and non-bonded. The non-bonded has racking and non-racking system for the various type of customer cargo. A system such as WMS is also available to support the warehousing activity. Improvement of warehouse capacity is also very much possible in the case that there is customer demand (the area is available, and the warehouse can be constructed in line with customer specification)
F12	Special Cargo Service	Sufficient capability of handling of various special type cargos	**Available**, for various types of special cargos such as Reefer, OOG, DG, Iso-tank, and fumigation service. Plugging, monitoring, and other facility to support these types of cargos are all available at the dry port

Table 6.6 Assessment of Level 4 – Total Solution

Level 4 - Total Solution			
No	**Functions**	**Description**	**Assessment Result**
F2	Consol-Deconsolidation	Sufficient capability of consol and deconsolidation of various cargos	**Available**, this is part of the service to support LCL (less than container load) cargo.

Level 4 - Total Solution			
No	**Functions**	**Description**	**Assessment Result**
F6	Value-added Activities	Sufficient capability of value-added activities for various cargos	**Available**, currently focuses on labelling, wrapping, and paleting that comes from a specific customer demand
F8	Freight Forwarding	Functioning forwarding services to support export-import activity	**Available with a note**, there are services that resambles that of a freight forwarding service with transport and custom clearance assistance service. However, it is not offered as a freight forwarding service due to concern regarding market competition.

From the assessment, it can be concluded that the dry port in focus is already at the total solution, or the last level in the maturity model. This implies that the company is already in the stage of offering functions that could meet the demand for an end-to-end logistic solution for their customers. The subject in the case study also further validates this result of the maturity level of the dry port with the acknowledgement of the company's vision to be an integrated logistic solution provider for their customers. Furthermore, it is learned that internet-based applications are also an integral part of enabling access to a variety of services from the dry port to their customers. Each of the services being offered was also designed to be tailored to meet customers' demands within the current dry port setup.

It is, however, important to note that some of the functions are available with some limitations. The container maintenance service, as an example, is currently only available for minor damage repair and not for heavy damage such as container structural problems. The freight forwarding service is also not being offered currently as a forwarding service, although it offers a service similar to that of a freight forwarding company. This is due to the concern of market aspects, as freight forwarding may have some issues, especially due to some advantages that a dry port has that might cause a stir in the freight forwarding and also shipping line markets. Interestingly, this is to be expected as the main challenge of implementing the freight forwarding service as suggested in the maturity model is market competition, which further validates the model's accuracy. From both of these findings, it hence raises the possibility to revisit the inclusion of both of the functions for a dry port in the future study. It may be that dry port does not need to aspire to have a heavy damage maintenance service or a freight forwarding service in their service portfolio.

Part 2: Reflection on past development process

To further assess the model's operability, the progress of development is being evaluated with a reflection on past development processes. This is done by comparing the suggested development path from the maturity model to the past development process in reality. Starting with the first level of maturity, or the basic level as

prescribed in the model, the model suggests that in this initial stage, the services that are needed to be employed by the dry port are transshipment, customs clearance, and full container storage. From the reflection, it is learned that in its initial stage, the dry port offers these three functions. Transshipment is obviously offered in the initial stage, as from the function analysis it has been revealed to be a core function making up a dry port. Customs clearance is also offered in the initial phase, as the regulations surrounding dry ports in Indonesia clearly mandate the clear establishment of a customs clearance system at a dry port. Lastly, full container storage is also offered in the first stage, as it is crucial to have this service to help the transshipment service fully operate.

As the dry port has already established the basic functions in the first level, or the basic level, the model suggests that the development is progressing to the intermediate level with the addition of three more services, which are road haulage, track & trace, and empty container storage. From the reflection, it is learned that in the past, the track and trace service had a high correlation with the customs clearance service. The customs clearance service requires information on container location and condition at all times between the seaport and the dry port. At first, this was done manually, with human personnel being placed to monitor the container and report it. Track & trace is then employed to provide automatic and real-time information about the container's location, which is later also shared with not only customs authorities but also customers. As for the empty container storage service, it has been decided to be added by the dry port operator once the flow and volume between the seaport and dry port have already been established and are considered to be quite stable. Empty container storage is added to improve the efficiency of the whole operation, as customers can now pick up and return the empty container at a closer and more convenient location. The same reason goes for the addition of road haulage service, which is heavily related to the stable flow going through the dry ports, and now the first and last mile movement is aimed at being supported more by the dry port operator as well.

At the third level, the advanced level, the model suggests that a dry port has a special cargo service, a warehouse service, and a container maintenance service. From the reflection, it is learned that, again, the past process reassembles the suggested process from the maturity model. First, the special cargo service is employed at a later stage. This is due to the fact that the dry port operator requires certain experience and confidence in handling general cargo before starting to handle specific types of cargo that require a certain handling process. The warehouse service is also only being established as the ecosystem of container movement is now at an arguably mature level with the whole movement (first and last mile combined with the movement between dry port and seaport). It is also argued by the dry port operator that the reason they do not have the warehouse service, for example, at the initial stages, is that the benefit that the warehouse service could offer may not be realized with the absence of the services that are needed prior to having a warehouse service. Lastly, for container maintenance, it is only established once the empty container storage is

up and running with a stable flow of empty containers that necessitates container maintenance service.

At the last level, the total solution level, the maturity model suggests that dry port have freight forwarding service, consolidation-deconsolidation service, and value-added activity service. From reflection, again, this is the case, as the consolidation-deconsolidation service and value-added activity service are offered once the warehousing service is already established since the two services take place on the warehouse premises. As for freight forwarding service, as has been learned previously, it has not been fully offered yet by the dry port operator due to concern about the market competition factor. The full process of past development and some of the highlighted points can be found in Figure 6.7.

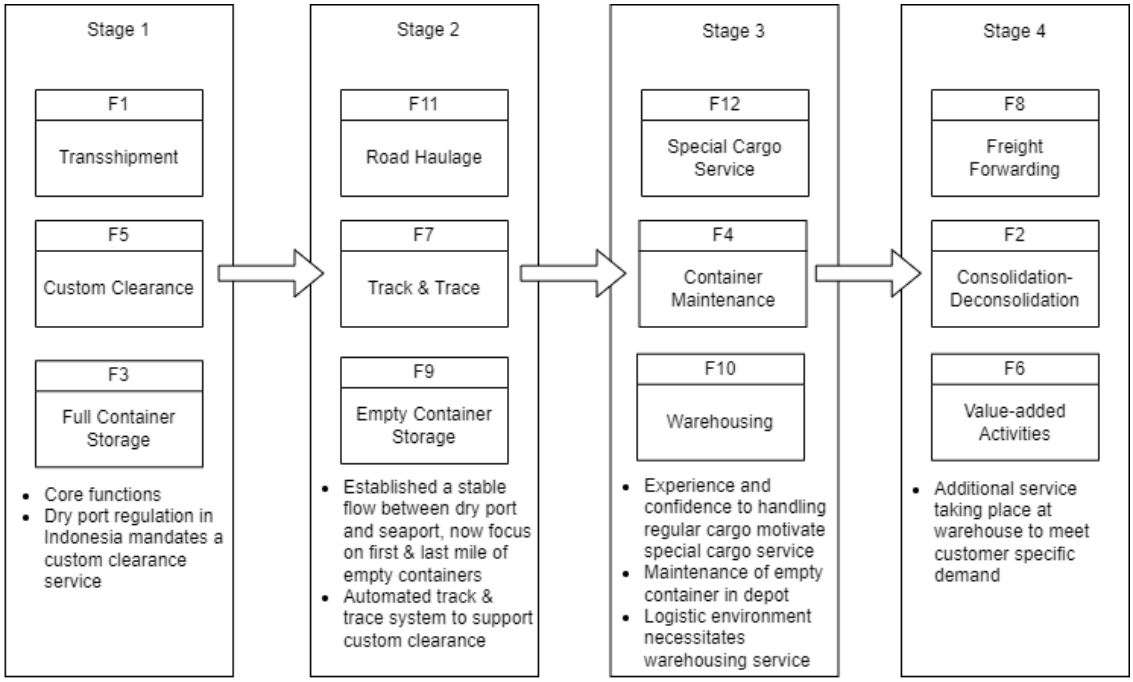

Figure 6.7 Dry Port Past Development Process

From this reflection, it may suggest a high relevancy of the development process suggested by the maturity model due to the similarity in process with the past development process in reality. From the reflection, it is also revealed the underlying reason for the similarity. The first is related to the path dependency theory that is being used in the function analysis to construct the maturity model. It is learned that in their development, the dry port operator requires a certain level of knowledge, experience, and confidence when choosing to improve their service portfolio, such as when opting to have a special cargo service. Second, the customer value theory that aims to maximize the benefits to the customer that is employed in the creation of the maturity model is also reflected in the past development progress. The decision to have a specific service, such as the warehousing service, offered at a later stage due

to the idea that the benefit could only be optimum at the later stage is in line with the customer value theory, which focuses on maximizing customer benefits. Lastly, the establishment of a specific service being offered after a specific service due to the relationship, especially from a technical perspective, is also found to be the case in the past development process, for example, the empty container storage and container maintenance service. This evaluation hence not only shows the operability of the model in order to navigate the dry port development process but also validates the theory-based approach underlying the process.

Part 3: Further development

To conclude the model operability assessment, the last part of the case study is conducted with a focus on further development of the dry port. The process of the case study will focus on specific dry port functions that the dry port operator wishes to add to its service portfolio or improve further. The process then follows the flow as illustrated in Figure 5.3. For this, the case study selects the service of road haulage as the focus service that is aimed at being further improved. The improvement of the road haulage service is aimed at adding a round-use scheme for the empty container movement. This round-use scheme is well-known in the empty container movement process, where instead of having the cargo owner return the empty container to the empty container depot once unstuffing has been done for the ex-import container, the empty container is instead being delivered to the export customer, who will directly use it for stuffing and export activity. This idea for further improvement is then further analyzed using the flow illustrated earlier and discussed as follows.

The analysis starts with the focus customer. It is learned from the maturity model that road haulage service is of concern for both customer groups, cargo owners, and shipping lines. This, therefore, relates to the business decision that might be of concern to the dry port operator. For the cargo owner, the dry port operator acknowledges that by having the round-use improvement, the workload to choose the specific type of containers that meet the cargo owner criteria will be taken from the cargo owner side, as this is a service that can be sub-contracted by them to another entity. This might then relate to a market expansion approach. Additionally, each cargo owner has its own window of stuffing schedule; hence, this will need to be thoroughly considered. As for the shipping line, the dry port operator acknowledges that the shipping lines will want to have a certain level of quality on their empty containers for the customer. This should be taken into consideration in applying the round-use improvement since shipping lines will not be able to control this directly, just as they have been able to with the control in empty container depot.

Next, the analysis focuses on the benefits of the service. From the maturity model, it can be learned that the road haulage service mainly benefits customers in the form of cost reduction and reliability improvement. Acknowledging this, the dry port operator argues that the round-use improvement will be able to further improve the two benefits. For cost reduction, the round-use improvement will result in a reduction in trucking movement for empty containers, which will avoid trucking costs.

Additionally, the round-use improvement is expected to improve shipping line reliability, as it is argued to improve customer satisfaction by meeting their demand. Not only on the two factors, but the improvement is also argued by the dry port operator to improve other benefits to the customer as well. First is the lead time reduction. Again, due to being able to avoid empty container movement, not only can the cost be avoided, but it will also cut the total lead time. Additionally, environmental sustainability will also improve since less movement equals less pollution.

Lastly, the analysis is done on the main implementation challenge. From the maturity model, it has been revealed that the main challenge for road haulage service is profitability. Acknowledging this fact, the dry port operator acknowledges that it is an issue, especially as the service at the empty container storage will also be affected, making them probably lose even more. With this, the approach of the dry port operator is to focus on productivity. The dry port operator claims that the round-use improvement will improve the truck fleet productivity, which will eventually translate to a better profit margin. This cost reduction, coupled with the improvement of customer usage, is expected to be the way to overcome the profitability challenge. The summarized result of the further development analysis can be found in Table 6.7. Again, this phase further shows the operability of the model, especially regarding helping dry port operators plan their further service development. Dry port operators could utilize the insight gained from utilizing the dry port maturity model in order to better strategize their service development plan.

Table 6.7 Further Development Case Study Result

Focus Function	F11 - Road Haulage with Round-use Improvement	
Aspects	**Information**	**Insight**
Focus Customer	Both Customer (Cargo owner & Shipping Lines)	• Shipping lines concern the technical side, specifically ensuring a certain level of quality for the empty containers. This is due to the fact the fact that the shipping line will have less control with the empty container not being processed through the empty container depot. • Cargo owners previously utilized another entity service to ensure a specific quality of empty containers. The round-use improvement will seize this opportunity and can be seen as a market expansion. Each cargo owner also has its own stuffing schedule, which needs to be considered.
Main Customer Benefit	Cost and Reliability	• Further improvement of current main benefit • More cost reduction due to less empty container movement • Improve reliability due to arguably improving customer satisfaction by meeting their demand • Improvement on other benefits such as reducing lead time and improving environmental sustainability that again due to less empty container movement

Focus Function	F11 - Road Haulage with Round-use Improvement	
Aspects	**Information**	**Insight**
Main Implementation Challenge	Profitability	• Acknowledge that profit is an issue especially that operation at empty storage depot will also be impacted (further loss) • However, the improvement will improve the trucking fleet productivity that will eventually translate to profit, coupled it also with the increase in volume

6.4 Chapter Conclusion

In this chapter, the framework to analyze the dry port functions and construct the subsequent maturity model has been put to us in a case study using Indonesian dry port as the test bed. From the function analysis, it has been learned about the importance of criteria for each of the stakeholders included in the analysis. The function analysis also resulted in the final ranking of the functions relative to how they contribute to the maximization of benefit to customers as well as how challenging they are to be implemented by the dry port operator. The results of the function analysis can be found in Figure 6.4 and Figure 6.5, while the priority analysis that will later be used to construct the maturity model can be found in Table 6.1. The maturity model for the Indonesian context has already been constructed and evaluated in this chapter. The dry port maturity model for the Indonesian context can be found in Figure 6.6 and Table 6.2. The evaluation has also been done on the constructed model, which assessed both the model construct and model operability. The evaluation reveals that the quality of the constructed maturity model is arguably fair while also showcasing the process of utilizing the dry port maturity model in the decision-making process for service development planning by the dry port operator.

7 Limitations

In every research project, recognizing and acknowledging the limitations is crucial to understanding the scope and validity of the findings. This chapter delves into the constraints encountered during the execution of this master's thesis project, providing a transparent view of the factors that may have influenced the results and interpretations. While the study was meticulously designed to explore the process of building a maturity model for dry port development, various challenges and inherent limitations were encountered. By critically evaluating these limitations as discussed below, this chapter aims to provide a balanced perspective on the research outcomes, paving the way for future studies to build upon this work.

Some of the limitations of this project are thoroughly discussed as below:

1. The scope of the model

As was laid out in the beginning, the scope of the model is limited to only the strategic and tactical levels of the decision-making process. This, therefore, resulted in the omission of the operational level, which considers the more practical and technical aspects of decision-making. This might be implied by a model not being very specific in guiding dry port development. This is indicated by the result of the model evaluation, where the addition of parameters to the qualitative description is argued to be able to improve the model performance.

2. The criteria to represent the stakeholder perspective

The selection of attributes and their definition to represent the dry port stakeholder perspective and analyze the dry port functions are argued to be still in the very early stages. This implies that the selected set of attributes may not fully capture reality. As a main highlight, one of the performance attributes selected to represent the dry port customer perspective is adaptability, which aims to encapsulate a very wide range of ideas related to the customer's ability to adapt to logistics's ever-changing conditions. The adaptability aspect, therefore, can be made up of a wide range of more specific terms, such as robustness and resiliency. Ultimately, the choice of attributes and definitions in this study might heavily impact the research outcome.

3. The collection of data

The collection of data in this project should also be highlighted in assessing and utilizing the research outcomes. The method by which the data is collected in this study is primarily based on a survey with one individual representing each specific dry port stakeholder. In this study, the authors focused on the representation of all stakeholders rather than having several respondents per stakeholder group. Although measures are being taken, such as pressing the idea of the individual to be as holistic as possible in representing their entity, bias might still occur. One of the indications

that has been identified is the weight of importance in dry port customer criteria. The most important criteria for shipping lines in this study is the reduction of cost. It is important to acknowledge that the subject that represents the shipping lines comes from the operation division, where cost savings are usually prioritized; hence, it is plausible that bias might occur in this case.

4. The Multi-Actor Multi-Criteria Analysis (MAMCA) approach

The approach used in conducting the MAMCA in this study has been acknowledged to not resemble the usual MAMCA approach. The selected actors and stakeholders being considered in the analysis are limited to the customer and operator rather than being opaque as other MAMCA analyses usually do. Additionally, the relative importance of each of the actors is not considered in this study, as the actors are all considered equally important. This approach is in respect to the focus of the study, which argues that the two actors are the most relevant in analyzing dry port services. The approach of only considering the two actors also emphasizes the possibility of having a correlation between the two actors in the analysis. As an indication, the market competitiveness criteria for the dry port operator might be related to the whole criteria of the dry port customer, since it is sensible that a service that is attractive to the customer can be very competitive in the market.

5. Consideration of other factors

The research is primarily centered on exploring and analyzing the benefits to the customer of the development of dry ports. This, therefore, relates more closely to the advantages of the utilization of a dry port. In the interview, indications of factors regarding the downside of using dry port are obtained, such as the possibility of a further increase in lead time. Thus, it is important to acknowledge that factors, specifically the disadvantages of using dry port, were not comprehensively examined within the scope of this study.

6. Maintenance of the model/Model evolution

The dry port maturity model scope of design in this project is currently only limited to the evaluation phase of the design approach, implying that the model maintenance that is closely related to the maturity model evolution process as described by Mettler (2010) is not covered yet. This may relate to the relevancy of the model being limited to the current condition, while it is expected that in the future there ought to be some changes that might affect the model's performance.

7. Context-specific setting

This article applied the MAMCA-Swing and maturity model methods to dry ports in Indonesia. This is in line with other applications of MAMCA, or maturity model method, to transport projects where one case is selected for the study, but the findings can be generalized to similar cases because stakeholders tend to have similar objectives in different contexts. However, this study will require further consideration as there are indications for concern regarding the generalizability of the study. To

illustrate, the maturity model has custom clearance at the first level of maturity, suggesting a very high impact and importance for the specific functions. It is, however, revealed from the interview that this might be unique to the Indonesian context, as the interview in the Netherlands suggests a probably different outcome.

8 Conclusion

Literature has revealed a research gap in the topic of dry port, specifically in considering dry port stakeholders' perspectives in order to construct a maturity model that could help dry port operators strategize their development plans. Therefore, the primary objective of this project is to address this research gap by developing a maturity model for dryports by considering the dry port stakeholders' perspectives. Throughout this study, a main research question has been formulated along with three sub-research questions to help meet the project objective. The conclusion of this study will be addressed by answering the research questions. The main research question is as follows:

How to utilize dry port stakeholders' perspectives to construct a dry port maturity model that will help dry port develop?

The sub-research questions along with discussion on to answer them is as follows:

SRQ1: What are the criteria relevant to represent dry port stakeholders' perspectives?

To answer the first question, it has been decided that the dry port stakeholders that will be considered in this project are the dry port customer and operator. This decision is justified by the argument that both are considered the most relevant actors and satisfy the supply and demand sides of the dry port industry. The dry port customers are further specified to consist of both the cargo owner and shipping lines. The process to obtain the criteria is by means of a literature study and an interview for further validation. The criteria that help represent the dry port customers' perspective have been listed out and thoroughly discussed, with the performance attribute formalized in Section 3.2. As for the criteria that represent dry port operators' perspectives, a list of innovation factors that are closely related to the implementation of dry port services has been formalized as can be found in Section 4.2.

SRQ2: What are the development steps for Dry Port considering the dry port stakeholders' perspective?

To answer the second sub-research question, the dry port stakeholders' criteria previously discussed are being put to use in order to formulate the development steps and eventually construct the dry port maturity model. First, the criteria are being used to conduct a multi-actor multi-criteria analysis (MAMCA) on the services that a dry port could offer. The dry port services consist of twelve dry port functions, as obtained from a literature review and interviews, and can be seen in Section 3.3. In the MAMCA, the services are being analyzed with the objective of ranking them relative to their impact on improving customer performance and their implementability in the innovation context. This approach is reasoned based on both

the customer value theory and the path dependency theory, as thoroughly discussed in Section 4.1.1 - 4.1.2.

Using a survey with a dry port in Indonesia as the case study to obtain the input for the MAMCA, the result of the analysis revealed the dry port services prioritization ranking for dry port operator to consider for their service development process. This result hence is further used to construct the maturity model that can be found in Section 6.3.1. The maturity model has four stages of maturity, with functions specified at each stage. The first maturity level consists of basic functions such as transshipment. As the maturity level progressed, the service is then gradually evolving to a more specific service to meet customers' unique demands. The maturity model also provides description of each of the functions to be considered present in the dry port, along with information regarding focus customer, main benefit, and main implementation challenge of each of the dry port functions.

SRQ3: How can the dry port maturity model be operationalized to ensure its relevance and integration with dry port development plan decision-making processes?

In order to answer the last sub-research question, the constructed maturity model is being evaluated. This evaluation process is aimed at both showcasing the model's operability and assessing the model's performance. The evaluation is first conducted with a focus on the model construct via a domain expert interview. This evaluation revealed that the model quality is arguably acceptable in terms of its understandability, ease of use, usefulness, maturity levels, and process-wise aspects. There is, however, input for further improvement of the model, and is discussed thoroughly in Section 6.3.2.

Moving on to the next part of the evaluation, it is mainly focused on showcasing the model's operability and can be found in Section 6.3.3. This evaluation is being done by doing a case study on several aspects of the maturity model objective. Firstly, this evaluation process resulted in an assessment of the focused dry port's maturity level, which concluded that the dry port in question is already at the total solution level or the last level of maturity, although there are some notes that need to be acknowledged. Secondly, the maturity progression suggested in the model is found to resemble that of the actual development process of the focused dry port. This hence suggests the high relevancy of the maturity model in helping Dry Port to plan their development plan, as well as supporting the chosen approach to construct the maturity model. Lastly, the further development process using the maturity model has been showcased, with a specific idea of improvement being tested out on the model. This last part of the evaluation highlighted the utilization of the information provided in the maturity model to help dry port operators plan their improvement strategies.

Contribution to Research

Taking the conclusions drawn from this project, it can be inferred that this thesis project has also made some contribution to the field of dry port research. Firstly, the

formalization of criteria that is argued to be relevant to represent the perspective of two dry port stakeholders, which are the dry port operator and dry port customers, can be a novel contribution to the field. It is argued that these criteria can help advance the discussion regarding aspects that are valued by the dry port stakeholders in their decision-making process. Not only on formulating the criteria, but this study has also further related the dry port stakeholder criteria to the dry port functions. This, therefore, helps to understand the value creation and challenges of each of the identified dry port functions.

The second and final contribution made to the field of dry port research focuses more on the methodological aspects. This study employs the MAMCA methodology, which is quite unique in its approach, while also using the results of the MAMCA to construct a maturity model. This approach is also based on theories such as customer value and path dependency that are found to be quite relevant to this topic. This demonstration of method as well as theory-based approaches is argued to also expand the knowledge within not only dry port research but also the wider logistic study.

Managerial Implications

This thesis project, with its results in the form of the dry port maturity model, is also argued to contribute to the industry with some managerial implications. The constructed maturity model can be considered a valuable tool to help dry port operators in Indonesia assess their current condition and identify areas for improvement in their service portfolio. The maturity model will also provide a standardized approach to guide the dry port operator in developing their services. It is revealed that the model can be used as a kind of tool to guide the thinking and discussion process in dry port development planning. Additionally, the unique features of the maturity model that provide information regarding the main benefits each of the dry port functions could offer are argued to be useful for dry port operators, especially to help them point out the benefits of using a dry port to prospective customers. This will enable dry port operators to persuade the customer to use dry port.

In summary, this chapter makes the case that the thesis project advances the field's understanding of dryports from an academic perspective as well as its practical application in industry. This study presents methodological demonstrations and a distinctive maturity model that contribute to the field's understanding of dryport development and establish a foundation for logistics networks that are more effective, integrated, and sustainable. Positive effects on the local and global supply chains may result from the knowledge gathered from this study.

9 Recommendations

This last chapter will cover recommendations for expanding the research from this thesis. Both the dry port industry and the area of dry port research gained substantially from this thesis project. Still, improvements can be achieved by expanding on the knowledge and conclusions from this research. In order to expand our knowledge and offer useful recommendations to dryport stakeholders, there are a number of areas that call for more investigation.

First, this study can be extended by considering the other level of decision-making, which is the operational level, which covers more on the technical side. The current study, as stated in the limitations chapter, only covers the strategic and tactical sides of decision-making. Hence, this resulted in the maturity model offering only qualitative guidance for dry port service development. This operational level of decision-making could be related to further considering each dry port's specific conditions in order to obtain a specific quantitative value. The next recommendation is to explore the criteria used to represent the dry port stakeholders' perspective. Currently, in this study, the criteria selection is made with the consideration of keeping simplicity. Hence, some criteria may be defined more accurately. Examples can be made of the adaptability criteria that in this study are being kept on a very general level, although it has been acknowledged that this particular criterion can be further defined with more specific criteria.

The next recommendation is made regarding the collection of data. Future studies can consider including more individual in obtaining the input for the MAMCA. The methodology can be used in future research by including more respondents from each stakeholder group. This would offer more variation in the criteria' definition and the relation of various services to the stakeholders. This ultimately could improve the quality of the MAMCA by avoiding bias by having only individual perspectives considered. More specifically on the dry port function performance data, the use of absolute values and not from surveys could also be considered for selected criteria where direct measurement is possible and can be considered reliable.

Furthermore, the dry port customer and operator may not be the only stakeholders considered in the research. Related to this, in the MAMCA, the analysis could also consider having different weights of importance for each of the dry port stakeholders, as this is the usual approach to have in a MAMCA. This approach also enables a sensitivity analysis to be conducted, which can also help deepen the understanding of each of the criteria. Other than the expansion of the study to consider other criteria as well as other stakeholders, the study can also be expanded by also focusing on the negative side or hindrance of using the dry port since this study is currently argued to be more focused on the benefit side of dry port usage.

It is also advised that future research attempt to address one of the study's limtations, which does not yet address model evoluation or model maintenance. It is likely that as time goes on, the dry port will be able to offer more services, or that certain functions will have different positions in the maturity model. The aspect of environmental sustainability is a good example to illustrate the model evolution concern. The focus on improving environmental sustainability in logistic operation has been in an ascending trend for the past years and this trend is expected to continue. Not only that logistic player will be more intense in their focus on sustainability, but the technology may also follow with innovations to further promote environmental sustainability. The use of electric trucks and electric stackers for loading and unloading activities are some of the examples of what to expect in the future.

By covering the model evolution or maintenance aspects, it could result in the dry port maturity model having the ability to cope with industry advancement as well as the dynamic conditions surrounding the logistic climate. As for the final recommendation, it is to repeat the study at various locations to further improve the understanding of dry port services and their stakeholders, particularly in other nations where the logistic network situation is not as developed. This, therefore, is expected to help reveal other context- or location-specific factors that can further enrich the understanding of dry port development.

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Appendix A. Scientific Paper

A Maturity Model for Dry Port Development:
a Case Study on Indonesian Dry Port

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***Abstract*— Dry ports have emerged as a promising solution to hinterland transport challenges. Existing literature implies an area of study on the topic of dry port that considers dry port stakeholders' perspectives to construct a maturity model that could help dry port develop. This study has tried to contribute to this subject, starting with considering arguably two of the most relevant dry port stakeholders: the customer and the dry port operator. A series of performance logistic attributes has been identified to represent dry port customers' perspectives, while a series of innovation factors is used to represent the dry port operator's perspective. Utilizing the creative approach of MAMCA-Swing to analyze the services offered by a dry port using each of the stakeholders' perspectives as criteria, the study has established a link between this analysis result and the creation of a dry port maturity model. A case study based on Indonesian dry ports has also been conducted to illustrate the use of such a framework, resulting in a dry port maturity model for Indonesia that is arguably relevant and useful in helping Indonesian dry ports develop.**

I. INTRODUCTION

Hinterland transport networks connect ports with inland areas, enabling the distribution of cargo to various regions. As container transport volumes continue to grow, seaport hinterland access becomes a critical factor for the competitive advantage of ports (Roso & Lumsden, 2010). Challenges such as congestion and inefficiencies often plague the hinterland transport system, leading to disruptions in supply chains and increased costs for businesses. Dry ports have emerged as a promising solution to these challenges. The idea of a dry port surpasses the conventional method of using rail shuttles to link seaports with their hinterlands (Roso et al., 2009). Roso and Lumsden (2010) describe a dry port as an inland intermodal terminal directly connected to seaports, with high-capacity transport means, preferably rail, where customers can leave or pick up their units as if directly to or from a seaport.

Research Gap

From the current body of literature, it is found that the study on dry port still lacks the consideration of dry port stakeholders' perspectives. Understanding the customer's requirements as well as the service that a dry port could provide to meet these demands, is argued to be crucial for designing dry ports' development strategies (Khaslavskaya et al., 2021). Based on this, Khaslavskaya et al. (2021) has then in their work tried to analyze many attributes relevant to a wide group of dry port stakeholders and their relation to the service offered at a dry port. Based on their study result, the understanding of the value that a dry port's service could bring to its stakeholders is argued to be able to be used to further improve a dry port's performance.

In this regard, one of the methods that have not been employed in the topic of dry port research is the construction of a maturity model. van Zanten et al. (2024) contend in their study on the Dry Port to Dry Port (DP2DP) concept that in order to achieve the intended benefits that dry ports could provide, a certain degree of maturity on the part of the dry ports involved will be necessary. Ultimately, the study suggests that it would be beneficial to consider over constructing a dry port maturity model (van Zanten et al., 2024).

Conceptual frameworks known as maturity models describe how organizational skills progressively advance along a desired, expected, or logical path (Pöppelbuß & Röglinger, 2011). This holds great significance in the context of dry ports, where services typically evolve gradually, beginning with the most fundamental and necessary offerings and then broadening into more specialized offerings to meet the unique needs of customers (Khaslavskaya et al., 2021).

To conclude, the findings in the literature imply an area of study on the topic of dry port that considers the dry port stakeholder perspective by analyzing the dry port services and their value to the stakeholder, and then continues to use this understanding to construct a maturity model that could help dry port operators strategize their dry port development plan. By leveraging the structured framework of a maturity model, Dry Port can delineate clear and actionable steps towards improving their service and bolstering stakeholder engagement.

Research Question

Applying the research gap, the following research question is formulated:

"How to utilize dry port stakeholders' perspectives to construct a dry port maturity model that will help dry port develop?"

Research Objectives

The objective of this research is to construct a maturity model that helps dry ports develop by considering the dry port stakeholder perspective, which in this project are the dry port customers and operator. This research will also aim to explore the process of considering the stakeholder perspective in constructing the dry port maturity model. The reason for this is that this process is considered unique and, to the extent of the author's knowledge, has not been done before. The creation of a dry port maturity model using dry port customers' and operators' perspectives will be a novel contribution to the scientific body of knowledge.

Research Scope

The project's approach encompasses three decision-making tiers: strategic, tactical, and operational, as delineated by Gunasekaran et al. (2004). While the project mainly centers on the strategic and tactical levels, the operational level will not be directly addressed due to the concern of focus and resource allocation in executing this project.

II. METHODS

This section further explains the methodology used to answer the main research question. The methods are further explained in the following subsections.

1. Maturity Model Design Approach

In order to ensure a replicable step in constructing the maturity model, a design approach is selected. The design approach will also be related to the maturity model construction process as described by Mettler (2010). The design of the maturity model will consist of three main phases which are: analysis phase, design phase, and evaluation phase. The analysis phase will cover the goal and scoping of the model, along with the dry port stakeholders' perspective formalization. The design phase will cover the dry port function analysis and the construction of the dry port maturity model. Lastly, the evaluation phase will cover the evaluation of both model's construct and operability. It is important to acknowledge that the model's maintenance aspect is omitted in the design due to focus and time constraints of the project.

2. Literature Study

A literature study is conducted in the initial planning phase of the project to find the research gap. Throughout the study, a literature review will also play an important role in gaining insight on the dry port concept, more specifically on formulating the functions that make up a dry port and the respective dry port stakeholder criteria. A literature study will hence ultimately help in the formulation of goals and scope, the listing of functions and attributes, and the construction of the model.

3. Interview

Interviews are also conducted to integrate relevant actors and expert views with the literature study process. This is to provide contemporary insights and contribute to a more comprehensive understanding of the research topic. The interviews conducted will first help to formulate the dry port functions and the dry port customer performance attributes. In the final part of the project, the interview will also help in the evaluation process of the constructed maturity model. A semi-structured interview with a clear list of interviewees and a set of questions will be prepared in order to conduct the interview.

4. Multi-Criteria Analysis (MCA)

Multi-criteria analysis (MCA) is a decision-making technique used to evaluate and prioritize alternatives or options when faced with multiple conflicting criteria or objectives. In this project, a formulation of the ranking of the elements, which in this case are the functions of dry ports, will provide the insight needed to construct the maturity model. The MCA in this project will be conducted to analyze the dry port customer performance attribute and determine its importance. In addition to the performance attributes, innovation factors such as economic constraints and human resources will be included in the multi-criteria analysis. This is meant to help gain more insight as well, in order to help with the later construction of the maturity model, where it is crucial to organize the development steps within the maturity model.

Considering the aims of having actors coming from different backgrounds within the dry port realms, a multi-actor multi-criteria analysis (MAMCA) will be utilized to systematically consider the different objectives of each of the actors on the dry port. In this project, the MCA weighting will be done using the swing weighting method. The swing weighting method was selected due to its ability to consider the full range of attributes as well as its simplicity in the data gathering activity. For the data gathering, a questionnaire was utilized to collect the required data from a specific list of targeted respondents. This data was later used to calculate the weight of each performance attribute and innovation aspect. For further analysis, performance data for each of the functions with regard to the performance attributes and innovation factors will also be gathered using a Likert questionnaire via a survey.

5. Case Study

The maturity model design framework will be used in a case study with a dry port entity in Indonesia. This hence suggests the application of the framework with the stakeholders of the subjected dry port. The MCA

will be part of the case study in order to construct the maturity model using input from the stakeholders. The case study will also include the final evaluation step, which will touch on how the constructed model could be used in the dry port assessment and decision-making activity in planning their service development strategy.

III. DRY PORT FUNCTIONS AND STAKEHOLDERS' CRITERIA

In this section, the focus will be on the conceptual understanding of a dry port. This understanding will be acquired through the formalization of the dry port stakeholder perspective using relevant criteria. With the stakeholders' criteria formally listed out, this part will follow with a formalization of the functions that constitute dry port operation. The functions will also be formalized using a function flow diagram to provide an understanding of the relationship between each of the dry port functions and the overall dry port operation process.

Dry Port Stakeholders' Criteria

As discussed previously, it is imperative to try to include the perspective of stakeholders in the exploration of the concept of dry port (Khaslavskaya & Roso, 2020). In order to give a clear scope to this project, it is important to first clarify which stakeholders are being considered in the study. Numerous research works have investigated this matter, specifically with regard to the selection of seaports, identifying influential parties including shipping lines, freight forwarders, and shippers (Rodrigues, 2021). The most significant stakeholder group in dry port decision-making is the user or customer group (Nguyen et al., 2021). These factors make the customer or user of dry ports the chosen stakeholder group that this study will concentrate on. Shippers and carrier companies are the subjects that a terminal operator, like Dry Port, believes most value the services provided at the terminal (Konings, 1996). As a result, in this project, these two entities, cargo owners and shipping lines are referred to as the customer group.

According to Andersson and Roso (2016), a dry port's value to its client may come from reducing costs or boosting service level. Hence, it is decided that to include the dry port customer perspective in this project, a series of performance attributes that are relevant to the dry port user will be utilized. In a way, dry port stakeholder objectives are translated into indicators that are of importance to stakeholders when selecting or using dry port services (similar to Khaslavskaya et al., 2021).

Next to considering the dry port customer perspective, the analysis will also be expanded to take into account other dry ports stakeholders. One way to find relevant stakeholders is to see if there is a demand and supply side of the problem at stake (Macharis et al., 2012). As the dry port customer is considered to answer the demand side, the dry port operator needs to be taken into consideration in order to fulfill the supply side. This decision is then argued so that the study can obtain the knowledge regarding how challenging it is for a dry port operator to implement a certain service. This approach is in line with the limitations of the study by Khaslavskaya et al. (2021), which did not consider other characteristics of the dry port system that could have some effect on the availability of services The process to obtain the criteria to represent both dry port stakeholders' groups is by means of a literature study. An interview is also being done for further validation of the dry port customer criteria. The result of this process is shown as follows.

Dry Port Customer Performance Attributes & Dry Port Functions

A two-step approach is applied in order to formalize the functions and performance attributes of a dry port in relation to its customer:

1. Defining an initial set of logistics performance attributes and functions using existing scientific literature.
2. Validation and further elaboration of the initial set of performance attributes and functions using interviews with dry port operator and its customer.

In order to validate the performance attributes as well as the dry port functions, an interview is being conducted with relevant dry port stakeholders, which consist of dry port operators and dry port customers, which are cargo owners and shipping lines, as shown in Table 1.

Table 1 List of Interviewee

Company	Designation
Dry Port Operator in Indonesia	General Manager in Terminal Business
Dry Port Operator in the Netherlands	Branch Manager
Trading Company (Cargo Owner)	Logistic Manager
Main Line Operator (Shipping Lines)	Operation Manager

The result of the dry port customer performance attributes formalization is shown in Figure 1 and the discussion is as follows.

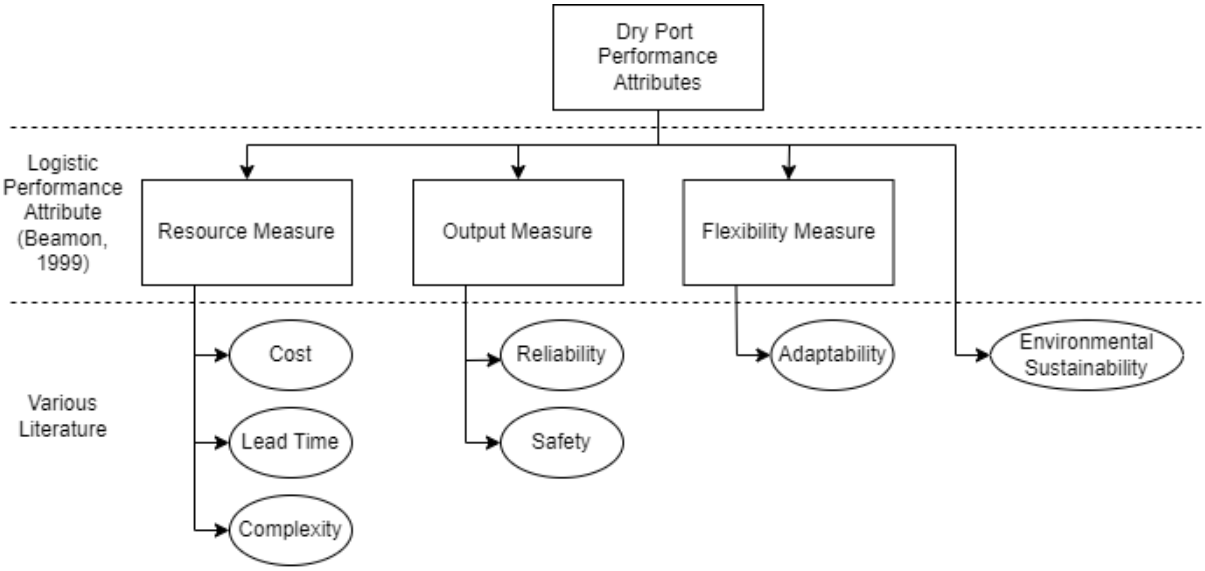

Figure 1 Identified Dry Port Performance Attributes

Dry Port Customers' Performance Attributes

Beamon (1999) identified the use of resources, the desired output, and flexibility (how well the system reacts to uncertainty) as vital components of supply chain success. His study further argues that a supply chain measurement system therefore must place emphasis on three separate types of performance measures: resource measures, output measures, and flexibility measures. In order to formalize the dry port performance attributes, these three types of performance measures are then considered the initial group of the dry port performance attributes. Hence, from the three initial groups of performance attributes, a more specific individual measure will be explored, bearing in mind the dry port context from the existing literature.

Cost

First, the focus is to identify performance attributes within the resource group. Resources are generally measured in terms of the minimum requirements (quantity) or a composite efficiency measure, with efficiency measuring the utilization of the resources in the system that are used to meet the system's objectives (Beamon, 1999). As suggested in his study, Beamon (1999) puts cost as the central measure of resource efficiency. Literature suggests that dry ports help reduce costs for logistic players (Bergqvist, 2015). This cost reduction convinces more logistics players to divert their operations through dry ports. The components of logistic costs that are reduced include transportation (Roso & Lumsden, 2010; Khaslavskaya & Roso, 2020; Rodrigues, 2021; Nguyen & Notteboom, 2016; Nguyen et al., 2021) and storage (Roso & Lumsden, 2010; Nguyen et al., 2021).

From the interview, the cost factor was found to be more significant on the cargo owner side and not on shipping lines. In the Netherlands, it is argued that the cost savings come from both intermodal transport and storage for the cargo owner. In Indonesia, storage is more significant for reasons such as cheaper storage costs compared to those on seaports, and customers could avoid additional penalties that are only relevant in seaports due to differences in regulations. In line with this, the first performance attribute for dry port in the resource group will be the logistic cost.

Lead Time

The second dry port performance attribute in the resource efficiency theme is the lead time. In line with the topic of the lead time in serving the customer, SCOR measurement uses the term responsiveness to refer to the speed at which tasks are performed or at which a supply chain provides products to the customer (APICS, 2017). The argument found in the literature to support this selection is that dry ports help decrease the transportation time for logistics players (Roso & Lumsden, 2010; Khaslavskaya & Roso, 2020; Bergqvist, 2015; Nguyen & Notteboom, 2016; van Zanten et al., 2024; Nguyen et al., 2021).

To this end, there are some mixed responses in the interview. From the Netherlands, it is believed that the direct lead time in the customer supply chain actually increased due to the use of dry ports. However, if we look at the bigger picture, due to the efficiency of the decoupling effect from using a dry port, the overall supply chain time might be decreasing. As for the Indonesian context, the lead time for cargo owners does significantly decrease due to the faster customs clearance. This is possible with a better custom clearance system in the dry port than in the seaport. As for shipping lines, it is believed that a dry port indirectly helps to ensure a low level of yard occupancy ratio (YOR), hence making the overall stevedoring or loading-unloading activity in the seaport much faster.

Complexity

As for the last performance attribute in the resource efficiency context, it is selected to be complexity in the supply chain. A supply chain's growing complexity reduces visibility and control, which raises risks and costs. (Musa, 2012). Dry port, on the other hand, is found to simplify documentation and customs-related activities for its users (Roso & Lumsden, 2010; Nguyen et al., 2021). This bureaucratic ease is believed to reduce complexity in logistic activities by involving fewer actors in day-to-day operations (Khaslavskaya et al., 2021).

In the interview, it is revealed that in the Netherlands, the complexity is not that much affected by the utilization of a dry port. However, in Indonesia, it is believed that complexity does reduce as customers do not have to coordinate with the many seaports that have their own systems and only need to coordinate with one entity, which is the dry port that is close to them. Additionally, the dry port has the potential to offer a wide range of services, helping customers avoid the trouble of working with too many parties that offer the specific services needed.

Reliability

Moving on, the focus is to identify performance attributes under the output group. The output measures can be regarded as the output of a logistics system, with customer satisfaction as the overall objective (van Zanten et al., 2024). In this study, the output measures are deemed closely related to the reliability that is offered by a dry port. Referring to APICS (2017), reliability focuses on the predictability of the outcome of a process, with typical metrics for the reliability attribute including: on-time, the right quantity, and the right quality.

Relating to this, literature suggests that, firstly, dry ports improve accessibility for logistics players. Accessibility improvement results from the provision of access and sufficient transport capacity to and from the dry port premises (Khaslavskaya et al., 2021; Nguyen et al., 2021). The accessibility aspect contributes to overall service level improvements in logistic activities facilitated by dry ports (Khaslavskaya & Roso, 2020). This ultimately relates to the role of dry ports in improving supply chain reliability as previously defined (Khaslavskaya et al., 2021; Kuncoro et al., 2021; Bergqvist, 2015; van Zanten et al., 2024; Nguyen et al., 2021).

From the interview, it was learned that the wide range of services that a dry port could offer helps to improve reliability. With the example of empty container storage and container maintenance services that enable shipping lines to serve their customers for their export activities, Moreover, services such as warehouses also help with the improvement of reliability. We then conclude with the selection of reliability as the first performance attribute in the output group.

Safety and Security

Literature also suggests that dry ports help reduce the risk of road-related accidents by employing consolidated modes of transportation (Roso, 2007). Enhanced cargo safety from external risks is also cited as a reason for the use of dry ports by its customers (Roso & Lumsden, 2010; Nguyen et al., 2021). From the interview, since it is considered already safe overall in the Netherlands, the dry port only contributes slightly to this aspect. However, in Indonesia, the use of e-seal as a tool to keep track of the container location and condition, along with a security measure in the customs area, does improve safety and security significantly. The use of intermodal transport by rail also helps since it avoids the risk coming from road transport. This foundation hence motivates the selection of another performance attribute, which is cargo and equipment safety, in the output group.

Adaptability

Next up, the focus is to identify performance attributes under the flexibility group. Flexibility refers to the ability to respond to a changing environment. In an uncertain environment, supply chains are able to respond to change (Beamon, 1999). In line with the term flexibility, SCOR measurement uses the term agility to refer to the ability to respond to external influences and the ability to respond to marketplace changes to gain or maintain competitive advantage (APICS, 2017). From the literature, it is found that dry ports offer flexibility in choosing transportation modes (Khaslavskaya et al., 2021; Bergqvist, 2015), improve transport punctuality (Kuncoro et al., 2021), and adaptability in effectively managing supply chain uncertainty (van Zanten et al., 2024). The later term of adaptability is considered in this project to encapsulate the idea of the dry port's ability to cope adequately with supply chain uncertainties. This term is argued to cover a wider topic than that of flexibility, as indicated by Beamon (1999). However, for the purpose of this study, the performance attribute selected in the flexibility group was decided to be adaptability in order to generalize the ability of customers to adapt to dynamic conditions in the supply chain.

In the interview, this has been one of the major benefits argued to be experienced in the Netherlands context. The customer can adapt their logistic plan more flexibly due to the decoupling ability that comes from utilizing a dry port. Similarly, in the Indonesian context, the cargo owner can also buffer their container at the location of the dry port in order to meet their efficiency plan. The option of intermodal transport also helps in the transport aspect since cargo owners

have more options in their planning to cope with disruptive conditions such as road congestion.

Environmental Sustainability

Lastly, when exploring performance attributes beyond the three- groups identified by Beamon, the environmental aspect is being considered. Over the past decade, environmental issues have drawn more attention, and with them, logistics systems may play a role a role in lessening environmental effects (Roso & Lumsden, 2010). According to Roso's (2007), the advantages of remote dry ports stem from the switch from road to rail modalities, which lessens traffic at the seaport gates and neighboring areas as well as the negative effects of the environment on the route. Literature also suggests that health and environmental improvements also persuade more logistics parties to utilize dry ports (Andersson & Roso, 2016; Rodrigues, 2021; Roso et al., 2009; van Zanten et al., 2024). Reduced emissions from consolidated transport via dry ports contribute to environmental sustainability and enhance the eco-friendly image of logistic entities (Khaslavskaya et al., 2021; Andersson & Roso, 2016; Nguyen et al., 2021).

In the interviews, all discussions lead to the common notion that the use of dry port and its intermodal transport enables a more sustainable supply chain for the logistic player. This comes from the use of intermodal transport as opposed to unimodal trucking. In Indonesia however, this care on sustainability has not been too significant. On the contrary, the Netherland has seen this as one of the critical aspects and even going so far to have the argument that if a logistic company wants to reduce their carbon emissions by 40%, then using a dry port is surely the way. This hence motivates the final dry port performance attributes of environmental sustainability.

Dry Port Functions

In essence, a dry port is a freight terminal that has certain unique characteristics that set it apart from other ports. According to Slack (1999), modern freight terminals perform four essential functions. First, the actual movement of the goods between two modes (usually in a unitized form). The second function involves the assembly of the cargo before transferring it. Third, the storage of freight in anticipation of delivery and pickup. The fourth function that results from the latter is the logistical distribution and control of products. Thus, these four functions are initially considered to be part of a dry port. The literature is further consulted in order to define the specific dry port functions.

In line with the first functions of a modern freight terminal by Slack (1999) of the moving of goods between two modes, it is found that transshipment service is one of the critical functions of a dry port (Khaslavskaya & Roso, 2020; Andersson & Roso, 2016; Roso et al., 2009; Rodrigue & Notteboom, 2011; Rodrigue et al., 2010; Roso, 2008; Khaslavskaya et al., 2021). A dry port should offer a high-capacity transport connection with the seaport, which implies the presence of infrastructure that facilitates the efficient, frequent, and reliable transport of consolidated cargo on a regular schedule, be it railway or inland waterway (Khaslavskaya et al., 2021). The transshipment services relate to several performance attributes, as has been discussed previously especially to reduce cost, improve sustainability, and help on firm adaptability in the supply chain. Furthermore, dry port could also offer a road haulage service with trucking, for example, as an additional service to accommodate roadside transportation (Khaslavskaya et al., 2021). From the interview, it is understood that this function relates closely to the adaptability and reliability attributes, as this service meets the needs of customers and offers alternatives in their day-to-day operation.

As for the second function of cargo assembly activities before the transportation phase, several specific dry port functions have been identified from the literature. The first function is the function of breaking down and/or combining smaller items to be transported, usually called the consolidation -deconsolidation function (Khaslavskaya & Roso, 2020; Rodrigues, 2021; Roso et al., 2009; Rodrigue et al., 2010; Roso, 2008; Khaslavskaya et al., 2021). Value-added services could also be considered as services to offer at a dry port, such as packaging, sorting, labeling, assembly operations, sequencing, and light manufacturing (Andersson & Roso, 2016; Rodrigue et al., 2010; Khaslavskaya et al., 2021). These functions have been found in interviews to relate to improving the reliability aspect since it helps to meet customer needs.

With the third function of storing freight, several functions have been identified from the literature. The first one is the storage of full or loaded containers, as this is an essential part of the intermodal transport taking place in a dry port (Khaslavskaya & Roso, 2020; Andersson & Roso, 2016; Kuncoro et al., 2021; Rodrigues, 2021; Roso et al., 2009; Khaslavskaya et al., 2021). A warehousing service could also be offered at a dry port to store raw or complete items and stuff (Rodrigue & Notteboom, 2011; Khaslavskaya et al., 2021). The warehouse service could also further develop to support the bonded logistic area (Li et al., 2015). Both the full container storage and warehouse have been found to help decrease costs, according to the interview. This is because the storage fee is arguably significantly cheaper than that in the seaport area.

Lastly, a dry port could also offer a storage facility for empty containers, usually called an empty container depot, to store empty containers that support the overall export and import activity of the location (Rodrigues, 2021; Roso et al., 2009; Roso, 2007; Rodrigue & Notteboom, 2011; Roso, 2008; Khaslavskaya et al., 2021). From the interview, this service is heavily related to improving reliability as it brings the empty container closer to the customer. The fourth function of a freight terminal by Slack (1999) is mostly considered to be the buffer functions that could be offered at a dry port to strategically postpone shipments in order to meet a certain requirement of the shipment (Rodrigue et al., 2010). This can be part of the storage of full containers, and from the interview, it was revealed that this function has a significant impact on the adaptability of the customer supply chain.

Moving further from the four functions group as delineated by Slack (1999), several other logistical services are identified in the literature as relevant in a dry port setting. First, a customs clearance service could be offered at a dry port to assist customers in completing their customs duty for export import activity with services such as customs inspection, quarantine, and other customs-related activity (Khaslavskaya & Roso, 2020; Andersson & Roso, 2016; Kuncoro et al., 2021; Rodrigues, 2021; Roso et al., 2009; Rodrigue & Notteboom, 2011; Roso, 2008; Khaslavskaya et al., 2021). It was learned from the interview that this service may reduce customer lead time due to faster clearance and reduce complexity since the process is centralized in one entity, which is the dry port. Additionally, dry port could also offer container maintenance service as part of their functions, with maintenance activities consisting of inspection, washing, and repair (Khaslavskaya & Roso, 2020; Andersson & Roso, 2016; Kuncoro et al., 2021; Rodrigues, 2021; Roso et al., 2009; Roso, 2008; Khaslavskaya et al., 2021). Again, similar to empty container storage, this service also improves reliability for the same reason of making sure empty containers are available for customer export activities.

Along the transportation of the container using a dry port, customers can also be provided with accurate information about the container's whereabouts with the service of track and trace as another function of a dry port (Khaslavskaya & Roso, 2020; Andersson & Roso, 2016; Rodrigues, 2021; Roso, 2007; Roso, 2008; Khaslavskaya et al., 2021). This significantly improves safety and security due to the ability to track a container's whereabouts in real time, as revealed in the interview. A dry port could also expand their service to not only handle general cargo but to also include special cargo service in their functionality (Khaslavskaya et al., 2021; Roso, 2008). The special cargo services can range from reefer handling, out-of-gauge cargo handling, fumigation, and other special cargo services. Lastly, dry port could also act as a freight forwarder to offer customers a single gateway for their shipment (Khaslavskaya & Roso, 2020; Khaslavskaya et al., 2021). From the interview, it was learned that this special cargo service relates heavily to reliability attributes since it entertains a wide array of customer requirements.

All identified services hence show the dry port's role as a seaport's interface with its hinterland, which implies that customers have the opportunity to handle their cargo at the dry port just as they would at the seaport (Khaslavskaya et al., 2021). The full list of the dry port functions can be found in Table 2.

Table 2 List of Dry Port Functions/Services

No	Functions	Definition
F1	Transshipment	Transfer of cargo, mostly unitized, between two modes. In dry port, this relates to the availability of railway service or inland waterway.
F2	Consol-Deconsolidation	Breaking down and/or combining smaller item to be transported
F3	Full Container Storage	Storage for full/laden container. This includes the option to strategically postpone shipment for adapting to shipment requirement.
F4	Container Maintenance	Damage inspection, cleaning, and repair of container
F5	Custom Clearance	Custom inspection, quarantine, and other custom related activity
F6	Value-added Activities	Value-added services including things such as packaging, sorting, labelling, assembly operations, sequencing, and light manufacturing
F7	Track & Trace	Real-time information of container location. This also includes EDI (Electronic-data Interchange) to relevant partners such as shipping lines and seaport
F8	Freight Forwarding	Freight forwarding service that help to offer a single gateway for a shipment
F9	Empty Container Storage	Storage for empty container
F10	Warehousing	Storage for raw and/or processed goods and items. This includes the bonded warehouse service.
F11	Road Haulage	Road transport for full and/or empty container
F12	Special Cargo Service	Special cargo services such as reefer handling, OOG handling, DG, fumigation, etc.

To further analyze the dry port functions, a process flow diagram is created using the dry port functions.

This process flow diagram is aimed at helping provide further understanding of the dry port functions, especially the relationship between each of the functions. The dry port flow process will be created for two processes, which are outbound and inbound of the dry port. The dry port flow process diagram can be found in Appendix 1.

Dry Port Innovation Factors

As previously discussed, in order to obtain an understanding of how challenging each of the dry port services is to be implemented by the dry port operator, a set of innovation factors is first being formulated for later analysis. Literature is consulted in order to find the innovation factors. First, the theory of innovations is used as inspiration in order to look for implementation factors. In his theory of the opportunity vacuum for innovations, Planing (2017) argues that there are three aspects that need to be focused on in order to have a successful innovation. The first aspect concerns how possible it is to implement the innovations. According to Planing (2017), every invention is built upon earlier ideas that were built upon earlier ones. This primarily has to do with innovation's technological component. The second aspect concerns how viable it is. to implement the innovation. The viability aspects stem from an economic point of view. According to Planing (2017), it is more precise when describing how the innovation is anticipated to result in cost savings for realization within a predetermined time frame.

Lastly, the third aspect concerns how acceptable innovation is to the current edges of socially accepted behavior, which currently only innovators embrace but will soon reach the early majority of technology adopters. In conclusion, an innovation can only be considered successful when it is both financially and technically feasible to implement the idea and when the majority of society is ready to accept it (Annema, 2022). From here, literature is further consulted in order to find more specific factors that could help define the three aspects of a successful innovation as laid out previously.

The innovation factors obtained from literature are illustrated in Figure 2.

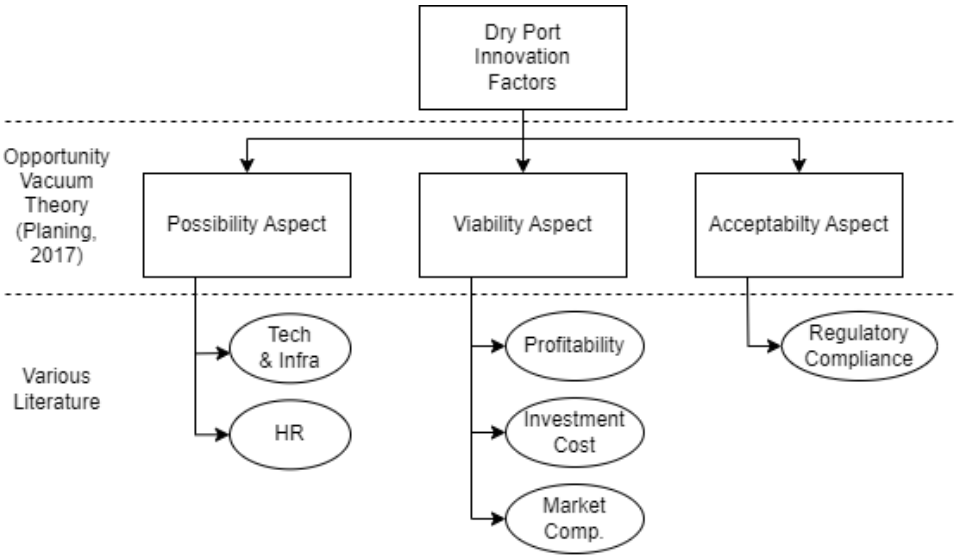

Figure 2 Identified Dry Port Innovation Factors from Literature

First, the aspect of possibility is being further considered. In line with the technological perspective as proposed by Planing (2017), the first innovation factor selected is technology and infrastructure. According to Richey et al. (2007), supply chain companies need to be technologically ready and technologically complementary in order to provide superior logistics services. Moreover, the technology used in delivering the service will likely depend on human control to operate it. Human capital is essential to economic growth because it creates new kinds of physical capital (Schultz, 1993). In the service sector, such as dry port, human capital planning is especially important for businesses to stay competitive in a market that is driven by services (Zula & Chermack, 2007). A freight terminal also remains very dependent on its human capital. In addition to helping transshipment maritime container terminals achieve high levels of productivity and offer shipping companies high-quality services, optimal human resource allocation can significantly reduce personnel shortages and operational delays (Di Francesco et al., 2015). This hence motivates the second innovation factor of human resources.

Moving on to the second aspect of viability, the focus is on the financial perspective. Straightforwardly, the first selection of innovation factor in this aspect is profitability. Planning for the construction of a new terminal or the expansion of an existing facility calls for careful consideration of the topic of overall profitability (Ferreira & Sigut, 1993). Moreover, in the context of dry port, it has been learned that profit is indeed one of the most important considerations for a dry port operator (Khaslavskaya et al., 2021). The second innovation factor in the viability aspect is investment cost. This aspect is crucial in the dry port setting. Policies for infrastructure investment are a significant component of terminal performance measurement (Ferreira & Sigut, 1993). Freight terminal investments are crucial because they can result in large cost reductions over the existing goods movement system (Clark & Ashton, 1977).

The third and last innovation factor in the viability aspect is market competitiveness. In a dry port setting, consideration of market competitiveness is crucial for terminal operators to address the strategic importance, location, and network configuration of freight terminals (Wiegmans et al., 1999). In particular, while creating a new service, it is critical to take market competitiveness into account when developing plans for frequency, mode, route, and staffing in order to provide dependable, superior services at reasonable costs (Wieberneit, 2007). The market competitiveness factor can therefore be argued to be very closely related to the dry port customer perspective with the performance attributes. Hence, for the purposes of this study, since the service advantage will be mostly covered by the performance attributes, this factor from the dry port operator perspective will only consider other aspects of market competition, such as market saturation and the company's experience and reputation.

The last aspect of social acceptability will be covered by a single innovation factor, which is regulatory compliance. In a way, the government regulation already summarizes the social acceptability of a service being offered, as it will already consider the community norms and practices. According to Lopez et al. (2020), legal compliance is crucial for verifying that a business process is operating correctly. Legal compliance is essential in the logistics sector because non-compliance can put workers, the environment, and one's finances and reputation at risk (Perez & Korth, 2020). Logistics compliance checking is crucial because it guarantees that operational procedures meet established legal criteria and minimize significant risk (Ramezani et al., 2013).

IV. MAMCA-SWING FOR DRY PORT FUNCTIONS

In order to analyze the dry port functions using the dry port operator and customer perspectives, the multi-actor multi-criteria analysis method, or MAMCA, will be utilized. In this methodology, which can be seen as an extension of the traditional multi-criteria decision analysis, or MCDA, the stakeholders are explicitly considered (Macharis et al., 2012).

Problem

The MAMCA starts by defining the problem and alternatives. The MAMCA goal is to analyze the dry port functions in order to understand which service brings the most benefit to the dry port customers as well as the least challenging to implement by the dry port operator. The reasoning behind this approach is based on the customer value theory and the path dependency theory as discussed below.

Customer Value Theory

As laid out in the previous chapter, a series of performance attributes relevant to the dry port customer have been formalized. These performance attributes will hence be utilized in order to consider customer interest in analyzing dry port functions, as it is argued to be able to measure the benefits that customers can obtain by utilizing a service from a dry port. One theory contends that customer value is essential to a company's ability to compete and to its long-term performance, which makes it crucial to consider when developing and researching service offerings (Khalifa, 2004). There are mechanisms that are thought to contribute to customer value; Khalifa (2004) has expanded on two of these theories.

The first one is explained in the value exchange model (Khalifa, 2004). In essence, the value exchange model is a benefits-costs model where the client agrees to forgo a specific amount of money, time, effort, and risk in exchange for anticipated advantages that exceed the total amount of sacrifices. Net customer value is the outcome of the difference between total benefits and total sacrifices; a purchase decision is only made if this value is zero or higher. The second one is the value build up model (Khalifa, 2004). The benefits side of the value equation is highlighted in this model, and the customer value accumulation model is derived from the implicit assumption that total customer benefits surpass total customer costs.

These models of customer value are used as the reasoning for utilizing the dry port performance attribute in analyzing the dry port functions, as these attributes are expected to be maximized in order to improve the dry port customer value.

Path Dependency Theory

Next to analyzing the functions based on customer value creation using the performance attributes, the analysis will also be expanded to include the innovation factors of the dry port services from the dry port operator perspective. The inclusion of innovation factors will aim to add another perspective to that of customer value that has been discussed previously. It is not only that dry port operators will want to implement services that maximize the benefit to the customer, but they will also need to consider the feasibility of implementing such services and how it relates to the overall state of the dry port.

In that sense, the service will be analyzed to understand which service is the least challenging to implement by a dry port and hence more attractive to the dry port operator. The reason behind this choice is again rooted in literature. In multi-level perspective theory, or MLP for innovations, there is a basic assumption that, due to the stabilizing character of the current socio-technical regime, radical innovations will not happen in this regime (Annema, 2022). Thus, stability and continuity have generally been emphasized in analyses of regime change (Berkhout, 2002). This is closely related to the condition in firms, which can be further explained by the path dependency theory. If initial actions in one direction result in more actions in the same direction, then the process is path-dependent (Kay, 2005).

Path dependency thus suggests that industries tend to focus on reproduction and smaller stages of progress rather than developing something entirely new because the "new thing" does not correspond with their routines, among other reasons (Annema, 2022). This is hence used as the reasoning behind the approach to analyzing the dry port functions that aims to obtain the least challenging to implement. Nonetheless, this is an instance where significant innovations could be made. To achieve this, the best possible incentive program that rewards long-term success and tolerates early failure will need to be implemented (Manso, 2010).

Alternatives & Stakeholders

As for the alternatives, the dry port functions will serve as the alternative as formalized in Table 2. Moving on to the next step is to determine the relevant stakeholder that will be considered in the MAMCA. Again, as has been discussed in the previous chapter, the stakeholders that will be considered in the MAMCA are the dry port operator as well as dry port customers, which consist of cargo owners and shipping lines.

Criteria & Weighting

Moving on, the next step in the analysis is defining the criteria for the analysis. As has been listed out previously, the criteria that will be used for the stakeholder coming from a dry port customer are the dry port performance attributes as shown in Figure 1. As for dry port operator, the criteria that will be used is the innovation factors as shown in Figure 2. Ensuring the independence of each of the criteria from one another is also crucial in conducting the multi-criteria analysis.

In order to weigh the importance of each of the criteria relative to each of the stakeholders, the swing weighting method (von Winterfeldt & Edwards, 1986) will be employed. The criteria range in the elicitation questions is explicitly incorporated by the swing weighting method (Pöyhönen & Hämäläinen, 2001). The swing weighting method was selected due to its ability to consider the full range of attributes as well as its simplicity in the data gathering activity.

Criteria Indicator & Measurement

The next step in the MAMCA is to define the indicator and measurement method for each of the criteria. To measure the dry port service performance in each of the considered criteria, a survey using a Likert scale will be utilized. For the performance attributes, each of the dry port customers (the cargo owner and the shipping line) will be asked to rate each of the dry port services a value of 1–5 in helping their organization perform in each of the performance attributes, with 1 suggesting a very low impact and 5 suggesting a very high impact. As for the innovation factors, the dry port operator will be asked to rate each of the dry port services a value of 1–5 in overcoming the innovation factors, with 1 suggesting the service is very challenging to overcome the particular factor and 5 suggesting the service is very able to overcome the particular factor.

Overall Analysis and Ranking

The last step in the MAMCA analysis will be to do an overall analysis and ranking of the alternatives. In order to do that, the additive value function will be used to conduct the analysis. The additive value function will be used to calculate the final value of each of the dry port services relative to its performance in the stakeholder criteria. The final value for each of the dry port functions will be plotted in a graph with the functions' value for dry port customer criteria plotted along the x-axes and functions' value for dry port operator criteria plotted along the y-axes. As there will be three stakeholders in the analysis, there will be three final values for each of the dry port functions for each of the dry port stakeholders. To show and further analyze these final values, a graph with two axes will be used for better illustration, as can be seen in Figure 3.

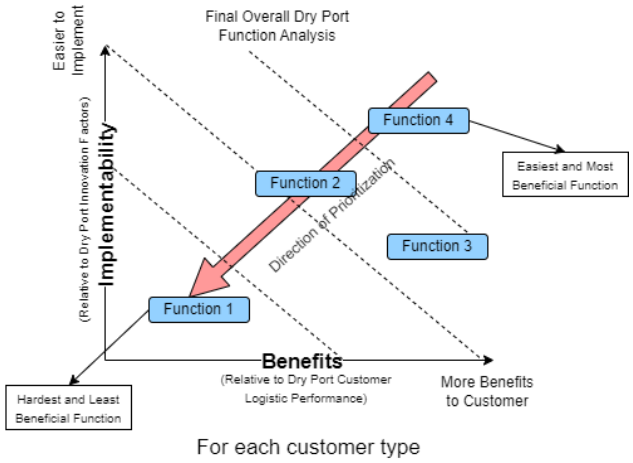

Figure 3 Dry Port Function MAMCA-Swing Final Overall Analysis Illustration

As there are two actors representing the dry port customer group, the analysis will result in two graphs for each cargo owner and shipping line. From the two graphs, a diagonal direction of prioritizing the functions within the two graphs is being conducted. This diagonal direction of prioritizing is based on the reasoning of the analysis to find the dry port services that maximize the benefit in relation to the performance attribute that is based on the customer value theory and minimize the effort for implementation in relation to the innovation factors based on the path dependency theory. This approach hence ranks the functions in a pareto interpretation based on the two stakeholders' perspectives. This approach for the overall analysis is motivated for the later maturity model design process.

V. MATURITY MODEL

The knowledge of the services from the previous analysis will be put to use in order to construct a dry port maturity model that will help dry ports plan their development. This approach is therefore expected to produce a very specific maturity model since it will heavily rely on the context-specific dry port stakeholders' perspective. This is justifiable referring to literature since it is suggested that a maturity model could consider either the two different focuses, general and domain-specific, that determine the specificity and extensibility of the maturity mode (Mettler, 2010).

By choosing to build a model to meet a specific domain, this presents the process to address the demand for maturity assessment to cover very specific requirements involving specific factors such as functional areas, economic sectors, and countries (de Jesus & Lima, 2020). It can be argued that specific maturity models can provide detailed, actionable guidance tailored to their intended context, which leads to efficient and targeted improvements in addressing domain-specific challenges. However, its narrow focus can limit the maturity model's applicability outside of specialized areas, making it less useful for organizations in different contexts.

The creation of maturity models is also considered to be a topic for design research studies (Pöppelbuß & Röglinger, 2011). Hence, it is decided that the steps on constructing a dry port maturity model will follow the generic design step as laid out in Section II that integrates the system engineering design approach and the maturity model design framework by Mettler (2010). The following section will first discuss the design goal and scope, followed by the design step, and lastly talk about the evaluation process of the constructed model.

Maturity Model: Analysis Phase

The process of designing the maturity model for a dry port starts with the definition of the goal as well as the scope of work. As thoroughly discussed previously, the goal is to have a maturity model that helps a dry port operator develop its service in order to improve its performance by considering the dry port stakeholder perspective. As for the scope of the design, it will be a combination of the many aspects of the design framework that have been laid out in the previous chapters. There are five items in the scope of the maturity model design, as follows: (1) Limited to only strategic and tactical level of planning for dry port development; (2) Utilize the formulated functions within a dry port; (3) Maximized the customer value in respect to the dry port customer performance attributes; (4) Minimized the effort to implement the wide range of services on a dry port; and (5) The maturity model must follow the components of a maturity model as suggested in the literature.

Additionally, in the analysis phase, the formalization of dry port stakeholders' perspectives is carried out. The formalization will be based on the results of the literature review and interview to formulate the dry port stakeholder's criteria, which can be found in Section III**.** The next sub-section will cover the design phase of the maturity model, with further discussion on the details of the dry port maturity model and the process to construct it following the scope of work as detailed previously.

Maturity Model: Design Phase

In line with Mettler's outline on creating a maturity model (2010), the subsequent step, which is the design phase, will provide more details of the maturity model construct. In order to construct the maturity model, a design space will be utilized in order to direct the design process. In his study, Mettler (2010) identified that, from the literature, there are at least two approaches to the design phase of a maturity model. One of the approaches is argued to be more of a top-down approach that starts with the identification of

aspects within the focus domain (similar to the process categories and process areas in CMMI) and then follows with the design of maturity levels relative to the domain's aspects. This approach is argued to be the one chosen in this project to construct the maturity model. In his work, Mettler (2010) found that this top-down approach is able to be materialized using a wide array of research methods, such as the Delphi method, literature review, and creativity techniques. It is argued that the approach to this project will be more on the creative side and will be further discussed as follows.

Firstly, the insights for the creation of the maturity model will be based on the result of the dry port function analysis. This result will be put in context with the design scope, especially points 3 and 4. As has been clearly defined in the previous chapter, the functions will be ranked with pareto interpretation to look for the ones that bring the most benefit as well as being less challenging to implement first. With those goals, the analysis result can be analyzed in a diagonal direction to group up the functions into a priority list for the dry port operator. This pareto interpretation is in line with the general view in which companies prioritize service improvements by considering both the increase in revenue through the increased customer value and the increase in cost from the implementation of the improvement (Srinivasan et al., 2015). The illustration for this approach can be found in Figure 4.

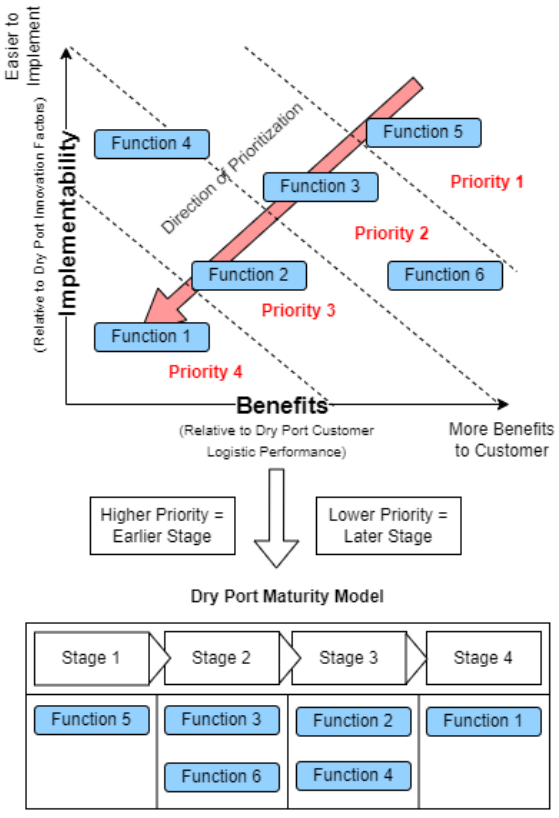

Figure 4 Dry Port Function Analysis for the Maturity Model Construction

The functions' priority will relate to their later position in the maturity model, with higher-priority functions likely being positioned in the early stages of the maturity model. Additionally, the relationship between the dry port functions as illustrated in the dry port process flow diagram (Appendix 1) will also be taken into account, as some services may require other services to exist first before the latter can be implemented.

Next up in the design space, the construct of the maturity model components is being formalized. The maturity model will have the essential components of a maturity model, as mapped out by Mettler (2010). The details of the maturity model are as follows: The maturity model will consist of four levels: **basic level, intermediate level, advanced level, and total solution level.** This leveling is consistent with the argument made by Khaslavskaya et al. (2021) that the development of services at dry ports frequently begins with the most fundamental, necessary ones before branching out into more specialized ones to meet the unique needs of clients.

After clearly defining the levels that make up the dry port maturity model, the next part is the dimension that makes up the maturity model. Since the idea is to utilize the formalized functions to construct the maturity model, it is then decided that the functions will be grouped up to make up the dimensions of the maturity model. The functions will be grouped into four groups, which are: container transport, administration service, logistical service, and container storage and maintenance.

The last detail of the maturity model is the description of each of the elements in each of the dimensions. As has been clearly defined, the dimension will have specific dry port functions as its elements. The first piece of information that will be provided to describe the functions concerns the focus customer. This will hence highlight the customer group (cargo owners or shipping lines) that is most benefited by the existence of those specific dry port functions. The second piece of information to describe the functions is the main performance benefit that the dry port functions offer to their customers. This, therefore, relates to the customer logistic performance attribute that the specific dry port functions help improve. The third piece of information that will be provided is the main challenge for the specific dry port function implementation. Hence, this will heavily relate to the implementation factor that is most challenging to overcome in order to implement a specific dry port function.

All this information will come from the prior function analysis process. Lastly, a generic description of the functions will also be provided in order to measure whether the function is available in the dry port. This

description will only be on the strategic and tactical level, as has been determined in the maturity model scope.

Maturity Model: Evaluation Phase

As suggested by Mettler (2010) process of designing a maturity model, the next part of the model is evaluation. Although maturity models represent assessment tools, they are also subject to evaluation and improvement activities. According to Salah et al. (2014), there are several types of maturity model evaluation. Domain expert evaluation, which is typically conducted through interviews, is an assessment carried out by experts in the kind of process that the maturity model aims to enhance but who were not involved in its development. In terms of practical setting evaluation, it entails analyzing and enhancing both the maturity model and the process under examination by applying the maturity model in a more realistic context. In terms of practical evaluation, the maturity model's usefulness will be evaluated based on user feedback (Mettler, 2010). For this type of evaluation, case studies, field studies, surveys, and longitudinal analyses are some suggested approaches. (Mettler, 2010).

In this project, the two foci of model evaluation will be assessed. The model's construct will be evaluated using the domain expert evaluation approach, and the model instrument, which is closely related to the model's operability, will be evaluated using the practical setting evaluation.

Evaluation: Model Construct

For this project, the model construct will be assessed with a domain expert evaluation by selected experts in the dry port/container logistic field. The evaluation will be conducted using a semi-structured interview with selected experts in the dry port/container logistic field to check on how the model meets the quality of a fair maturity model. The list of questions used for the domain expert evaluation is carefully designed based on the maturity model expert evaluation template by Salah et al. (2014).

Evaluation: Model Operability

The next step is to conduct the model operability evaluation using the practical setting evaluation. This, therefore, relates to the role of the maturity model in improving the decision-making process of planning the service development strategy at a dry port. This improvement may show up in the organization's economic evaluation as a result of applying the designated maturity model; examples of this include cost savings, improved quality etc. (Mettler, 2010).

The practical setting evaluation will be conducted via a case study with a dry port operator. The practical setting evaluation's case study will consist of three parts. Each part is meant to assess one of the three application-specific purposes of a maturity model, as pointed out by Pöppelbuß & Röglinger (2011), which are descriptive, comparative, and prescriptive purposes. The three parts of the case study, along with their context for the application-specific purpose, are discussed as follows:

Part 1: Assessment of the dry port maturity level

This part aims to assess the existing conditions of the dry port and relate them to the maturity model (to conclude its maturity level). This will be done by thoroughly going through one by one of the model dimensions and assessing their condition (existing or non-existing) relative to the maturity model function description. Because it is used for as-is assessments, where the existing capabilities of the item under examination are evaluated in relation to the model's specified criteria, this phase thus connects to the descriptive goal of a maturity model as described by Pöppelbuß & Röglinger (2011).

Part 2: Reflection on past development process

This part will focus on reflecting on the past process of developing the dry port to reach its current state. This part aims to compare the reality of past development processes to the process suggested in the maturity model. This part aims to help the study assess the relevance of the maturity model as well as its performance. This step hence relates to the comparative purpose of a maturity model, as it allows for internal or external benchmarking (Pöppelbuß & Röglinger, 2011).

Part 3: Further development

This part will aim to utilize the maturity model to help provide insights on the dry port service's further development process. This, therefore, will be on either the dry port plan to add non-existing functions to its service portfolio or the plan to further improve the quality of existing services. To this end, the focus customer, main benefits, and main challenges that are attributed to each of the dry port functions in the maturity model will be put to use. Thus, this action is related to the prescriptive function of a maturity model, which aids organizations in determining appropriate degrees of maturity and offers recommendations for improvements (Pöppelbuß & Röglinger, 2011).

VI. CASE STUDY

The case study is being conducted with a dry port located in Indonesia with the aim of utilizing the previously formulated framework to design the dry port maturity model. The studied dry port is located in the province of West Java, Indonesia, approximately 50 kilometers east of the nation's capital city of

Jakarta. The dry port is designated to support the industrial estate located in the Cikarang area by connecting the industry to the seaports, mainly the one located in Tanjung Priok, Jakarta, for their trade activity.

The case study starts with the function analysis, where a survey is being conducted to gain input for the analysis. Each of the stakeholders related to the studied dry port in Indonesia that are part of the MCA is asked to fill out the survey, which consists of input for criteria weighting (the swing method) and the assessment of the dry port function performance relative to each of the criteria. The stakeholders are represented in the survey by individuals that were previously involved in the interview process, as detailed in Section III, meaning that the dry port operator is represented by a general manager in terminal business, the shipping lines are represented by an operation manager, and the cargo owner is represented by a logistic manager of a trading company.

Function Analysis Result

The final analysis using the shipping line final value, and the dry port operator final value can be found in Figure 5 and the final analysis using cargo owners' final value and dry port operator final value can be found in Figure 6.

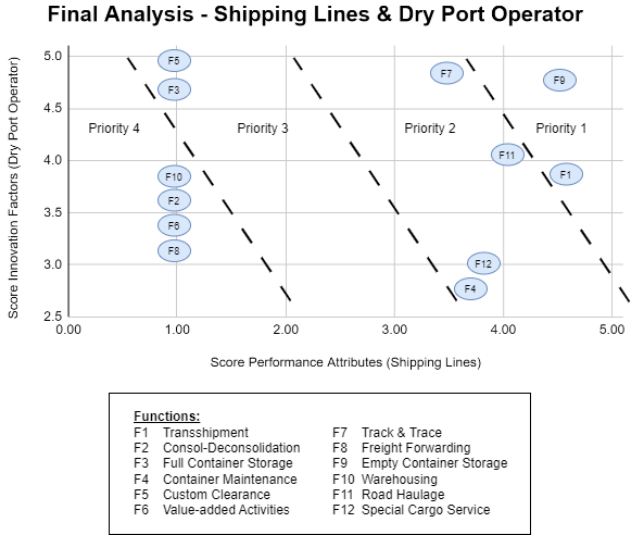

Figure 5 Final Analysis 1 – Shipping Lines & Dry Port Operator

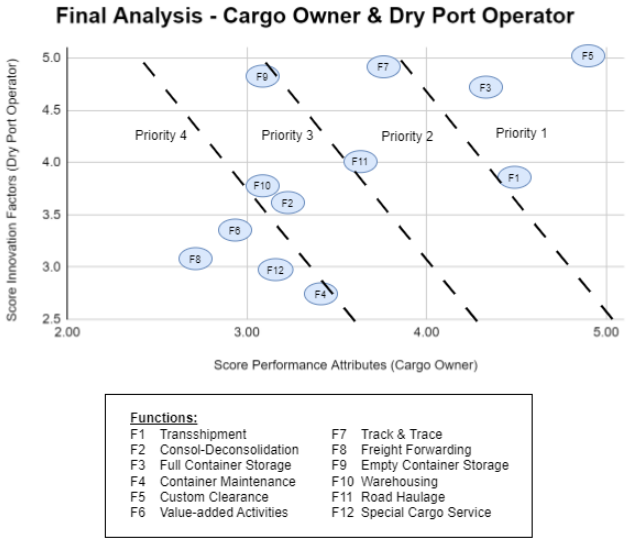

Figure 6 Final Analysis 2 – Cargo Owner & Dry Port Operator

From the two graphs, a diagonal direction of prioritizing the functions within the two graphs is being conducted. Prioritization is being done to obtain four priority groups. This number of priority groups is based on the level that the aspired dry port maturity model had of 4 levels; hence, this grouping is expected to help in the later construction of the maturity model. This prioritization also shows which customer group is more relevant to which dry port functions.

From the priority grouping of the dry port functions, some aspects can be learned. Focusing on the shipping line analysis result, only transshipment and empty container storage lie in priority group 1. This is understandable as transshipment is a core service of a dry port, and for shipping lines specifically, their ability to bring empty containers to their customers is a key aspect of their business, as previously shown in the dry port function flow diagram. As for the result from the cargo owner analysis, functions that are considered in the first group are transshipment, full container storage, and customs clearance. For transshipment again, it is clear that this is a core part of a dry port operation. As for full container storage, it was learned from the interview that there are many great benefits coming from the availability of the full container storage function within a dry port, such as reducing storage costs, which are relatively more expensive in the seaport. This is also found to be the case in the Netherlands, based on the previous. interview result.

Lastly, for customs clearance, as learned from the interview, this function relates to an overall reduction in complexity and cost due to the transparent and integrated system of customs clearance in the dry port, especially when compared to that in the seaport. This is also found to be quite unique for the Indonesian context, as the high impact of customs clearance services offered by a dry port is not suggested from the interview in the Netherlands. This may be due to the difference in the customs clearance system at the seaport compared to the two countries, where a dry port may not contribute as much to the Netherlands as it does in Indonesia on the customs clearance side.

Constructed Maturity Model

Using the result from the function analysis as has been thoroughly discussed in the previous sections, the dry port maturity model can then be constructed. The result of the constructed maturity model can be found in Figure 7 and Table 3.

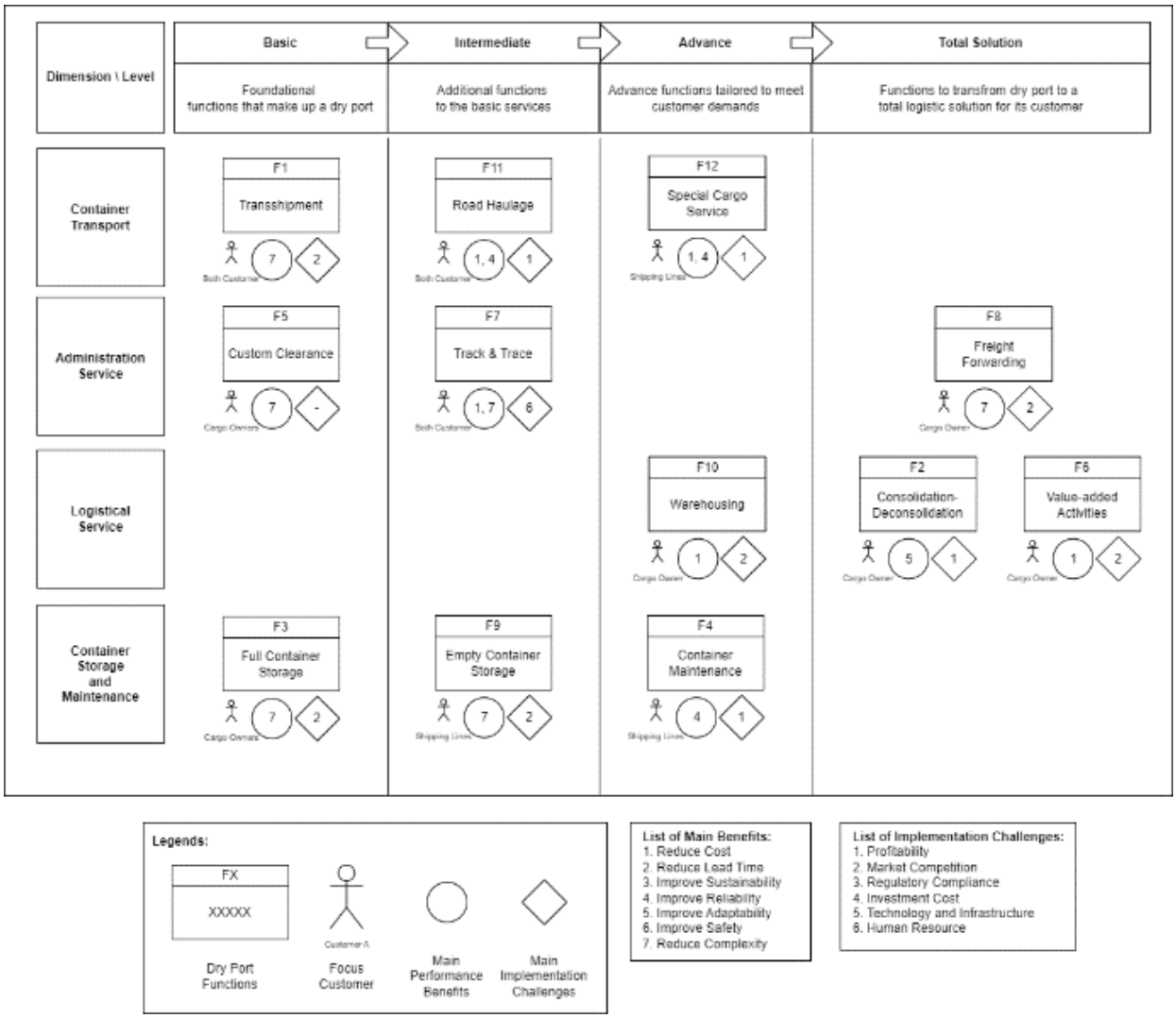

Figure 7 Dry Port Maturity Model – Case: Indonesia

Table 3 Dry Port Functions Description

No	Functions	Description
F1	Transshipment	High frequency intermodal transport between the dry port and the seaport.
F2	Consol-Deconsolidation	Sufficient capability of consolidation and deconsolidation of various cargos.
F3	Full Container Storage	Sufficient capacity of storage yard for full containers to meet the logistic flow demand.
F4	Container Maintenance	Operational container maintenance facility with ample capacity to meet customer demand.
F5	Custom Clearance	Sufficient capability to assist customer demand on custom clearance activity with service such as inspection, quarantine, etc.
F6	Value-added Activities	Sufficient capability of value-added activities for various cargos such as packaging and labelling.
F7	Track & Trace	Real-time operational and accessible data of container location and condition.
F8	Freight Forwarding	Functioning forwarding services to support export-import activity.

No	Functions	Description
F9	Empty Container Storage	Sufficient capacity of storage yard for empty containers to meet the logistic flow demand.
F10	Warehousing	Functioning warehousing services to support export-import activity.
F11	Road Haulage	Sufficient capacity of trucking to meet the logistic flow.
F12	Special Cargo Service	Sufficient capability of handling of various special type cargos such as DG and Reefer.

The construction of the maturity model is using the result of the function analysis and is accordance with the scope of the design as formalized previously. Transshipment service is positioned at level 1 as it is pretty clear that from the literature, interview, and the analysis (having priority group 1 in both analysis) that transshipment is the core service in a dry port. Custom clearance is also put in level 1 with similar reason, although with slight difference since on priority analysis with shipping line perspective, the priority group is not priority 1. However, it is made the case that the impact it has on cargo owner is very critical motivating its position in level 1. For the last function in level 1, the full container storage is also placed in level 1 with similar reasoning with custom clearance. Additionally, from the dry port operation flow diagram, it can be argued that a full container storage is central in supporting a transshipment function hence the two must be offered at the same stage.

At level 2, the maturity model first has the road haulage as the function from the container movement dimension. It is pretty clear from the analysis that road haulage is prioritized quite highly from both customer groups (both analyses show priority group 2). The second function at level 2 is track and trace from administration service dimensions. Again, the reasoning is pretty similar to that of road haulage. The last function at level 2 is from the container storage dimension which is the empty container storage. This function lies on priority group 1 in the shipping line analysis and is argued to bring quite significant impact as well to the shipping lines. However, as full container storage is understood to be critical in order to operate the transshipment service (the full container will require a stacking yard and storage space prior to and after the transshipment activity), hence the full storage service is placed in the first level and empty storage service is being placed in the second level.

At level 3, first, the special cargo service of the container transport dimension is being placed at this level. This is due to being on priority group 2 for shipping lines and priority group 4 for cargo owners, hence making it appropriate to put it at level 3. Warehousing service will be the first logistical service placed in the maturity model at level 3, having lies on priority group 4 for shipping lines and priority group 3 for cargo owners. The last function at level 3 is container maintenance having lies on priority group 2 for shipping lines and priority group 4 for cargo owners. Additionally, it is learned from the dry port flow process that a container maintenance service is usually is offered at the empty container storage facility hence making it crucial to first offer the empty storage facility before having the maintenance service.

At the last level, level 4, freight forwarding function of the administration service dimension is placed at this level. This is due to having lies on priority group 4 on both analyses hence it is reasonable to put this function at the last level. Two functions from logistical service dimensions, which are the consolidation-deconsolidation and added-value functions, also lie low on priority analysis hence it is reasonable to put them on level 4 as well. It is also understood from the flow process that both these logistical service functions usually are conducted within the warehouse hence making them reasonable to be placed after the warehousing service.

The main customer information at the maturity model is also based on priority analysis where if a function lies on high priority it is understood as the main concerned customer to the specific dry port functions. Transshipment, road haulage, and Track & Trace are of concern to both customer groups, and this is sensible as these functions are both heavily utilized by both customers. Empty container storage and container maintenance is primarily concerned by the shipping line. This is to be expected since these functions are more closely related to dry port operation on the shipping line side as can be learned from the dry port operation flow diagram. Another function that has been primarily concerned by shipping line is the special cargo service and this might be due to their aim to provide services for a wide range of customers with various types of cargo. As for the rest, the main concerned customer group is the cargo owners as these functions primarily relate to the cargo owner side of dry port operation as shown in the dry port process flow diagram.

Lastly, the main benefit and challenges information on the maturity is based on the score and weight of importance as a result of the MCA. Reduction of cost,

reduction of complexity and improvement of reliability are found to be the three main benefits from the dry port functions. As for the main implementation challenges, many of the dry port functions have profitability and market competition as the main challenge.

Maturity Model Evaluation: Model's Construct

The first evaluation conducted on the constructed maturity model is on the model construct. As laid out previously, an expert evaluation interview is employed in order to assess the maturity model construct with focus on aspects such as completeness, simplicity, understandability, ease of use, efficiency and impact on the users. The expert evaluation interviews are done with two different selected experts that both possess extensive experience in both the academic and professional realm of logistics. Both experts are also selected due to their familiarity with dry port concepts as well as the logistics context of Indonesia in which this project case study is based on. The following sub-sections will discuss the overall result of the model construct evaluation.

Understandability

The first aspect of the model construct being assessed is its understandability. Both experts argued that the model is relatively simple to understand. One expert pointed out that the legends and information are clearly presented. The other expert argued that it is easy to understand the model since it is intuitively in line with the concept of dry port service development process.

Ease of use

On to the second aspect, which is ease of use. Similar to the first aspect, both experts argued that the model will be easy to use. It has been learned that both experts view the model as easy to use as a tool to assess the condition of the dry port as well as to help plan the dry port's future development.

Usefulness

The third aspect of the model construct is its usefulness. Both experts view the constructed dry port maturity model as useful, although it has different focus aspects. One expert argues that the model is particularly useful for the dry port operator's internal discussion and can later be used to make a more detailed plan for improvement, such as the creation of KPIs. This model, therefore, is more of a tool to guide the thinking and discussion process. The other expert argues that the model will be useful for dry port operators, especially to help them point out the benefits of using a dry port to prospective customers.

Maturity Levels

The maturity level in the maturity model is next assessed. The model currently has four levels in its maturity progression. The two experts view four levels (basic, intermediate, advanced, and total solution) as sufficient. One expert argued that adding more levels will not add much value to the model, while the other expert views the 4 levels as sufficient as they show the gradual level of the service challenge and knowledge needed from the dry port operator.

Processes

The last aspect of concern in assessing the maturity model construct is the process within the maturity model. To assess the process, first the functions are being focused on, specifically its relevancy, comprehensiveness, and mutual exclusiveness. Both experts argue that the twelve functions used in the maturity model are currently accurate, and there is no pressing need to add or remove any more functions. The other expert further focuses on the freight forwarding service being offered at a dry port, as it serves as an additional concern, especially about data sharing as it might relate to sensitive data. As an example, the expert argued that, from an advanced level, the data collected by the dry port operator could already be a lot, and this could lead to problems if a freight forwarding service is being offered (such as conflicts of interest).

The next focus on assessing the process within the maturity model is its accuracy, specifically addressing the description being used to describe each of the dry port functions. Both experts view the qualitative approach in the description as sufficient, although improvement could also be beneficial. The first expert argues that the qualitative description could be improved by acknowledging parameters that could help define the qualitative performance.

The last focus in assessing the process within the maturity model is again regarding its accuracy, but this time more on the positioning of each of the functions at the specific maturity level. Both experts agree that the positioning of all the functions in the maturity level is sensible. The first expert views the positioning of all the functions at the maturity level as showing the gradual process of dry port service development. The other expert views the function's positioning as showing the level of customer demand and the challenge of implementing progress in the right direction in the maturity model.

Maturity Model Evaluation: Model's Operability

The result of the evaluation conducted to assess the maturity model's operability is next discussed. The evaluation is executed using a case study with a dry port entity in Indonesia that previously helped with the input of the dry port function analysis. The case study result will be discussed in the following sub-sections.

Part 1: Assessment of the dry port maturity level

From the assessment, it can be concluded that the dry port in focus is already at the total solution, or the last level in the maturity model. This implies that the company is already in the stage of offering functions that could meet the demand for an end-to-end logistic solution for their customers. The subject in the case study also further validates this result of the maturity level of the dry port with the acknowledgement of the company's vision to be an integrated logistic solution provider for their customers. Furthermore, it is learned that internet-based applications are also an integral part of enabling access to a variety of services from the dry port to their customers.

It is, however, important to note that some of the functions are available with some limitations. The container maintenance service, as an example, is currently only available for minor damage repair and not for heavy damage. The freight forwarding service is also not being offered currently as a forwarding service, although it offers a service similar to that of a freight forwarding company. This is due to the concern about market aspects. Interestingly, this is to be expected as the main challenge of implementing the freight forwarding service as suggested in the maturity model is market competition, which further validates the model's accuracy. From both of these findings, it hence raises the possibility to revisit the inclusion of both of the functions for a dry port in the future study.

Part 2: Reflection on past development process

To further assess the model's operability, the progress of development is being evaluated with a reflection on past development processes. This is done by comparing the suggested development path from the maturity model to the past development process in reality. From this reflection, it suggests a high relevancy of the development process suggested by the maturity model due to the similarity in process with the past development process in reality.

From the reflection, it is also revealed the underlying reason for the similarity. The first is related to the path dependency theory that is being used in the function analysis to construct the maturity model. It is learned that in their development, the dry port operator requires a certain level of knowledge, experience, and confidence when choosing to improve their service portfolio, such as when opting to have a special cargo service.

Second, the customer value theory that aims to maximize the benefits to the customer that is employed in the creation of the maturity model is also reflected in the past development progress. The decision to have a specific service, such as the warehousing service, offered at a later stage due to the idea that the benefit could only be optimum at the later stage is in line with the customer value theory, which focuses on maximizing customer benefits. Lastly, the establishment of a specific service being offered after a specific service due to the relationship, especially from a technical perspective, is also found to be the case in the past development process, for example, the empty container storage and container maintenance service. This step not only shows the operability of the model in order to navigate the dry port development process but also validates the theory-based approach underlying the process.

Part 3: Further development

For this, the case study selects the service of road haulage as the focus service that is aimed at being further improved. The improvement of the road haulage service is aimed at adding a round-use scheme for the empty container movement. The improvement of the road haulage service is aimed at adding a round-use scheme for the empty container movement. This round-use scheme is well-known in the empty container movement process, where instead of having the cargo owner return the empty container to the empty container depot once unstuffing has been done for the ex-import container, the empty container is instead being delivered to the export customer

The analysis starts with the focus customer. It is learned from the maturity model that road haulage service is of concern for both customer groups. This, therefore, relates to the business decision that might be of concern to the dry port operator. For the cargo owner, the dry port operator acknowledges that by having the round-use improvement, the workload to choose the specific type of containers that meet the cargo owner criteria will be taken from the cargo owner side, as this is a service that can be sub-contracted by them to another entity. This might then relate to a market expansion approach. Additionally, each cargo owner has its own window of stuffing schedule; hence, this will need to be thoroughly considered. As for the shipping line, the dry port operator acknowledges that the shipping lines will want to have a certain level of quality on their empty containers for the customer. This should be taken into consideration in applying the round-use improvement since shipping lines will not be able to control this directly, just as they have been able to with the control in empty container depot.

Next, the analysis focuses on the benefits of the service. From the maturity model, it can be learned that the road haulage service mainly benefits customers in the form of cost reduction and reliability improvement. Acknowledging this, the dry port operator argues that the round-use improvement will be able to further improve the two benefits. For cost reduction, the round-use improvement will result in a reduction in trucking movement for empty containers.

Additionally, the round-use improvement is expected to improve shipping line reliability, as it is argued to improve customer satisfaction by meeting their demand. Not only on the two factors, but the improvement is also argued by the dry port operator to improve other benefits to the customer as well. First is the lead time reduction. Additionally, environmental sustainability will also improve since less movement equals less pollution.

Lastly, the analysis is done on the main implementation challenge. From the maturity model, it has been revealed that the main challenge for road haulage service is profitability. Acknowledging this fact, the dry port operator acknowledges that it is an issue, especially as the service at the empty container storage will also be affected, making them probably lose even more. With this, the approach of the dry port operator is to focus on productivity. The dry port operator claims that the round-use improvement will improve the truck fleet productivity, which will eventually translate to a better profit margin. This cost reduction, coupled with the improvement of customer usage, is expected to be the way to overcome the profitability challenge.

Again, this phase further shows the operability of the model, especially regarding helping dry port operators plan their further service development.

VII. LIMITATIONS

Some of the limitations of this project are thoroughly discussed as follows. The first limitation is regarding the scope of the model. As was laid out in the beginning, the scope of the model is limited to only the strategic and tactical levels of the decision-making process. This, therefore, resulted in the omission of the operational level, which considers the more practical and technical aspects of decision-making. The second limitation is on the criteria to represent the stakeholder perspective. The selection of attributes and their definition to represent the dry port stakeholder perspective and analyze the dry port functions are argued to be still in the very early stages. This implies that the selected set of attributes may not fully capture reality. Ultimately, the choice of attributes and definitions in this study might heavily impact the research outcome.

Thirdly, the limitations concern the collection of data. The collection of data in this project should also be highlighted in assessing and utilizing the research outcomes. The method by which the data is collected in this study is primarily based on a survey with one individual representing each specific dry port stakeholder. In this study, the authors focused on the representation of all stakeholders rather than having several respondents per stakeholder group. Although measures are being taken, such as pressing the idea of the individual to be as holistic as possible in representing their entity, bias might still occur. The fourth limitation is regarding consideration of other factors in analyzing the dry port. The research is primarily centered on exploring and analyzing the benefits to the customer of the development of dry ports. This, therefore, relates more closely to the advantages of the utilization of a dry port. Thus, it is important to acknowledge that factors, specifically the disadvantages of using dry port, were not comprehensively examined within the scope of this study.

The next limitations are regarding the maintenance of the model or model evolution. The dry port maturity model scope of design in this project is currently only limited to the evaluation phase of the design approach, implying that the model maintenance that is closely related to the maturity model evolution process as described by Mettler (2010) is not covered yet. This may relate to the relevancy of the model being limited to the current condition, while it is expected that in the future there ought to be some changes that might affect the model's performance. Next limitation is on the context-specific setting. This article applied the MAMCA-Swing and maturity model methods to dry ports in Indonesia. This is in line with other applications of MAMCA, or maturity model method, to transport projects where one case is selected for the study, but the findings can be generalized to similar cases because stakeholders tend to have similar objectives in different contexts. However, this study will require further consideration as there are indications for concern regarding the generalizability of the study.

VIII. CONCLUSION AND RECOMMENDATION

Conclusions

To conclude, this study has tried to contribute to the identified gap in the study of dry port that considers dry port stakeholders' perspectives to construct a maturity model that could help dry port develop. Relating to the main research question which is "How to utilize dry port stakeholders' perspectives to construct a dry port maturity model that will help dry port develop?", this study first considers two of arguably the most relevant dry port stakeholders: the customer and the dry port operator. A series of performance logistic attributes has been identified to represent dry port customers' perspectives (Figure 1), while a series of innovation factors is used to represent the dry port operator's perspective (Figure 2).

By applying MAMCA-Swing's innovative methodology to evaluate dry port services by considering the perspectives of the relevant stakeholders, the research has created a connection

between the analysis's outcome and the development of a dry port maturity model, as illustrated in figure 4. A case study based on Indonesian dry ports has also been conducted to illustrate the use of such a framework, resulting in a dry port maturity model for Indonesia, as can be found in Figure 7 and Table 3. The model has also been evaluated for both the model's construct and the model's operability, with the results suggesting that the model is arguably relevant and useful in helping Indonesian dry ports develop.

Recommendations

First, this study can be extended by considering the other level of decision-making, which is the operational level, which covers more on the technical side. The current study, as stated in the limitations chapter, only covers the strategic and tactical sides of decision-making. The next recommendation is to explore the criteria used to represent the dry port stakeholders' perspective. Currently, in this study, the criteria selection is made with the consideration of keeping simplicity. Hence, some criteria may be defined more accurately. The next recommendation is made regarding the collection of data. Future studies can consider including more individual in obtaining the input for the MAMCA. This ultimately could improve the quality of the MAMCA by avoiding bias by having only individual perspectives considered. More specifically on the dry port function performance data, the use of absolute values and not from surveys could also be considered for selected criteria where direct measurement is possible and can be considered reliable.

Furthermore, the dry port customer and operator may not be the only stakeholders considered in the research. Related to this, in the MAMCA, the analysis could also consider having different weights of importance for each of the dry port stakeholders, as this is the usual approach to have in a MAMCA. Other than the expansion of the study to consider other criteria as well as other stakeholders, the study can also be expanded by also focusing on the negative side or hindrance of using the dry port since this study is currently argued to be more focused on the benefit side of dry port usage.

It is also advised that future research attempt to address one of the study's limtations, which does not yet address model evoluation or model maintenance. It is likely that as time goes on, the dry port will be able to offer more services, or that certain functions will have different positions in the maturity model. By covering the model evolution or maintenance aspects, it could result in the dry port maturity model having the ability to cope with industry advancement as well as the dynamic conditions surrounding the logistic climate. As for the final recommendation, it is to repeat the study at various locations to further improve the understanding of dry port services and their stakeholders, particularly in other nations where the logistic network situation is not as developed.

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Appendix 1. Dry Port Function Flow Diagram

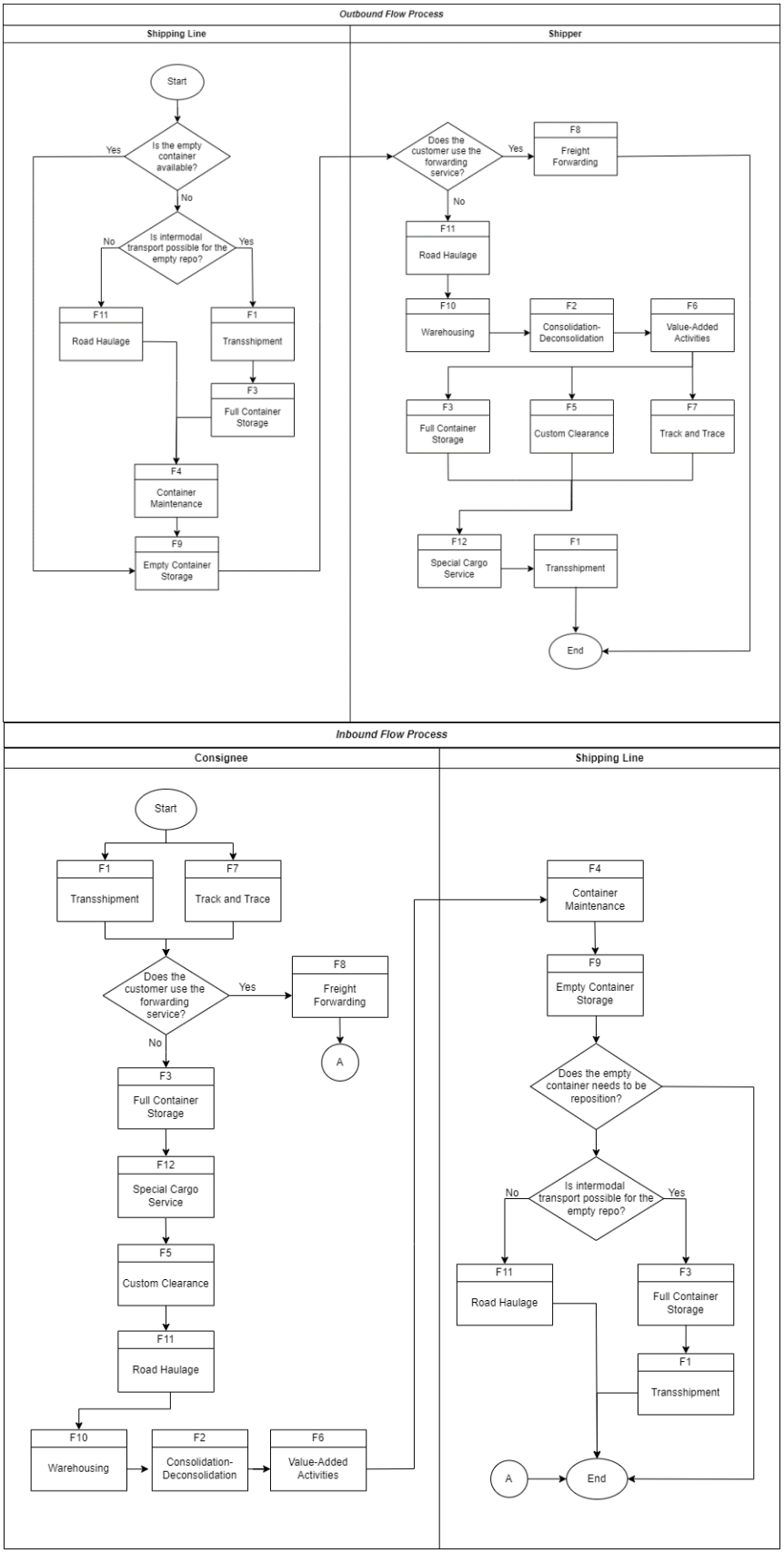


Figure A-1 Dry Port Function Flow Diagram

Appendix B. Interview Details

Interview – Dry Port Overview – Dry Port Operator 1

1. Could you kindly introduce yourself and your role within your organization?

XXX – Branch Manager – XXX Dry Port in the NL

2. Could you provide a brief overview of your experience with and understanding of dry ports?

5 years of experience with the dry port business as a branch manager.

3. In your understanding of dry ports, what are the elements or services that make a dry port different from just an intermodal terminal?

Dry ports are different because it's transport by inland waterway not trucks. And the location is in hinterland closer to customer. Mainly customers do their custom clearance in the seaport, but it is also possible to do it in the dry port. Customer can pick up container closer due to dry port. Dry port also has special services such as custom clearance, fumigation, and storage.

4. We have a diagram illustrating the dry port service operation. Could you please share your insights into it?

Everything is relevant but we do not offer consol-deconsolidation and warehousing service at the moment.

5. How can the use of dry ports impact the total supply chain costs for customers (including transportation, storage, and documentation)? Please also relate the answer to the dry-port service flow illustration!

Agree that it is decreasing the cost especially from DnD charges and storage cost. Dry port helps optimize customer supply chain in their own warehouse because of the decoupling point from the storage service. Intermodal transport could also help to reduce the cost.

6. In what ways can the presence of a dry port contribute to the overall lead time of the supply chain for customers? Please also relate the answer to the dry-port service flow illustration!

Increases to 1 or 2 days but as a whole optimized the customer due to integrated transport. Efficient and lean management due to the use of DP.

7. How can a dry port align with customers' environmental goals and aspirations? Please also relate the answer to the dry-port service flow illustration!

Yes, 40% less CO2 from the transport, less traffic less transport less NOx. In general, dry port is very sustainable option.

8. How can a dry port help to provide reliable access for their customers to the right service, at the right time, with the right quantity and quality? Please also relate the answer to the dry-port service flow illustration!
   Notes: The customer has a lot of requirements and demands a wide range of services, such as empty containers, value-added activities, etc.

It has so many dimensions. Connection point on the terminal for stocking to pick up and stack container to improve logistical process on their side. They have the option to allocate their resources more efficiently due to the availability of the services at dry port located closer to them.

9. How can a dry port assist customers in effectively adapting to or managing uncertainty within their supply chains? Please also relate the answer to the dry-port service flow illustration!
   Notes: There are a lot of uncertainties in the supply chain, such as the delay of vessels, the delay of production, etc.

Relates to the previous point. About targeting lean management. This really makes the customer stay. This is the best value that they can give that comes from decoupling point from the storage service. For export, buffer function from the storage is also a helping to adapt with uncertainty.

10. How can the existence of a dry port enhance cargo and equipment safety and security during logistic activity? Please also relate the answer to the dry-port service flow illustration!

In general, is already quite a safe country. Dry port, however, has a good security measure to help improve this. For transport, it is also not so significant.

11. How can the use of a dry port impact the level of complexity of the supply chain for customers, particularly regarding the number of actors involved and bureaucratic ease? Please also relate the answer to the dry-port service flow illustration!

More or less the same, just the place to face the complexity is different due to the use of a dry port. Pick up on empty container is slightly easier due to customer doesn't need to ask the shipping lines (less coordination work).

Interview – Dry Port Overview – Dry Port Operator 2

12. Could you kindly introduce yourself and your role within your organization?

XXX – General Manager Terminal Business – Dry Port XXX in Indonesia

13. Could you provide a brief overview of your experience with and understanding of dry ports?

Has been with the company since its inception in 2011. This was the first dry port in Indonesia since this is the first inland terminal that formally acknowledge as a dry port by the government. Dry port inception was critical in the custom aspects of the operation and was the main challenge to tackle.

In order for a dry port to be successful, the cooperation with the shipping line is of high importance due to the documentation related stuff especially as reflected in the Bill of Lading (B/L). A dry port is a form of extension from seaport and again the main thing is to ensure the obligation to the state regarding this aspect is not to be missed.

Dry port also has the responsibility to move the containers between the seaport and the dry port with custom being able to monitor it. This is done now with an e-seal that helps monitor container location. Dry port current focus now is on expanding the terminal service.

14. In your understanding of dry ports, what are the elements or services that make a dry port different from just an intermodal terminal?

Dry port aims to reduce the congestion at seaport in order to speed things up. It has to be located near the industry in order to reduce costs and improve efficiency. Custom clearance is one of the main focuses since it usually takes the longest time in seaport, with physical inspection taking the most time.

Dry port tries to improve this issue with clearance by uniformity and transparency with the system that is being utilized. The total cost is then far cheaper, and the process is clear to the customer. Joint inspection from custom and quarantine is also being tested to speed things up further. This is all being done in order to ensure not to neglect the obligation regarding custom activities in the dry port area.

15. We have a diagram illustrating the dry port service operation. Could you please share your insights into it?

The buffer in the storage happens both before and after entering the terminal. Before entering is to wait for all documents to be cleared up and after entering can be for specific strategic reasons. This is done with total assurance of the cargo safety and security.

16. How can the use of dry ports impact the total supply chain costs for customers (including transportation, storage, and documentation)? Please also relate the answer to the dry-port service flow illustration!

Indeed, it is expected to reduce costs. Firstly, since the custom clearance activity is transparent and uniform, this makes it cheaper for customers to do their clearance. Transport costs actually increase a bit since trucking is cheaper. Storage cost is also down due to lower tariff and also the ability to avoid DnD and penalties that usually occurred in seaport (different regulations). Handling cost is regulated so not significantly cheaper. The warehouse cost is more competitive compared to one near seaport due to land price difference. Last mile transport can be cheaper due to partial delivery that can be adjusted to the customer stuffing window time.

17. In what ways can the presence of a dry port contribute to the overall lead time of the supply chain for customers? Please also relate the answer to the dry-port service flow illustration!

Again, custom clearance is faster due to transparency and is safeguarded by a clear system. The last mile delivery again is very fast and could save about 50% time in total.

18. How can a dry port align with customers' environmental goals and aspirations? Please also relate the answer to the dry-port service flow illustration!

The utilization of dry port helps lower carbon emission due to transshipment service with the intermodal transport. Some customers do want to utilize the intermodal transport as much as possible.

19. How can a dry port help to provide reliable access for their customers to the right service, at the right time, with the right quantity and quality? Please also relate the answer to the dry-port service flow illustration!
    Notes: The customer has a lot of requirements and demands a wide range of services, such as empty containers, value-added activities, etc.

With all the services in one channel, it helps with reliability due to the availability of these services. Another example is also with the bonded warehouse that enables the customer to check imported items and only pay the custom fees according to their choice. It is important to note that dry port need to comply with certain set of rules to be part of a bonded area.

20. How can a dry port assist customers in effectively adapting to or managing uncertainty within their supply chains? Please also relate the answer to the dry-port service flow illustration!
    Notes: There are a lot of uncertainties in the supply chain, such as the delay of vessels, the delay of production, etc.

The buffer function before and after entering dry port as mentioned previously does help a lot in adapting with uncertainty. Adaptation with technology also helps a lot in order to improve adaptability such as with track and trace with an app.

21. How can the existence of a dry port enhance cargo and equipment safety and security during logistic activity? Please also relate the answer to the dry-port service flow illustration!

Improves a lot due to custom mandated monitoring using the e-seal hence the location and condition of the cargo is always known. A lot of monitoring is also in the gate to the storage side. Reefer container also has its own system of monitoring.

22. How can the use of a dry port impact the level of complexity of the supply chain for customers, particularly regarding the number of actors involved and bureaucratic ease? Please also relate the answer to the dry-port service flow illustration!

The complexity is expected to be reduced since previously customers needed to coordinate with different seaports with different systems but now it is centralized to only coordination with the dry port. Dry port also helps on the coordination to the many governmental body such as customs, quarantine, etc.

Interview – Dry Port Overview – Cargo Owner

23. Could you kindly introduce yourself and your role within your organization?

XXX – Logistic Manager at XXX Import Export Co. (Scope: control export-import for all supplier and customer including the distribution side)

24. Could you provide a brief overview of your experience with and understanding of dry ports?

One of the pioneer customers in using the dry port in Cikarang, Indonesia. Dry Port is seen as a more efficient alternative to the seaport due to its location that is inland and close to the company distribution center (Less than 10 km). In Indonesia, there are some differences in regulation at seaport and dry port especially in custom duties (example: Once SPPB (letter for pick-up) has been issued, a maximum of two days is imposed for customer to pick up from seaport. This is different with in Dry Port where this regulation is non existence)

25. In your understanding of dry ports, what are the elements or services that make a dry port different from just an intermodal terminal?

Dry port is an extension of the seaport that is located Inland that is aimed to help customer avoid the congestion happening in the seaport. There is a custom clearance activity in the dry port happening just like in seaport. Additional information in Indonesia, the online customs system is first implemented for dry port before being implemented in seaport.

26. We have a diagram illustrating the dry port service operation. Could you please share your insights into it?

Has accurately depicted the process especially from the consignee side. No further comment on the process flow.

27. How can the use of dry ports impact the total supply chain costs for customers (including transportation, storage, and documentation)? Please also relate the answer to the dry-port service flow illustration!

Storage cost at the dry port is relatively cheaper compared to that in seaport. Additional costs can also be avoided such as the SPPB penalty from customs. Demurrage also can be avoided. This heavily relates with the full cargo storage service.

28. In what ways can the presence of a dry port contribute to the overall lead time of the supply chain for customers? Please also relate the answer to the dry-port service flow illustration!

Customs and other formal clearance are quicker than that in seaport due to less crowd and good system (mostly online). Transport to warehouse also

improved significantly due dry port located near the warehouse.

29. How can a dry port align with customers' environmental goals and aspirations? Please also relate the answer to the dry-port service flow illustration!

Currently, no concrete environmental aspiration however with the use of intermodal transport (heavily related with the transshipment service) it results to the overall efficiency that includes the emission due to logistic activity.

30. How can a dry port help to provide reliable access for their customers to the right service, at the right time, with the right quantity and quality? Please also relate the answer to the dry-port service flow illustration!
Notes: The customer has a lot of requirements and demands a wide range of services, such as empty containers, value-added activities, etc.

All the current services are helping the overall process. More specifically, the warehouse with total logistic solution can help to bring service needed by the company's customer.

31. How can a dry port assist customers in effectively adapting to or managing uncertainty within their supply chains? Please also relate the answer to the dry-port service flow illustration!
Notes: There are a lot of uncertainties in the supply chain, such as the delay of vessels, the delay of production, etc.

Since the company is a trading company, it prefers the cargo to be transported as fast as possible. A strategic postponement to adapt to a certain condition has been conducted (related to the full cargo storage service) however it is not preferred in general. Adaptability is more closely felt in the integrated custom clearance service that is far quicker. The availability of rail service and road haulage service has also served as alternatives to adapt to the dynamic condition of road transport especially congestions.

32. How can the existence of a dry port enhance cargo and equipment safety and security during logistic activity? Please also relate the answer to the dry-port service flow illustration!

Believe that the use of dry port improves safety due to the custom regulation and mandates (such as the use of e-seal to monitor the container location). This helps ensure the cargo location and safety.

33. How can the use of a dry port impact the level of complexity of the supply chain for customers, particularly regarding the number of actors involved and bureaucratic ease? Please also relate the answer to the dry-port service flow illustration!

Dry Port has helped with the complexity of its centralized access to wide range of service especially with the help of digital platform. This is possible with the use of web-based application from the dry port operator.

Interview – Dry Port Overview – Shipping Lines

34. Could you kindly introduce yourself and your role within your organization?

XXX – Operation Manager at XXX (Main Line Operator)

35. Could you provide a brief overview of your experience with and understanding of dry ports?

A dry port is an inland port that enables customers to do their custom clearance and deliver or pick up their cargo on a location that is closer to their industrial base. In other words, a dry port is similar to a seaport but is located inland. The company has utilized the dry port since the early days of the dry port due to its ability to bring more service closer to the customer.

36. In your understanding of dry ports, what are the elements or services that make a dry port different from just an intermodal terminal?

In Indonesian context, a customer clearance service defines a dry port apart from another inland terminal. This enables the inland terminal to become a custom area and also helps customer to avoid the DnD charges. Additionally, dry port offers alternative for customer to store their container.

37. We have a diagram illustrating the dry port service operation. Could you please share your insights into it?

Some services have a challenge to be implemented such as trucking since it will be taking the share from other business and could result in unwanted competition. These services aimed not on improving revenue but more on optimizing operations (round trip for trucking as an example). Empty container can be repositioned using the transshipment service although still quite challenging especially due to cost but can be preferred from sustainability perspective (most relevant with global company).

38. How can the use of dry ports impact the total supply chain costs for customers (including transportation, storage, and documentation)? Please also relate the answer to the dry-port service flow illustration!

Cost saving should be more on the cargo owner side however it is usually less due to the big top up done by forwarding company. Cost saving is relatively low for shipping lines from the intermodal service and storage.

39. In what ways can the presence of a dry port contribute to the overall lead time of the supply chain for customers? Please also relate the answer to the dry-port service flow illustration!

Not directly affecting the movement time but can be indirectly affected due to less dwelling time in the seaport. This relates to the low Yard-Occupancy-Ratio or YOR that resulted in a more efficient operation at the seaport.

40. How can a dry port align with customers' environmental goals and aspirations? Please also relate the answer to the dry-port service flow illustration!

There are green initiatives from shipping lines, however not directly targeting the use of a dry port. The intermodal transport due to transshipment service however definitely helps on reducing carbon footprint.

41. How can a dry port help to provide reliable access for their customers to the right service, at the right time, with the right quantity and quality? Please also relate the answer to the dry-port service flow illustration!
Notes: The customer has a lot of requirements and demands a wide range of services, such as empty containers, value-added activities, etc.

This is very relevant as the availability of services such as empty container storage and container maintenance makes it possible to support the shipping lines customer for their export import activity by having these service closer to customer.

42. How can a dry port assist customers in effectively adapting to or managing uncertainty within their supply chains? Please also relate the answer to the dry-port service flow illustration!
Notes: There are a lot of uncertainties in the supply chain, such as the delay of vessels, the delay of production, etc.

Indirectly affected since the cargo owner can adapt to situations such as road congestion. However, the option to strategically postpone a shipment from

and to a seaport can be useful for some situations such as to target a certain level for YOR at the seaport. It is however important to note that in Indonesia, the storage cost will be under the customer.

43. How can the existence of a dry port enhance cargo and equipment safety and security during logistic activity? Please also relate the answer to the dry-port service flow illustration!

Improves safety and security both on the transport and storage side. In transportation, the use of consolidated movement using railways is relatively safer than transported separately using trucks. In the storage, the additional supervision from customs does help improve security.

44. How can the use of a dry port impact the level of complexity of the supply chain for customers, particularly regarding the number of actors involved and bureaucratic ease? Please also relate the answer to the dry-port service flow illustration!

Again, is more relevant for the cargo owner since it enables them to work with parties that are closer and more familiar, especially compared to regular inland terminal since a lot of stuff still needs to be done at the seaport. For shipping lines, the complexity reduces but not significantly.

Appendix C. MAMCA-Swing Process Details

Problem, Alternatives, and Stakeholders

The MAMCA starts by defining the problem and alternatives. As already discussed thoroughly in chapter 4, the goal is to analyze the dry port functions in order to understand which service brings the most benefit to the dry port customers as well as least challenging to implement by the dry port operator. As for the alternatives, the dry port functions will serve as the alternative as formalized in Table 3.3. Moving on to the next step is to determine the relevant stakeholder that will be considered in the MAMCA. Again, as has been discussed in the previous chapter, the stakeholders that will be considered in the MAMCA are the dry port operator as well as dry port customers, which consist of cargo owners and shipping lines.

Criteria

Moving on, the next step in the analysis is defining the criteria for the analysis. As has been listed out in Chapter 3, the criteria that will be used for the stakeholder coming from a dry port customer are the dry port performance attributes as shown in Table 3.2. As for dry port operator, the criteria that will be used is the innovation factors as shown in Chapter 4 on Table 4.1. Ensuring the independence of each of the criteria from one another is crucial in conducting the multi-criteria analysis, and the reason for that will be further discussed in separate parts of this section.

To illustrate independence, each set of criteria for the stakeholder will be thoroughly discussed. First, the set of criteria for the dry port customer, which are the performance attributes, will be discussed. The attribute of cost is acknowledged to have the potential to pose a risk of correlation with the other attributes. To illustrate, the criteria of lead time could be further translated to a monetary value since it is usually the case the case that the longer the lead time, the higher the cost. In order to avoid this correlation in the attributes, each of the attributes will be clearly defined, especially the corridor of meaning that each of the criteria has.

To start, the cost criteria are clearly defined. The cost criteria in this analysis will only consider the direct cost of using the dry port, referring to, as an example, the tariff that needs to be paid due to using a certain service. Relating it to the lead time criteria, it suggests that the indirect cost due to delays or more time on transport will not be considered when considering the importance of cost. Next are the criteria for environmental sustainability. This will relate to the company's benefit of having a greener operation. In considering the cost criterion, it will be made clear that this criterion will not consider the monetary value of switching to a greener option since it will be covered by the environmental sustainability criterion.

The next criteria of reliability will also be defined clearly. The reliability aspect will consider the aspect of customer satisfaction that relates to the positive relationship that this might lead to, including monetary benefit. Moving on to adaptability, this criterion is defined as the ability to have an adequate choice and strategy to cope with a certain situation that might be faced and the benefits it leads to, including in

monetary terms. Next, the attribute of safety is also considered in the same way as the previous two criteria by considering the less risk of there being safety-related issues with the equipment and cargo and further considering the avoidance of monetary burdens in the case when these accidents happen. Lastly, for complexity, this criterion will consider the discomfort in day-to-day operation due to the complex issues that need to be resolved and again will consider the monetary implications. The discussion of each performance attribute is summarized in Table C1.

Table C1 MAMCA - Dry Port Customer Criteria

Performance Attributes	Definition
Costs	(Total) logistic cost i.e transport, storage, etc. Limited to only the direct cost due to tariff to use a certain service. Not considering the indirect cost saving due to the other aspects below.
Lead Time	(Total) delivery time and the positive benefit that comes with it.
Environmental Sustainability	Environmental impact, relates to company green image and the other benefit of environmentally friendly operation.
Reliability	Meeting customer expectations; i.e providing reliable access to the right service, at the right time, with the right quantity and quality.
Adaptability	The ability to adequately adapt or respond to uncertainty that is reflected with having the choices/alternative solutions to cope with a certain situation faced in supply chain.
Safety	Cargo and equipment safety throughout logistic activity. Reflected with minimum number of accidents.
Complexity	The numbers of actors involved and bureaucratic easiness in managing the supply-chain. This is reflected with the discomfort that may arise due to those factors.

Next, the focus is on the independence of the dry port operator criteria, which are the innovation factors that can be found in Table 4.1. Similar to the performance attributes, the innovation factors have several attributes from a financial perspective, namely profitability and investment cost. This again meant that there was a risk that the other factors may have a correlation with the two factors. Hence, to avoid that in the MCA, a clear definition of the factors is again laid out.

The investment cost refers to the total amount of money that the dry port operator spends to implement a service. Hence, the cost of acquiring something in order to have a certain service run will fall under this investment cost. As for profitability, it is the margin of profit that Dry Port could make by implementing the service. This is heavily related to the tariffs or fees and the operational costs that are related to certain dry port services. Moving on to the next innovation factor, which is technology and infrastructure, in order to avoid a correlation with investment cost, the technology and infrastructure criteria will only refer to the direct availability of obtaining and familiarity of usage of a certain technology or infrastructure needed to operate a certain service. This means that the extra effort that could be needed and has usually

come in monetary value in order to access certain technology or infrastructure is not considered in this factor and will be based on the investment cost.

Moving on to the next factor, which is human resources, this factor refers to the human aspect of operating a certain service. This heavily relates to the availability of capable human resources and the effort it takes to educate the staff. This is therefore very much related to acquiring a new workforce in the event that internal staff do not meet the requirement. Again, similar to technology, the extra effort that may come in terms of monetary value, such as a fee for training and hiring, will not be considered in this factor and will be an investment cost. As for the market competition factor, this will be limited to the competitive factor in order to gain the market that relates to the number of competitors, company's experiences, and reputation that ultimately relates to the market saturation. This will then not consider the tariff offered for a certain service to avoid correlation with profitability. Lastly, for regulatory compliance, it will refer to the complexity and experience of meeting a certain regulation that is necessary to implement a certain service. This again will not consider the additional cost that may come in monetary value in order to meet a certain regulation criterion. The discussion of each implementation factor is summarized in Table C2.

Table C2 MAMCA - Dry Port Operator Criteria

Innovation Factors	Definition
Technology and Infrastructure	Technological assets and physical infrastructure to support their operations, processes, and capabilities. It relates to the difficulty of accessing and familiarity with the technology and infrastructure.
Human Resource	The skills, knowledge, experience, and abilities possessed by individuals in the dry port contribute to the success of implementing a service. It relates to ensuring the availability of the right individual and training or such.
Profitability	Profitability refers to the ability of the dry port service to generate profit or financial gain over a specific period. It relates to the margin from the service's tariff and the operational cost.
Investment Cost	Investment cost refers to the total amount of money that a dry port operator spends to implement a service. This cost includes the purchase price of the investment itself, as well as any associated fees, commissions, taxes, and other expenses.
Market Competition	Market competitiveness refers to the ability of the dry port service to effectively compete with other entities in the marketplace. It relates to market saturation and the dry port's competitive position in terms of experience and reputation.

Innovation Factors	Definition
Regulatory Compliance	Regulatory compliance refers to the adherence to laws, regulations, guidelines, and specifications relevant for a dry port to implement a specific service. It refers to the complexity and experience of meeting a certain regulation that is necessary to implement a certain service.

Criteria Weighting

With the criteria clearly defined for all the stakeholders, the next part that will be covered is the method of weighing each of the criteria. In order to weigh the importance of each of the criteria relative to each of the stakeholders, the swing weighting method (von Winterfeldt & Edwards, 1986) will be employed. The criteria range in the elicitation questions is explicitly incorporated by the swing weighting method (Pöyhönen & Hämäläinen, 2001). In the swing weighting method, the dry port stakeholder is first asked to consider a hypothetical dry port service in which all the criteria are at their worst consequence levels. Then, the stakeholder is asked to identify the most important criteria, that is, a criterion whose consequence is most preferable to be changed from its worst level to its best level. This is given a hundred points.

Next, the dry port stakeholder is asked to identify a criterion whose consequence is preferred next to be changed to its best level. To this end, the DM is asked to assign fewer points to denote the relative importance of the change in this compared to the change in the most important criteria. The procedure continues similarly for the other criteria. Following normalization, the scores are understood as the weights assigned to each criterion (Pöyhönen & Hämäläinen, 2001). Suppose we have n criteria (j = 1, 2, …, n), s_j is the score that decision-maker assigns to criteria j, and w_j is the importance weight of the criteria j. Then the weight of criteria j is obtained by normalizing the scores as shown in Equation C.1.

$$W_j = \frac{s_j}{\sum_{j=1}^{n} s_j} \qquad \text{(C.1)}$$

Criteria Indicator and Measurement

With the weight of each of the criteria covered, the next step in the MAMCA is to define the indicator and measurement method for each of the criteria. To measure the dry port service performance in each of the considered criteria, a survey using a Likert scale will be utilized. For the performance attributes, each of the dry port customers (the cargo owner and the shipping line) will be asked to rate each of the dry port services a value of 1–5 in helping their organization perform in each of the performance attributes, with 1 suggesting a very low impact and 5 suggesting a very high impact. As for the innovation factors, the dry port operator will be asked to rate each of the dry port services a value of 1–5 in overcoming the innovation factors,

with 1 suggesting the service is very challenging to overcome the particular factor and 5 suggesting the service is very able to overcome the particular factor. The full survey used for the swing weighting as well as measuring each of the dry port services' performances is shown in Appendix D. MAMCA-Swing Survey Details. It may be argued that an alternative to this approach of using the Likert scale to measure function performance is by using an absolute value, such as the absolute value of lead time reduction or the absolute value of investment cost. However, this may neglect other factors that are also argued to be important in assessing performance. As an example, it may be that a specific dry port function will require a hefty amount of investment in order to be implemented. However, it may be that the specific function is a service that attracts investors easily or is even heavily subsidized by the government, making it relatively easy to overcome the investment cost challenges. In order to try to consider this wide spectrum of aspects in assessing the dry port functions' performance, the Likert questionnaire as has been laid out previously is chosen to be employed in this project.

Overall Analysis

The last step in the MAMCA analysis will be to do an overall analysis and ranking of the alternatives. In order to do that, the additive value function will be used to conduct the analysis. The additive value function will be used to calculate the final value of each of the dry port services relative to its performance in the stakeholder criteria. The additive value function may only be employed in the case where full independence is ensured for all the criteria, hence is the reasoning for the thorough discussion on independence of the criteria used in the analysis. Suppose that we have m alternatives (i = 1, 2, …, m), n criteria (j = 1, 2, …, n), p_{ij} is the performance of a dry port service i on criteria j, and w_j is the importance weight of the criteria j, then the final value of dry port service i is obtained by following the formula as shown in Equation C.2.

$$V_i = \sum_{j=1}^{n} w_j p_{ij} \qquad \text{(C.2)}$$
$$w_j \geq 0 \, , \sum w_j = 1$$

The final value for each of the dry port functions will be plotted in a graph with the functions' value for dry port customer criteria plotted along the x-axes and functions' value for dry port operator criteria plotted along the y-axes. This approach for the overall analysis is motivated for the later maturity model design process. The overall MAMCA process with the Swing weighting method employed in this study is summarized with an illustration in Figure C1.

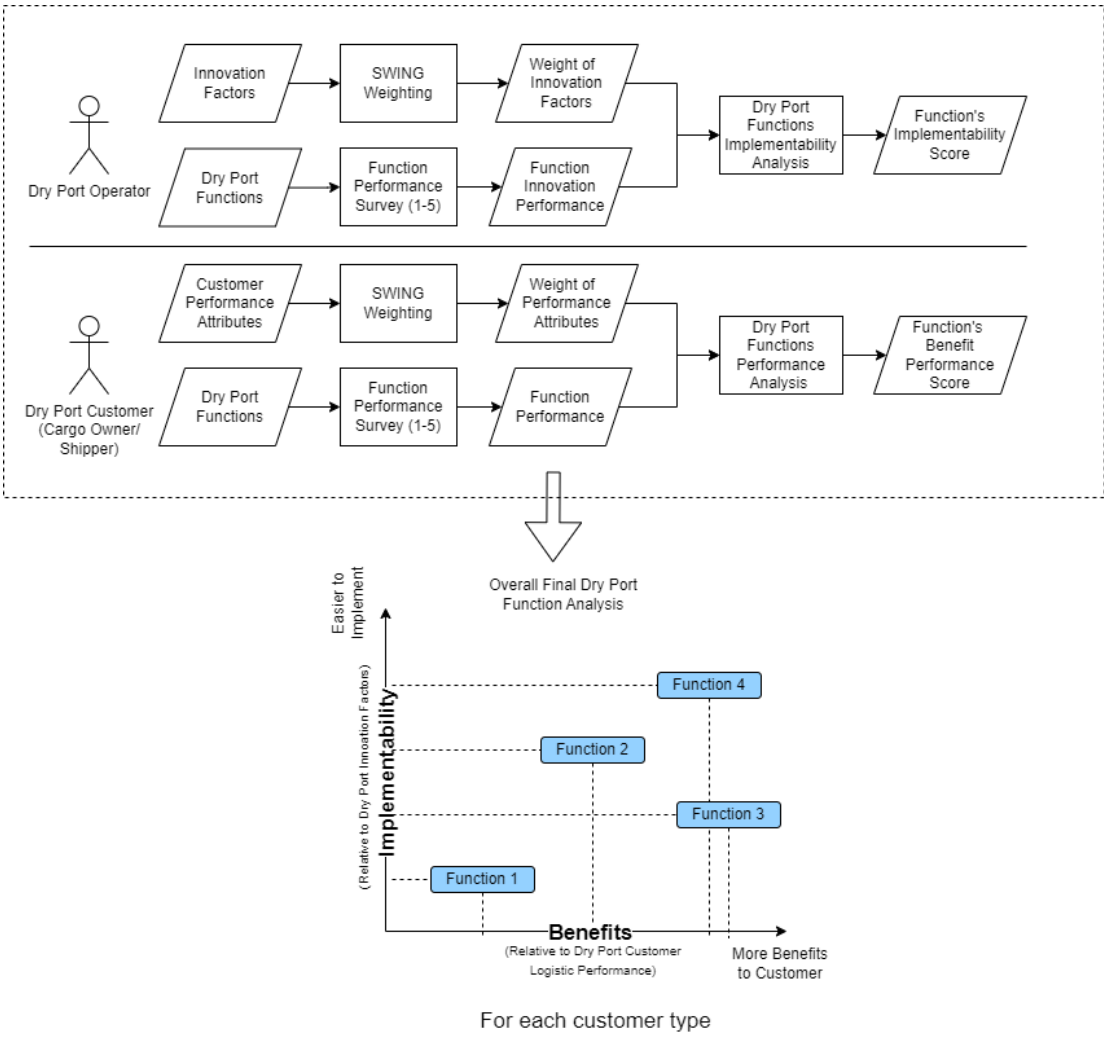
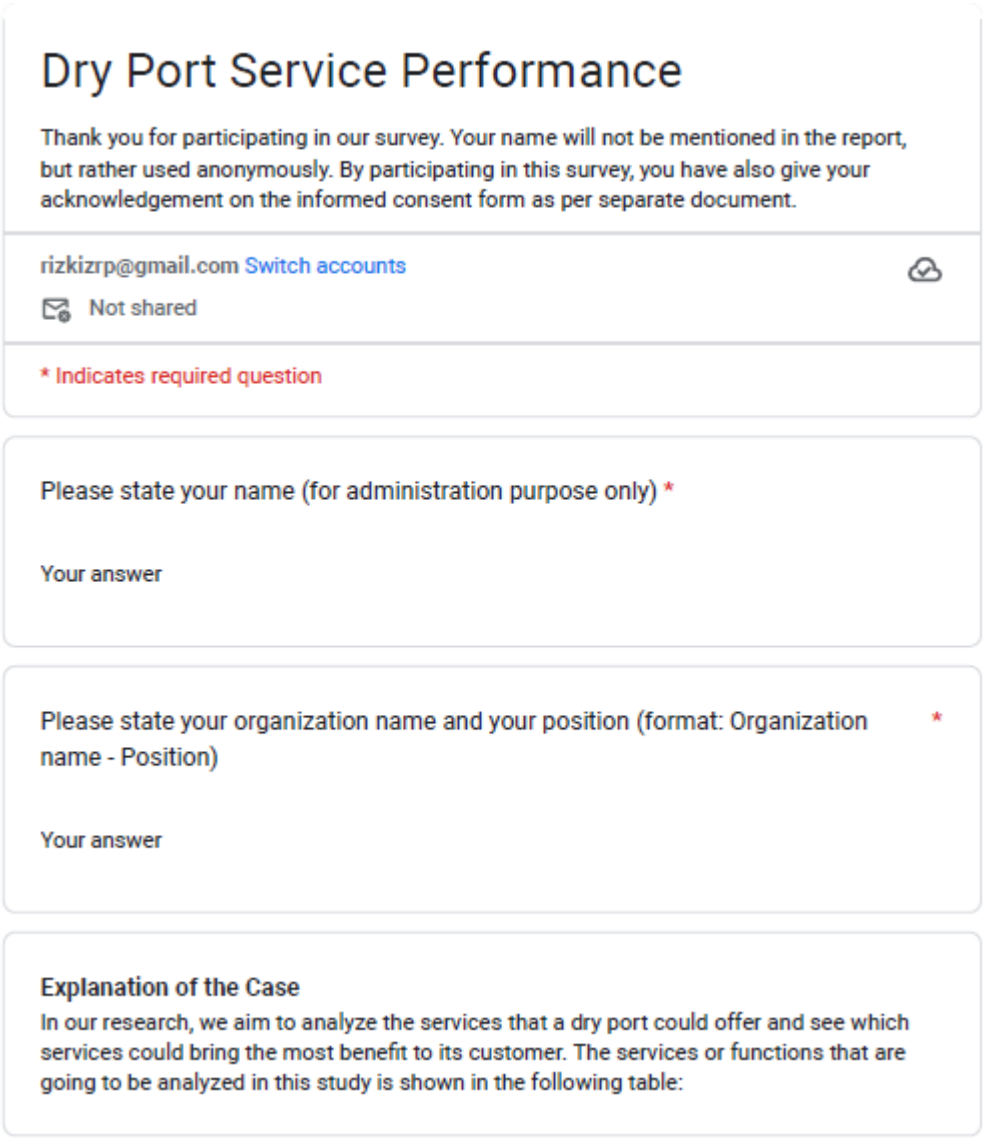


Figure C1 MAMCA-Swing Process on Dry Port Functions

Appendix D. MAMCA-Swing Survey Details

Performance Attributes Survey



Dry Port Service Performance

Thank you for participating in our survey. Your name will not be mentioned in the report, but rather used anonymously. By participating in this survey, you have also give your acknowledgement on the informed consent form as per separate document.

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* Indicates required question

Please state your name (for administration purpose only) *

Your answer

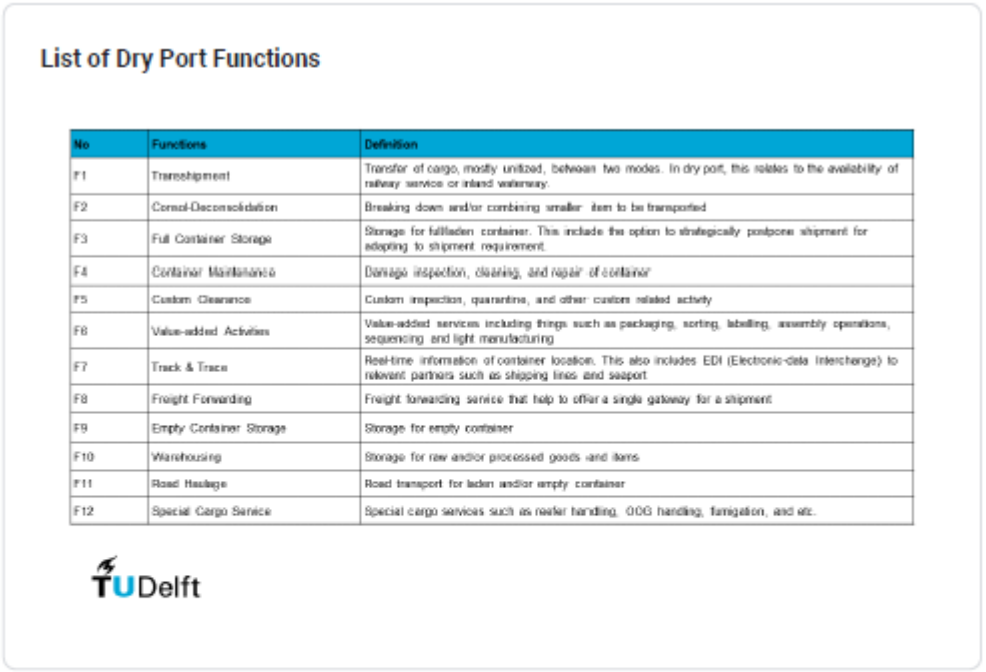
Please state your organization name and your position (format: Organization name - Position) *

Your answer

Explanation of the Case

In our research, we aim to analyze the services that a dry port could offer and see which services could bring the most benefit to its customer. The services or functions that are going to be analyzed in this study is shown in the following table:

Figure D1 Survey Performance Attributes 1



List of Dry Port Functions

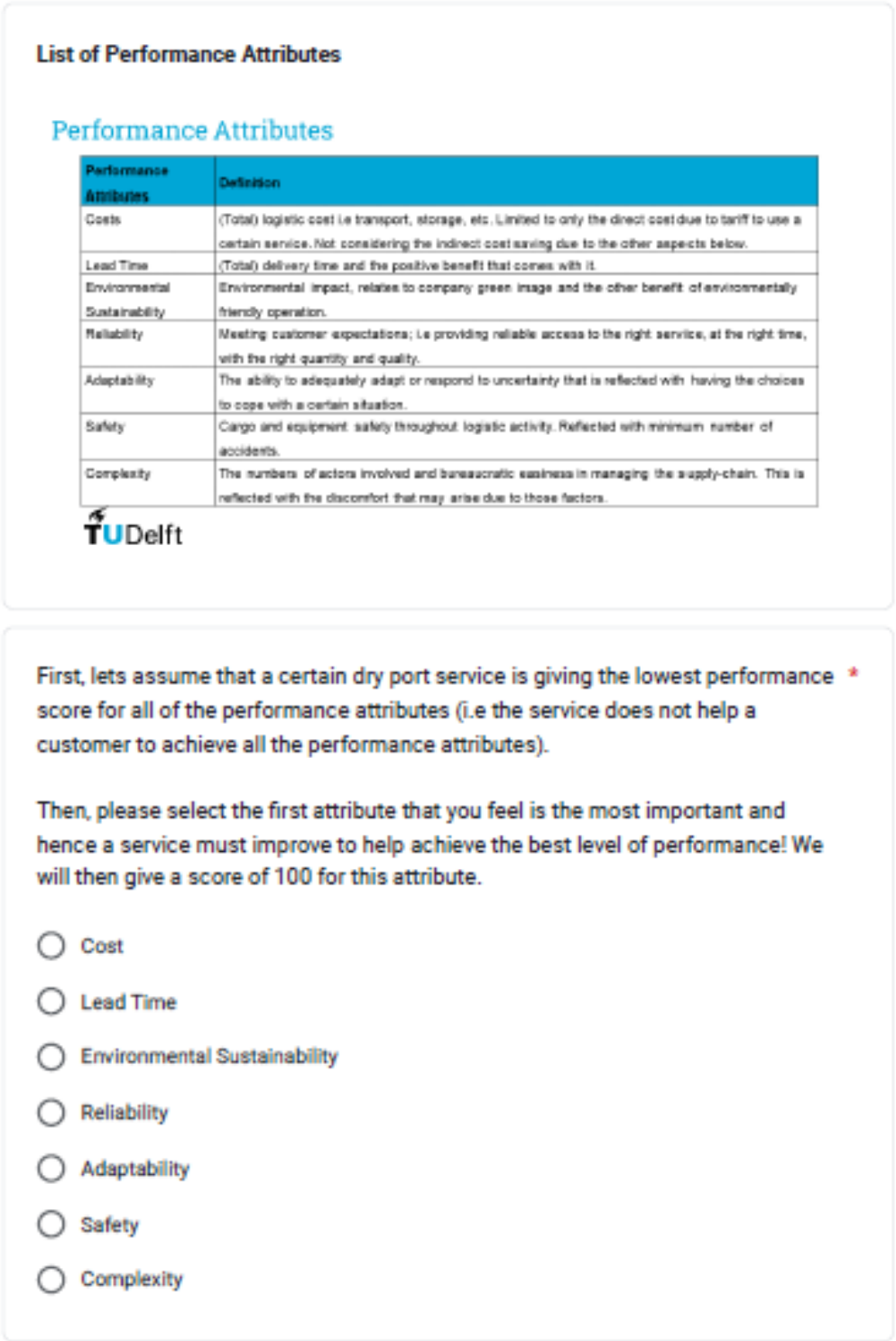
No	Functions	Definition
F1	Transhipment	Transfer of cargo, mostly unitized, between two modes. In dry port, this relates to the availability of railway service or inland waterway.
F2	Consol-Deconsolidation	Breaking down and/or combining smaller item to be transported
F3	Full Container Storage	Storage for fullladen container. This include the option to strategically postpone shipment for adapting to shipment requirement.
F4	Container Maintenance	Damage inspection, cleaning, and repair of container
F5	Custom Clearance	Custom inspection, quarantine, and other custom related activity
F6	Value-added Activities	Value-added services including things such as packaging, sorting, labelling, assembly operations, sequencing and light manufacturing
F7	Track & Trace	Real-time information of container location. This also includes EDI (Electronic-data Interchange) to relevant partners such as shipping lines and seaport
F8	Freight Forwarding	Freight forwarding service that help to offer a single gateway for a shipment
F9	Empty Container Storage	Storage for empty container
F10	Warehousing	Storage for raw and/or processed goods and items
F11	Road Haulage	Road transport for laden and/or empty container
F12	Special Cargo Service	Special cargo services such as reefer handling, OOG handling, fumigation, and etc.

TUDelft

Performance Attributes

In order to analyze the services, we will utilize several performance attributes to see how each of these functions could help the customer to perform in each of the attributes. The performance attributes used in this study is shown in the following table:

Figure D2 Survey Performance Attributes 2



List of Performance Attributes

Performance Attributes

Performance Attributes	Definition
Costs	(Total) logistic cost i.e transport, storage, etc. Limited to only the direct cost due to tariff to use a certain service. Not considering the indirect cost saving due to the other aspects below.
Lead Time	(Total) delivery time and the positive benefit that comes with it.
Environmental Sustainability	Environmental impact, relates to company green image and the other benefit of environmentally friendly operation.
Reliability	Meeting customer expectations; i.e providing reliable access to the right service, at the right time, with the right quantity and quality.
Adaptability	The ability to adequately adapt or respond to uncertainty that is reflected with having the choices to cope with a certain situation.
Safety	Cargo and equipment safety throughout logistic activity. Reflected with minimum number of accidents.
Complexity	The numbers of actors involved and bureaucratic easiness in managing the supply-chain. This is reflected with the discomfort that may arise due to those factors.

TUDelft

First, lets assume that a certain dry port service is giving the lowest performance score for all of the performance attributes (i.e the service does not help a customer to achieve all the performance attributes). *

Then, please select the first attribute that you feel is the most important and hence a service must improve to help achieve the best level of performance! We will then give a score of 100 for this attribute.

- ◯ Cost
- ◯ Lead Time
- ◯ Environmental Sustainability
- ◯ Reliability
- ◯ Adaptability
- ◯ Safety
- ◯ Complexity

Figure D3 Survey Performance Attributes 3

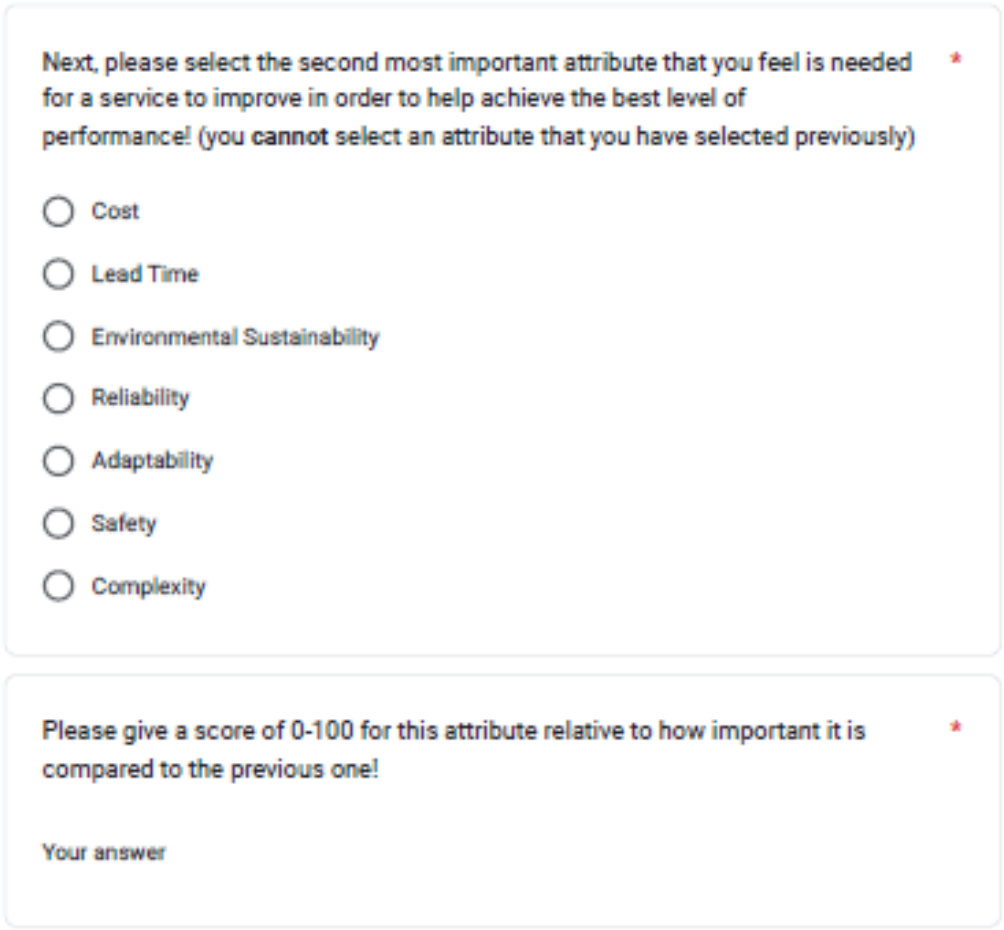
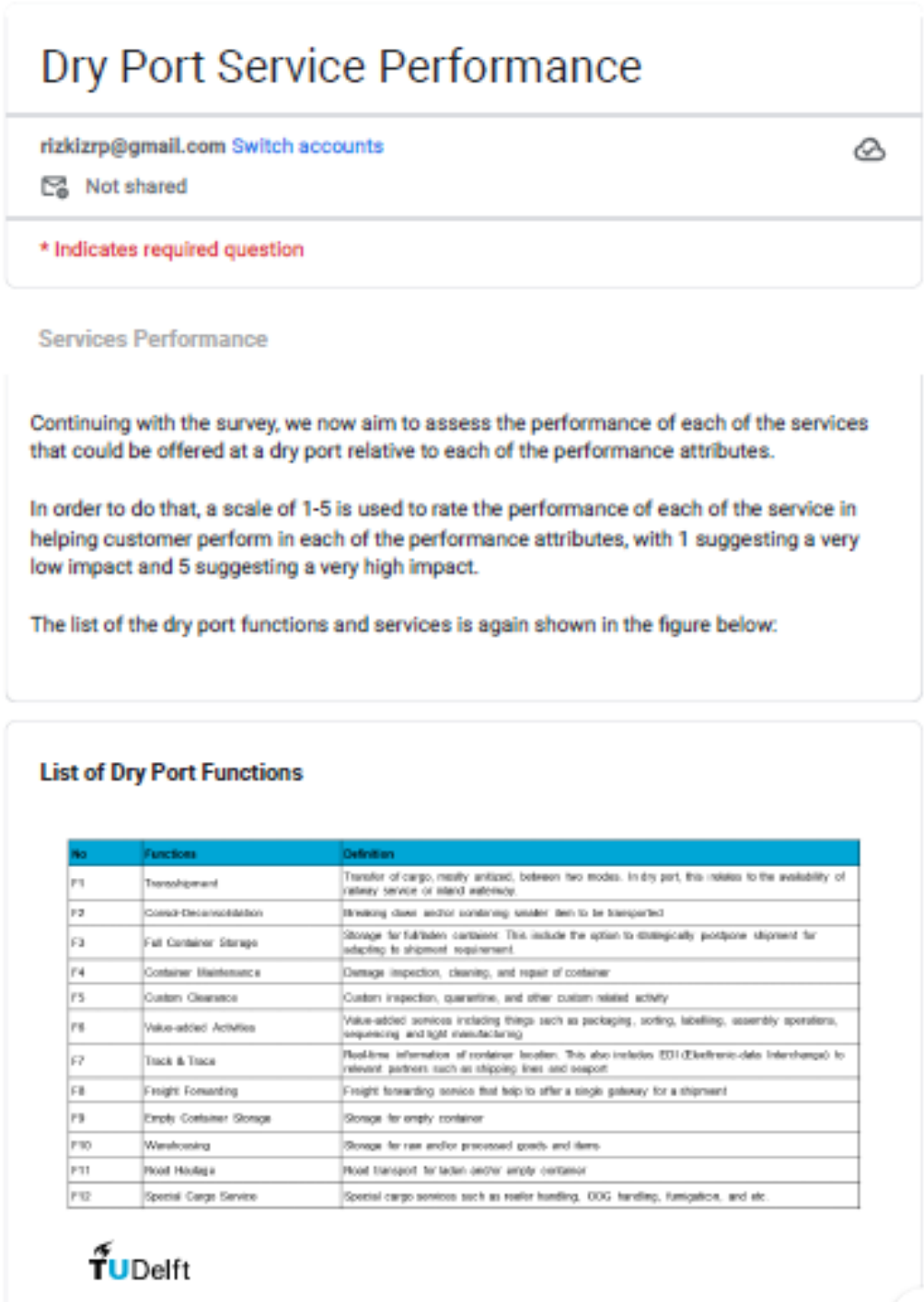


Figure D4 Survey Performance Attributes 4



Dry Port Service Performance

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* Indicates required question

Services Performance

Continuing with the survey, we now aim to assess the performance of each of the services that could be offered at a dry port relative to each of the performance attributes.

In order to do that, a scale of 1-5 is used to rate the performance of each of the service in helping customer perform in each of the performance attributes, with 1 suggesting a very low impact and 5 suggesting a very high impact.

The list of the dry port functions and services is again shown in the figure below:

List of Dry Port Functions

No	Functions	Definition
F1	Transshipment	Transfer of cargo, mostly anticipated, between two modes. In dry port, this relates to the availability of railway service or inland waterway.
F2	Consol-Deconsolidation	Breaking down and/or combining smaller item to be transported
F3	Full Container Storage	Storage for full/laden containers. This include the option to strategically postpone shipment for adapting to shipment requirement.
F4	Container Maintenance	Damage inspection, cleaning, and repair of container
F5	Custom Clearance	Custom inspection, quarantine, and other custom related activity
F6	Value-added Activities	Value-added services including things such as packaging, sorting, labelling, assembly operations, sequencing, and light manufacturing
F7	Track & Trace	Real-time information of container location. This also includes EDI (Electronic data Interchange) to relevant partners such as shipping lines and seaport
F8	Freight Forwarding	Freight forwarding services that help to offer a single gateway for a shipment
F9	Empty Container Storage	Storage for empty container
F10	Warehousing	Storage for raw and/or processed goods and items
F11	Road Haulage	Road transport for laden and/or empty container
F12	Special Cargo Service	Special cargo services such as reefer handling, OOG handling, fumigation, and etc.

TUDelft

Figure D5 Survey Performance Attributes 5

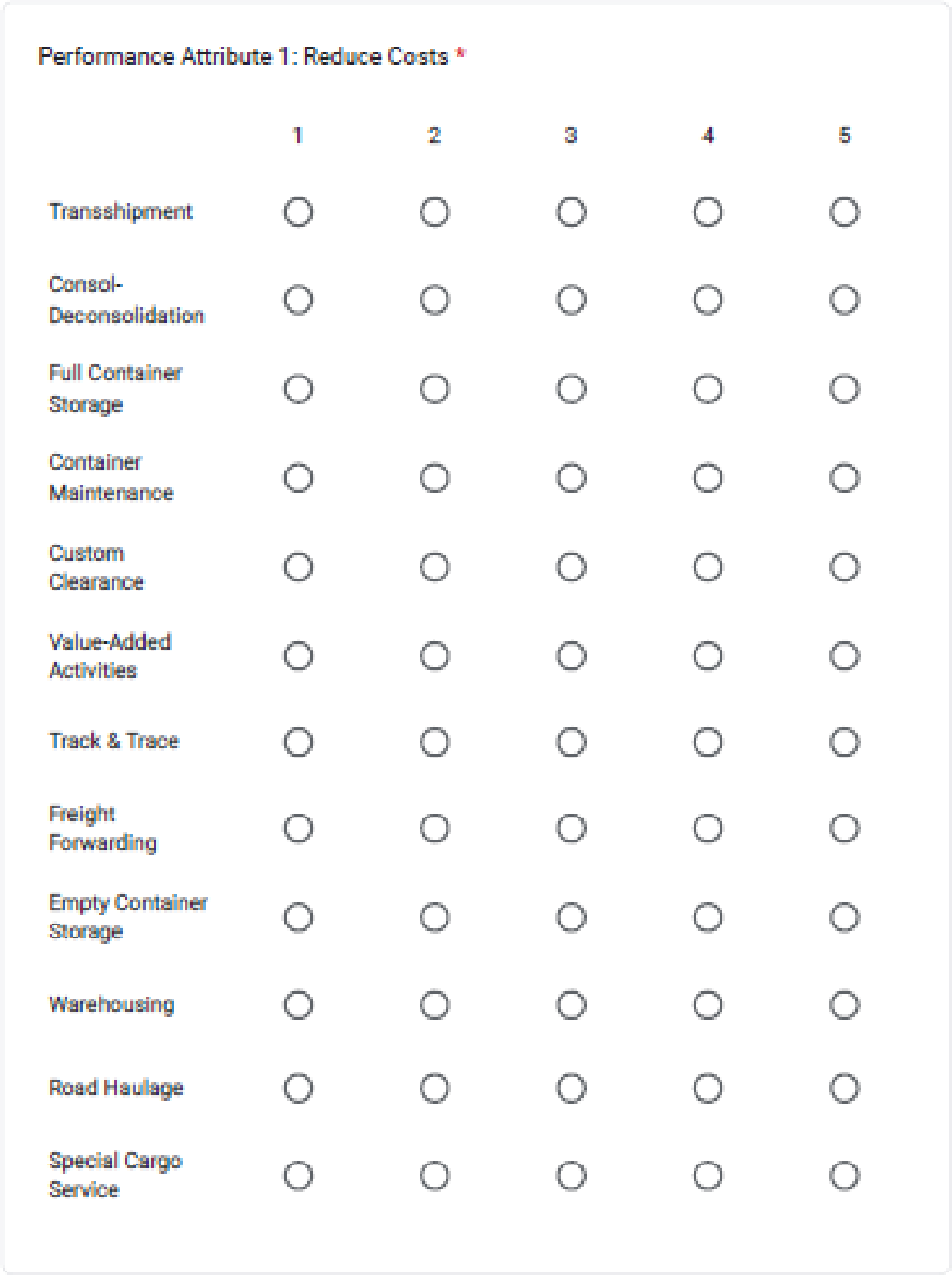
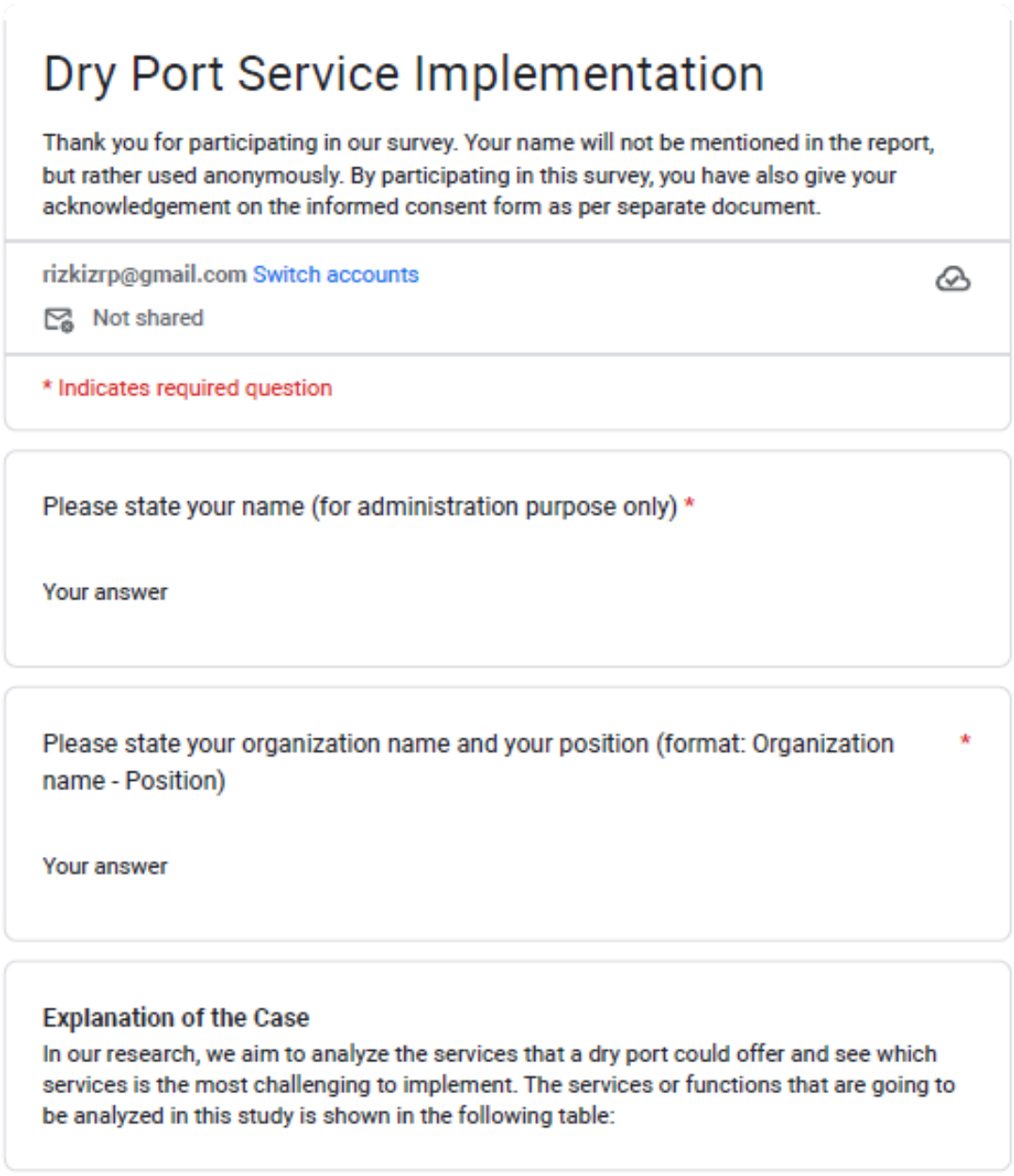


Figure D6 Survey Performance Attributes 6

Implementation Factors Survey



Dry Port Service Implementation

Thank you for participating in our survey. Your name will not be mentioned in the report, but rather used anonymously. By participating in this survey, you have also give your acknowledgement on the informed consent form as per separate document.

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Not shared

* Indicates required question

Please state your name (for administration purpose only) *

Your answer

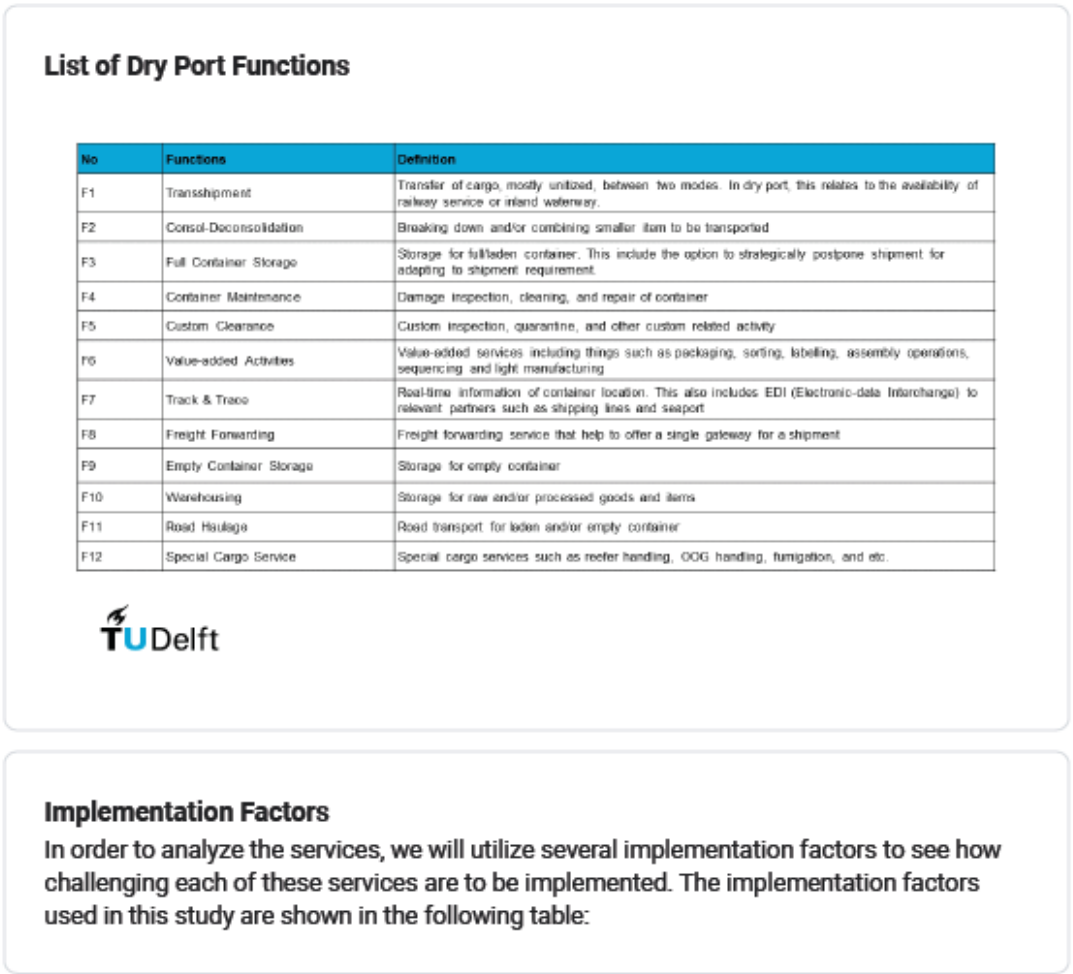
Please state your organization name and your position (format: Organization name - Position) *

Your answer

Explanation of the Case

In our research, we aim to analyze the services that a dry port could offer and see which services is the most challenging to implement. The services or functions that are going to be analyzed in this study is shown in the following table:

Figure D7 Survey Innovation Factors 1



List of Dry Port Functions

No	Functions	Definition
F1	Transshipment	Transfer of cargo, mostly unitized, between two modes. In dry port, this relates to the availability of railway service or inland waterway.
F2	Consol-Deconsolidation	Breaking down and/or combining smaller item to be transported
F3	Full Container Storage	Storage for full/laden container. This include the option to strategically postpone shipment for adapting to shipment requirement.
F4	Container Maintenance	Damage inspection, cleaning, and repair of container
F5	Custom Clearance	Custom inspection, quarantine, and other custom related activity
F6	Value-added Activities	Value-added services including things such as packaging, sorting, labelling, assembly operations, sequencing and light manufacturing
F7	Track & Trace	Real-time information of container location. This also includes EDI (Electronic-data Interchange) to relevant partners such as shipping lines and seaport
F8	Freight Forwarding	Freight forwarding service that help to offer a single gateway for a shipment
F9	Empty Container Storage	Storage for empty container
F10	Warehousing	Storage for raw and/or processed goods and items
F11	Road Haulage	Road transport for laden and/or empty container
F12	Special Cargo Service	Special cargo services such as reefer handling, OOG handling, fumigation, and etc.

TUDelft

Implementation Factors

In order to analyze the services, we will utilize several implementation factors to see how challenging each of these services are to be implemented. The implementation factors used in this study are shown in the following table:

Figure D8 Survey Innovation Factors 2

List of Implementation Factors

Implementation Factors	Definition
Technology and Infrastructure	The technological assets and physical infrastructure to support their operations, processes, and capabilities. Relates to the difficulty to access and familiarity with the technology and infrastructure.
Human Resource	The skills, knowledge, experience, and abilities possessed by individuals in the dry port that contribute to the success of implementing a service. Relates to assuring the availability of the right individual and training or such.
Profitability	Profitability refers to the ability of the dry port service to generate profit or financial gain over a specific period. Relates to the margin from service's tariff and the operational cost.
Investment Cost	Investment cost refers to the total amount of money that dry port operator spends to implement a service. This cost includes the purchase price of the investment itself, as well as any associated fees, commissions, taxes, and other expenses.
Market Competitive	Market competitiveness refers to the ability of the dry port service to effectively compete with other entities in the marketplace. Relates to how saturated the market is and the dry port competitive position in terms of experience and reputation.
Regulatory Compliance	Regulatory compliance refers to the adherence to laws, regulations, guidelines, and specifications relevant for a dry port to implement a specific service. Relates to the complexity and experience of meeting a certain regulation that is necessary to implement a certain service.

TUDelft

First, lets assume that a certain service is giving the lowest score for all of the implementation factors (i.e the service is hard to be implemented based on all the implementation factors). *

Then, please select the first factor that you feel is the most important and hence a service must tackle to help achieve the implementation of the service! We will then give a score of 100 for this factor.

- ◯ Investment Cost
- ◯ Profitability
- ◯ Human Resource
- ◯ Regulatory Compliance
- ◯ Market Competitiveness
- ◯ Technology and Infrastructure

Figure D9 Survey Innovation Factors 3

Next, please select the second most important factor that you feel is needed for a service to tackle in order to help achieve the implementation of the service ! (you **cannot** select a factor that you have selected previously) *

- ◯ Investment Cost
- ◯ Profitability
- ◯ Human Resource
- ◯ Regulatory Compliance
- ◯ Market Competitiveness
- ◯ Technology and Infrastructure

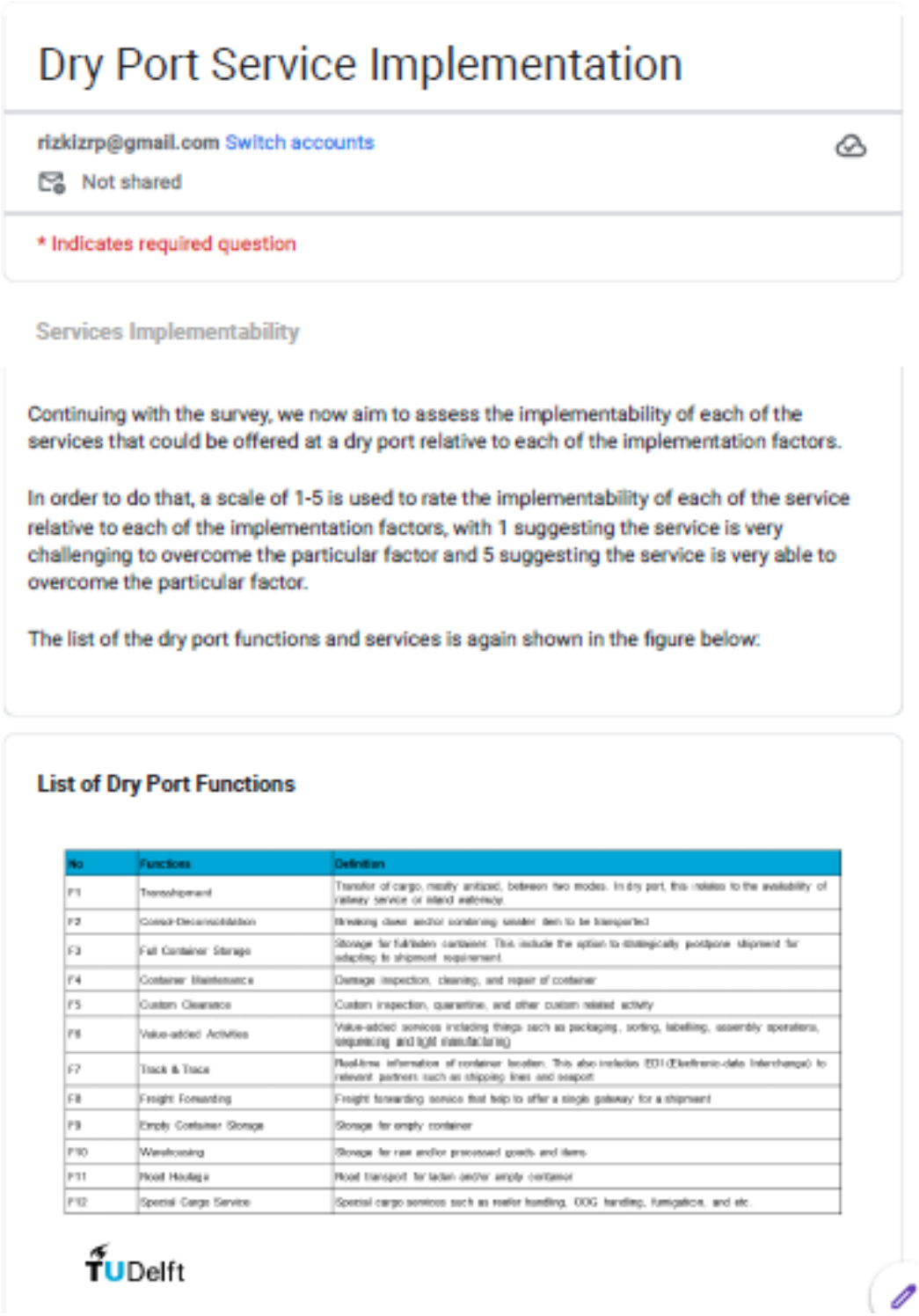
Please give a score of 0-100 for this factor relative to how important it is compared to the previous one! *

Your answer

Next, please select the third most important factor that you feel is needed for a service to tackle in order to help achieve the implementation of the service! (you **cannot** select a factor that you have selected previously) *

- ◯ Investment Cost
- ◯ Profitability
- ◯ Human Resource
- ◯ Regulatory Compliance
- ◯ Market Competitiveness
- ◯ Technology and Infrastructure

Figure D10 Survey Innovation Factors 4



Dry Port Service Implementation

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* Indicates required question

Services Implementability

Continuing with the survey, we now aim to assess the implementability of each of the services that could be offered at a dry port relative to each of the implementation factors.

In order to do that, a scale of 1-5 is used to rate the implementability of each of the service relative to each of the implementation factors, with 1 suggesting the service is very challenging to overcome the particular factor and 5 suggesting the service is very able to overcome the particular factor.

The list of the dry port functions and services is again shown in the figure below:

List of Dry Port Functions

No	Functions	Definition
F1	Transshipment	Transfer of cargo, mostly anticipated, between two modes. In dry port, this relates to the availability of railway service or inland waterway.
F2	Consol-Deconsolidation	Breaking down and/or combining smaller item to be transported
F3	Full Container Storage	Storage for full/laden containers. This include the option to strategically postpone shipment for adapting to shipment requirement.
F4	Container Maintenance	Damage inspection, cleaning, and repair of container
F5	Custom Clearance	Custom inspection, quarantine, and other custom related activity
F6	Value-added Activities	Value-added services including things such as packaging, sorting, labelling, assembly operations, sequencing and light manufacturing
F7	Track & Trace	Real-time information of container location. This also includes EDI (Electronic-data Interchange) to relevant partners such as shipping lines and seaport
F8	Freight Forwarding	Freight forwarding service that help to offer a single gateway for a shipment
F9	Empty Container Storage	Storage for empty container
F10	Warehousing	Storage for raw and/or processed goods and items
F11	Road Haulage	Road transport for laden and/or empty container
F12	Special Cargo Service	Special cargo services such as reefer handling, OOG handling, fumigation, and etc

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Figure D11 Survey Innovation Factors 5

Figure D12 Survey Innovation Factors 6

Appendix E. MAMCA-Swing Data

Dry Port Operator

Table E1 Dry Port Operator MAMCA Data

Functions	Technology and Infrastructure	Human Resource	Profitability	Investment Cost	Market Competitiveness	Regulatory Compliance	Final Score	Rank
Transshipment	4	3	4	4	3	5	3.87	6
Consol-Deconsolidation	5	3	3	3	3	5	3.65	8
Full Container Storage	5	4	5	5	4	5	4.69	4
Container Maintenance	3	3	2	3	3	3	2.78	12
Custom Clearance	5	5	5	5	5	5	5.00	1
Value-added Activities	3	3	4	3	3	4	3.39	9
Track & Trace	5	4	5	5	5	5	4.89	2
Freight Forwarding	4	4	4	3	2	2	3.10	10
Empty Container Storage	5	5	5	5	4	5	4.80	3
Warehousing	4	4	4	4	3	4	3.80	7
Road Haulage	5	5	3	5	4	3	4.02	5
Special Cargo Service	3	3	3	3	3	3	3.00	11

Shipping Lines

Table E2 Shipping Lines MAMCA Data

Functions	Cost	Lead Time	Environmental Sustainability	Reliability	Adaptability	Safety	Complexity	Final Score	Rank
Transshipment	4	4	5	5	5	5	5	4.66	1
Consol-Deconsolidation	1	1	1	1	1	1	1	1.00	7
Full Container Storage	1	1	1	1	1	1	1	1.00	7
Container Maintenance	4	5	3	5	5	1	3	3.78	5
Custom Clearance	1	1	1	1	1	1	1	1.00	7
Value-added Activities	1	1	1	1	1	1	1	1.00	7
Track & Trace	3	1	1	5	5	4	5	3.53	6
Freight Forwarding	1	1	1	1	1	1	1	1.00	7
Empty Container Storage	4	5	3	5	5	5	5	4.59	2
Warehousing	1	1	1	1	1	1	1	1.00	7
Road Haulage	5	3	4	4	4	3	5	4.11	3
Special Cargo Service	4	3	4	4	4	3	5	3.91	4

Cargo Owners

Table E3 Cargo Owners MAMCA Data

Functions	Cost	Lead Time	Environmental Sustainability	Reliability	Adaptability	Safety	Complexity	Final Score	Rank
Transshipment	4	3	5	4	5	5	5	4.44	2
Consol-Deconsolidation	4	3	3	3	5	3	2	3.23	7
Full Container Storage	5	4	3	3	5	5	5	4.31	3
Container Maintenance	5	4	3	3	3	3	3	3.41	6
Custom Clearance	5	5	5	5	5	4	5	4.86	1
Value-added Activities	4	2	4	3	3	3	2	2.96	11
Track & Trace	5	3	3	3	4	4	4	3.73	4
Freight Forwarding	2	2	3	3	3	3	3	2.73	12
Empty Container Storage	2	3	3	3	5	3	3	3.12	9
Warehousing	5	3	3	3	3	3	2	3.11	10
Road Haulage	5	3	3	5	3	3	3	3.60	5
Special Cargo Service	3	3	3	4	3	3	3	3.16	8

Appendix F. Model Evaluation - Expert Interview

Expert 1: Logistic professional & academics – work in NL and ID

1. **Topic: Understandability** – Is the maturity model understandable for evaluating dry ports maturity?

I think so, yes. It's clear especially with the legends and information provided to help describe the model.

2. **Topic**: **Ease of use** – Is the maturity model easy to be used as assessment tool and in helping development of a dry port?

I also think so. Dry port operator can assess where they are at the moment what they service that they could add to improve its maturity level.

3. **Topic**: **Usefulness** – Will the maturity model be useful for use as an assessment tool and in helping development of a dry port?

I think the model will be useful and work well. The model is clear and transparent although still is very qualitative. It is still fine to keep it to be very qualitative. The model will be useful for the dry port operator internal discussion that later can be used to make a more detailed plan for improvement such as the creation of KPI. This model hence is more as a tool to guide the thinking and discussion process.

4. **Topic: Maturity Levels** - Is the maturity model have sufficient level or does it need more or maybe less level? Please also explain the reasoning for the answer. [Sufficiency & Accuracy]

I think 4 levels are sufficient as I believe that more levels will not add much value

5. **Topic: Processes** – Are there any functions that needed to be added or removed in the maturity model? Please also explain the reasoning for the answer. [Relevance, Comprehensiveness, & Mutual Exclusiveness]

Freight forwarding is a concern especially about data sharing as it might relate to sensitive data. This might concern another client's group. As an example, from advanced level, the data collected by dry port operator could already be a lot and this could be causing a problem (such as conflict of interest). To put more context, the freight forwarding will help cargo owners to select which shipping line to use and since a lot of information has already been obtained on various shipping lines, this might cause concern. However, it could also be argued to helps improve shipping line performance.

6. **Topic: Processes** – Is there any need for a change on any of the function's description? Please also explain the reasoning for the answer. [Accuracy]

For people in business, it is clear in general. The description can be summarized to add example and clarification on each of the terms of the following activities. For operational level is very depending on each of the dry port. So, it will be difficult to have a quantitative description. But it can be for another research to each of the specific dry port (size, number of clients, etc). It is clearer to keep it on qualitative. The model could at least contain parameters to explain each of the services (without the number). A more specific description is also advised on F11 – Road Haulage.

7. **Topic: Processes** – Are there any suggestions for updates related to the position of the functions on the maturity level? Please also explain the reasoning for the answer. [Accuracy]

All position is logical as it shows the gradual process of dry port service development.

Expert 2: Coordinator of logistic course at Indonesian university with past professional experience in logistic industry

1. **Topic: Understandability** – Is the maturity model understandable for evaluating dry ports maturity?

It is easy to understand the model since the concept of dry port service is expected to progress from the most basic to the integrated solution level as prescribe in the model.

2. **Topic**: **Ease of use** – Is the maturity model easy to be used as assessment tool and in helping development of a dry port?

It is easy for the model to be used especially in helping to plan the dry port future development

3. **Topic**: **Usefulness** – Will the maturity model be useful for use as an assessment tool and in helping development of a dry port?

Indeed, it will be useful for dry port operators especially to help them point out the benefit of using a dry port to the prospective customer. This is to persuade the use of dry port to the customer that eventually will experience the benefit themselves.

4. **Topic: Maturity Levels** - Is the maturity model have sufficient level or does it need more or maybe less level? Please also explain the reasoning for the answer. [Sufficiency & Accuracy]

The 4 levels selected is sufficient as it shows the gradual level of the service challenge and knowledge needed from the dry port operator.

5. **Topic: Processes** – Are there any functions that needed to be added or removed in the maturity model? Please also explain the reasoning for the answer. [Relevance, Comprehensiveness, & Mutual Exclusiveness]

All the functions have captured the services offered at a dry port. Only additional thought is to include any other additional, more detailed functions to the freight forwarding or the value-added services function.

6. **Topic: Processes** – Is there any need for a change on any of the function's description? Please also explain the reasoning for the answer. [Accuracy]

The qualitative description is enough to capture each of the functions in the maturity model. The quantitative aspects may not be needed. Other things that could added on the qualitative description could be on highlighting more on the regulation aspect of each of the functions.

7. **Topic: Processes** – Are there any suggestions for updates related to the position of the functions on the maturity level? Please also explain the reasoning for the answer. [Accuracy]

The positioning of the functions is sufficient as it shows the level of customer demand and the challenge to implement progress in the right direction in the maturity model. These positioning hence suggest a level of skills and knowledge needed from a dry port on a certain maturity level.

Additional comments on Indonesia:

Dry port in Indonesia has not been entirely understood by the customer especially regarding the benefits that a dry port could offer. Hence, it is imperative that the benefit of dry port is being campaigned further to push the usage rate of dry port in Indonesia further.