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Digital Ecosystem Transformation

A Case Study of a Port Ecosystem

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The purpose of digital transformation is not to become more digital, but to generate value. It is an increasingly dominant topic among organizations and in unison with an increasing importance aimed at ecosystem perspectives, companies are destined to understand these topics in order to maintain their competitiveness.

While understanding of what digital transformation means, as well as what are the drivers behind the phenomenon, there is a clear gap in literature in terms of how to undergo a transformation. Especially, regarding digital transformation on an ecosystem level, which can provide great potential for improving inter-relations among ecosystem members, while improving the value creation of the ecosystem as an entity.

Hence, this thesis aims to this study aims thus to uncover a process for undertaking an ecosystem wide digital transformation, based on an intervention that investigates dependencies between characteristic, challenges, and opportunities within the ecosystem's industry. The main question is: How can an ecosystem wide digital transformation process be organized?

The empirical part of this thesis presents a single case study. Data has been collected through a threefold process; first conducting informal meetings with participants, secondly conducting semi-structured interviews, and lastly organizing an intervention workshop. Analysis follows an iterative process, creation of boundary material, transcribing interviews, coding, and examining inter-dependencies among attributes found in the research.

As a result, this thesis provides a conceptual model for undergoing a digital ecosystem transformation. Findings suggest that a top-down and bottom-up approach through an intervention that provides a shared logic and governance structure is a sufficient path for digitally transforming.

Keywords: Ecosystems, digitalization, digital transformation, data sharing

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Syftet med digital transformation är inte att bli mer digital, utan att skapa värde. Det är ett allt mer dominerande ämne bland organisationer och i samklang med en ökande betydelse riktat mot ekosystemperspektiv, är företag tvungna att förstå dessa ämnen för att behålla sin konkurrenskraft.

Medan förståelse för vad digital transformation betyder, likväl vad som är drivkrafterna bakom fenomenet, finns det ett tydligt tomrum i litteraturen när det gäller hur man genomgår en digital transformation. Speciellt när det gäller digital transformation på en ekosystemnivå, som kan ge stor potential för att förbättra förhållandena mellan ekosystemmedlemmarna, samtidigt som ekosystemets värdeskapande skapas som en enhet.

Därför strävar denna avhandling till att klargöra en process för att genomföra en omfattande digital transformation av ekosystem, baserat på ett ingrepp som undersöker beroendet av karaktärsdrag, utmaningar och möjligheter inom ekosystemets industri. Huvudfrågan är: Hur kan en digital transformationsprocess av ett ekossystem organiseras?

Den empiriska delen av denna studie presenterar en fallstudie. Data har samlats in genom en trefaldig process; Först, genomförande av informella möten med deltagarna, två genomförande av halvstrukturerade intervjuer och slutligen organisering av en interventionsverkstad. Analysen följer en iterativ process, skapande av gränsmaterial, transkriberande intervjuer, kodning och undersökning av beroenden mellan attribut som finns i forskningen.

Som ett resultat ger denna avhandling en konceptuell modell för genomgång av en digital ekosystemtransformation. Resultaten tyder på att en top-down och bottom-up-tillvägagångssätt genom ett ingrepp som ger en gemensam logik och styrningsstruktur är en tillräcklig väg för digital omvandling.

Asiasanat: Ekosystem, digitalisering, digitaal transformation, data delning

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Grazie mille,

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I INTRODUCTION

1. INTRODUCTION

In this thesis, knowledge creation on digital ecosystem transformation is pursued. The objective entails designing a conceptual digital ecosystem transformation model, that focuses on the ecosystem's collective value proposition. Theoretical contributions include addressing a research gap of digital transformation processes, especially considering ecosystems. From a practical perspective, this thesis provides novel insights for ecosystem members to guide an initiation of ecosystem wide digital transformation efforts.

This thesis is based on an empirical and theoretical analysis on digital ecosystem transformation, with an exploratory nature and with an emphasis on the empirical part. The empirical part is based on single-case study, whereas through an intervention inter-organizational processes are uncovered to reveal challenges and avenues for ecosystem wide development. The theoretical part in turn combines digital transformation, inter-organizational data sharing, and ecosystem literature to support the empirical study. In unison, these two entities are utilized to design a tentative and conceptual digital ecosystem transformation model.

1.1. BACKGROUND AND MOTIVATION

Ecosystems, digital transformation, and inter-organizational data sharing are all contemporary subjects that have received wide interest among researchers as well as practitioners (Panetto *et al.,* 2016; Vial, 2019; Jacobides, Cennamo and Gawer, 2018; Adner, 2017). Simultaneously, each of these topics are not completely understood as concepts.

However, value is a central theme within each topic. Form an ecosystem perspective, value is created internally within the ecosystem by individual organizations, as well as the ecosystem produces and shares value as an entity. More precisely, an organizations ability to provide its offering and thus creating value to itself and to end-users, is dependent on the loosely interconnected network of entities it is involved in (Iansiti and Levien, 2004). Digital transformation in turn, utilizes digital technologies to open new paths for value creation, with possible impacts on the larger society as a whole. It can be described as a strategic attempt to undergo a socio-technological

transformation through continuous digital innovation, due to external forces. (Vial, 2019). From an Industrial Internet perspective, inter-organizational data sharing is considered as one of the key drivers to create value (Jernigan, Kiron and Ransbotham, 2016; Rüßmann *et al.,* 2015; PwC, 2017)). This can be seen in the international interest in creating research and collaboration consortiums around the topic. In order to foster the coordination of value creation both from a digital transformation and an ecosystem perspective, inter-organizational data sharing provides a prospecting avenue as it is identified as an enabler of collaboration. Despite the growing interest in these topics, there are still numerous digital transformations that fail (Davenport and Westerman, 2018). One reason is the lack of knowledge in regards of how digital transformation should unfold (Skog, 2018).

Therefore, it is paramount to understand how digital transformation can be designed as a process, especially on an ecosystem level, in order to ensure a unison of value creation while simultaneously mitigating frictions in contradicting agendas among the network participants.

1.2. RESEARCH APPROACH, PROBLEM AND OBJECTIVES

There is a prevailing gap in literature regarding a lack of comprehension on detailed guidelines for how digital transformation can unfold, especially for an ecosystem. Research suggests, however, that interventions for co-creation can result in a governance structure, as well as shared logic to undergo a digital transformation (Lavikka *et al.,* 2017).

The aim of this thesis is to **to uncover a process for undertaking an ecosystem wide digital transformation,** based on an intervention that investigates dependencies between characteristic, challenges, and opportunities within an ecosystem's industry.

The objective of the thesis is to contribute to theory by addressing the research gap of digital transformation processes, especially considering ecosystems. From a practical perspective, this thesis provides novel insights for the ecosystem members to guide an initiation of ecosystem wide digital transformation efforts.

The study is based on a qualitative research approach, utilizing a single case-study. Qualitative research can be defined as "a set of complex interpretive practices" (Denzin and Lincoln, 2011) that aim to build a comprehension of the meaning of

concepts in social or human problems (Creswell, 2002). Furthermore, the qualitative researcher relies on the interpretation of data, that in contrast to quantitative studies cannot be measured in terms of amount, intensity, or frequency (Denzin and Lincoln, 2011). A case study as a research method strives to address questions requiring an in-depth comprehension of an organizational or social phenomenon, while typically providing explanations for "how" and "why" the phenomenon occurs (Yin, 2017). The approach is in particular suitable for research topics demanding novel insights and for which little empirical evidence is available due to immaturity of research conducted on the phenomenon and when current theories do not provide answers for the research questions (Eisenhardt, 1989; Eisenhardt and Graebner, 2007). As this thesis explores a contemporary subject distinguished by many unknowns while proven to be an important phenomenon lacking a firm theoretical foundation, the case study approach is well suited.

1.3. RESEARCH CONTEXT

This thesis studies the digital transformation of the Port of Helsinki ecosystem, within the cargo traffic and shipping sector. The aim is to examine current ecosystem level processes, value networks, and inter-organizational data sharing opportunities in order to evaluate how the ecosystem could carry out a digital transformation. The participating stakeholders range from small and medium sized local organizations to large global enterprises with over 100 000 employees.

The Port of Helsinki manages in total eight separate harbors and is the busiest passenger port in Europe, in addition to being Finland's leading port for foreign trade. While the port is set up as a private limited company, it is owned by the City of Helsinki. In this thesis two harbors have been examined: the West Harbour and Vuosaari Harbour, whereas greater focus have been directed towards the latter. While West Harbour mainly serves passenger traffic, a significant volume of Roll On Roll Off (RORO) heavy traffic passes through the port as well. The West Harbour functions as a connection to Tallinn and has been one of the fastest growing routes in Europe, partly due to it being used as a trade route between Finland and Eastern Europe. Vuosaari Harbour in turn serves both container and RORO traffic.

The author of this thesis has not been employed by the Port of Helsinki, but instead studied the ecosystem around the port from a neutral perspective, working for a multi-disciplinary research project named Digital Disruption of Industry.

1.4. STRUCTURE OF THE THESIS

The structure of the thesis is divided into to four main parts. First, the introduction (I) describes the motivation of the thesis, presents the research problem, and outlines the objectives of the research. Furthermore, the approach and the scope, in addition to the methods of the thesis are discussed. The second part of the thesis, in turn, focuses on the theoretical framework (II) by presenting the background literature and key concepts of this thesis. The theoretical framework reviews the core concepts of this thesis: ecosystems, digital transformation, and data sharing. The third part (III) lays out the empirical study of the thesis, including the case context, data collection and analysis, and at last a presentation of the empirical findings. The fourth (IV) and last part consists of a discussion, whereas empirical findings are contrasted in the light of the theoretical framework. Additionally, the conclusions of the research are presented, while implications of the study are considered. At last, the research is evaluated.

II THEORETICAL FRAMEWORK

This part of the thesis presents the theoretical background, based on literature reviews. The literature reviews have been conducted utilizing two distinctive approaches: a systematic review based on Boolean searches, as well as Webster and Watson's (2002) approach of reviewing backwards- and forwards-looking references.

The theoretical framework begins by exploring ecosystems, followed by a review of digitalization and digital transformation as concepts. The intent is to create a foundation for the empirical research, by outlining a high-level review of the domains that are explored in this thesis. Furthermore, the prominent traits of the concepts need to be delineated, in order to fathom the potential impact as well as the relational relevance of the findings of this thesis. Secondly, a brief review on inter-organizational data-sharing is provided, with an aim of presenting the current status of ongoing research of the topic. At last a theoretical synthesis is provided, in order to tie the topics together.

2. DEFINING ECOSYSTEMS

The term ecosystem stems, as anticipated, from the scientific field of ecology, where it revolves around viewing the natural world as systems of systems and focuses on the interactions between organisms and their environment (Chapin III, Matson and Vitousek, 2011, p. 3). While interactions between organisms and their environment has been a driver for various studies among several sub-fields of ecology and biology since the seventeenth century, a British ecologist, Arthur Tansley, was the first to introduce the term ecosystem in the early 20th century, as an outcome of distress around former and then contemporary studies focusing excessively on the organism. Thus, Tansley aimed to accentuate the importance of material exchange between organisms and their surrounding environments. More recent development within the field has revolved around understanding *how* and *why* ecosystems change. (Chapin III, Matson and Vitousek, 2011, p. 8-11).

Early works of adopting ecosystem conceptualization in social sciences originates from works by Rothschild (1990) and Moore (1993). The former, focusing on macroeconomics, acknowledges that "*organizations, like organisms, are built on complex hierarchies"* and that they are affected by central "*key phenomena observed in nature - competition, specialization, cooperation, exploitation, learning, [and]*

growth" (Rothschild, 1990, p. xi-xiv). Thus, an analogy is provided of the economy as an ecosystem at large. The latter, in turn, identifies the cyclical nature of co-evolution in the natural world and the complete regeneration of established compositions due to environmental disruption as fitting comparable starting points to understand the essence of the external surroundings organizations are operating in (Moore, 1993, p. 75-76). The author managed to provide an increasingly holistic frame of reference when studying organizations, by extending the notion of companies engaging beyond its own industry. While both authors draw parallels between the fundamental characteristics of ecological ecosystems and organizational playing fields, such as coopetition and internal evolution, Moore's pioneering work resembles more closely the recent development within ecological ecosystem research as it is concerned on ecosystem formation as well as aspects of how ecosystems as entities evolve. Since its introduction, the term has received much attention both in academic as well as non-scholarly literature (Jacobides, Cennamo and Gawer, 2018, p. 2; Adner, 2017, p.39).

Despite the growing interest in ecosystems and the concepts recognition as a prominent business concept over the years, there is no consensus on a definition, but rather definitions are continuously evolving along with increasing comprehension on the subject. Although several different iterations on a definition have emerged, certain shared features have been cemented from Moore's (1993) original proposition. First, business ecosystems are comprised of interrelations that extend the bilateral connections found in supply chains. Moore (1993, p. 9) presents the aspect interrelations as "*an economic community supported by a foundation of interacting organizations and individuals*". Iansiti and Levien (2004, p.8-9) in turn draw a parallel between business networks and biological ecosystems by both being "*characterized by a large number of loosely interconnected participants*". Secondly, ecosystem research recognizes that not only do organizations have relations beyond the supply chain, but these are furthermore dependent on each other to varying degrees. Moore describes the interdependency by emphasizing coevolution of capabilities and organizational alignment, while Iansiti and Levien state that the dependency affects the "*mutual efficiency and survival*" of organizations. Zahra and Nambisan (2012, p. 220) in turn state that an organization "*shares a set of dependencies as it produces the goods, technologies, and services customers need*". Subsequently, Zahra and Nambisan raise the last common feature shared among ecosystem definitions, namely the intent and ability to create value (Moore, 1993; Iansiti and Levien, 2004; Kapoor

and Lee, 2013; Zahra and Nambisan, 2012; Adner, 2017; Jacobides, Cennamo and Gawer, 2018). Crystallizing these three characteristics further, an ecosystem is comprised of a *network of participants* that have a *governance structure* coordinating value creation and where participants *share a logic* that glues them together (Thomas and Autio, 2014). An absent yet common feature of ecosystems in these definitions is *modularity*, meaning the ability to autonomously organize internal operations while only adherence to coordination agreements in inter-organizational cross points is required to deliver value (Jacobides, Cennamo and Gawer, 2018).

In addition to the common characteristics recognized in various definitions of ecosystems, Jacobides *et al.* (2018) identify three main angles for studying the concept; the business ecosystem introduced above, innovation ecosystems, and platform ecosystems. While business ecosystems put a focal organization at the core, innovation ecosystems encompass collaboration efforts among organizations with an intent to create a shared value proposition. Platform ecosystems in turn, examine external (industry)- or internal (company specific)- platforms, exploring a central concept of same-side and cross-side either positive and negative network effects (Gawer and Cusumano, 2014; Parker, Van Alstyne and Choudary, 2016) and how they create value to the platform itself (Jacobides, Cennamo and Gawer, 2018).

Overlooked by Jacobides *et al*., is the notion of digital and knowledge ecosystems. Digital ecosystems can be defined as "*sociotechnical networks of interdependent digital technologies and associated actors that are related based on a specific context of use*" (Skog, Wimelius and Sandberg, 2018a), resulting in a difference when compared to platform ecosystems as the interest does not rely on one particular platform, but rather affiliations between different digital technologies, companies, institutions, and individuals. Knowledge ecosystems in turn can be closely compared to innovation ecosystems, with the difference that the aim is to generate knowledge, however where the similarity lies is in a focus on the nodes that collaboratively creates the knowledge (Valkokari, 2015).

In contrast to the various conceptualizations of different types of ecosystems, Adner (2017) recognizes that the majority of studies, whether taking an innovation, business, or platform perspective, take largely a single individual company or platform as its focal point, while examining interactions of the involved parties around said actor/platform. The same holds true for examining the networks of digital ecosystems. Adner describes this viewpoint as *ecosystem-as-affiliation*, while emphasizing the

drawbacks of the approach. First, the strategic guidance the perspective offers is limited to a narrow focus on governance aspects. Secondly, despite the inclusion of value creation in different definitions, the affiliation approach provides limited understanding of *how* the value is created within the ecosystem. As an example, within the realm of innovation ecosystems strategies, Olsson and Bosch (2016) regard value as a core aspect, yet the emphasis is on a focal company and how it can align different collaborators to deliver value for end customers.

In order to shift focus from the interdependence perspective and address the drawbacks, Adner (2017) proposes an alternative approach in viewing *ecosystems-as-structures*, whereas the starting point is the value proposition of an ecosystem and from there examining participating actors are positioned and organized, in order to deliver that value. The author states that:

> *"the ecosystem is defined by the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize"* (Adner, 2017, p. 42).

The definition suggests that a number of actors beyond the bilateral relations in supply chains share activities among each other with an intent to serve an end customer by creating a value offering. Despite the joint end goal, it is important to raise the notion that the individual "partners" can have their own agendas, strategies, as well as conflicting internal goals. Ecosystem orchestration processes can however ensure that value creation possibilities are equally distributed within the ecosystem (Dhanaraj and Parkhe, 2006). The rather new approach of viewing ecosystems opens avenues for uncovered challenges. For instance, *coordination* is considered key open questions on the multilateral level. (Adner, 2017) As have been pointed out in a multitude of studies, innovations are condemned to fail without proper coordination (Adner and Kapoor, 2010; Adner, 2006; Kapoor and Lee, 2013).

As a last effort to distinguish what constitutes an ecosystem, an overview of how the concept differs from clusters and value networks ought to be presented. Both clusters and value networks have found their foothold in organizational studies and both share certain similar characteristics to ecosystems, yet clear disparities can be identified. Clusters are unique through the aspect of geographical concentration and fierce competition, while value networks are characterized by co-operation. Business ecosystems on the other hand are neither geographically concentrated, nor strictly

competitive or co-operative, but rather entail coopetitive relations among its members. (Peltoniemi, 2004) While value networks are distinctive from business ecosystems, they can be used as a beneficial analytical tool in order to understand the often complex roles and relationships of an ecosystem, as well as how monetary and non-monetary value is created (Den Ouden, 2011). As a last remark on similarities and differences, so called entrepreneurial ecosystems can be argued to form an intersection between clusters and business ecosystems, as these are described as both geographically concentrated as well as coopetive (Roundy, Bradshaw and Brockman, 2018).

3. DIGITAL TRANSFORMATION – THE WHAT, THE WHY, AND THE HOW

3.1. THE WHAT AND THE WHY

The transformative capability of information technology has been a recognized research topic since early works published by Davenport (1990), focusing on practical guidelines for business process redesign with IT as support, and Venkatraman (1994) going beyond processes to outlining ramifications of IT as a catalyst for different levels of business transformation. Digital transformation (DT), which has received increasing attention in recent years (Vial, 2019), is not a directly interchangeable concept despite sharing similarities with Venkatraman's (1994) IT enabled business transformation model. These similarities include the recognition of technology being a prominent but not a principal driver of the phenomenon (Davenport and Westerman, 2018; Tabrizi, Lam and Irvin, 2019; Kane *et al.,* 2015; Vial, 2019). Rather, these concepts incorporate, in addition to technological, also strategic, social (including structural changes in organizations as well as cultural), and operational (process) aspects (Skog, 2019; Vial, 2019; Kane, 2017). The purpose is thus to not become more digital, but instead to generate growth. However, despite the increasing interest and the high level notion of what DT entails, there is a significant knowledge gap of the finer details (Kane, 2017; Vial, 2019), including a lack of knowledge on the processes of how DT should unfold (Skog, 2019). The knowledge gap in unison with misconceptions on the phenomenon is further evident in that a large portion of digital transformation initiatives fail (Davenport and Westerman, 2018).

Then, what is DT, why should attention be paid to it, and how does it differ from IT enabled business transformation?

II THEORETICAL FRAMEWORK

As an opening, digitization and digitalization should be outlined in order to introduce these interrelated terms. Digitization is the process of converting something into digital form. As a result of advancements and emergence of mobile technology, Internet of Things, social networks, and cloud computing, an exponentially increasing amount of digitized data has become available. In unison with improved analytical capabilities, these technologies (social, mobile, analytics, cloud, and IoT - SMACIT) have induced digitalization, meaning the changing nature of organizations, industries, and society as the physical and the cyber space are becoming ever more intertwined (Kagermann, 2015). Digitalization has further generated disruptive forces, due to technology and/or business model innovations forcing disrupted actors to "*redesign strategy to survive a change in their environment*" (Kilkki *et al.,* 2018, p. 276). These disruptions can arise through vertical layers within an industry and/or horizontally across industries (Kilkki *et al.,* 2018).

Proceeding to digital transformation, the phenomenon refers to the "*processes whereby organizations continuously engage in digital innovation to develop or improve products, services and business models*" (Skog, 2019, p. 9). In other words, DT can be regarded as the process of digitalization. The underlying reason for carrying out a digital transformation is described as an organization's response to "*change in their business and technology environments*" (Skog, 2019, p. ii), thus sharing similarities to Kilkki *et al.* (2018) understanding of digital disruption. While Skog *et al.* (2018b) acknowledge that digital innovations of DT have an impact on the wider ecosystem of an organization, Vial (2019, p. 4) withdraws the notion of organizations in his definitions by referring to an *entity* and the "*processes that aims to improve [it] by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies*". Hence, Vial recognizes that a digital transformation is not restricted to an organizational level, dominating most definitions. However, Figure 1, which provides an overview of the current understanding on the phenomenon, reveals how the organizational level is in focus at various DT process phases, while larger entities are addressed as being impacted by these organizational transformations, *i.e*. organizational use of digital technologies can generate wider societal impacts.

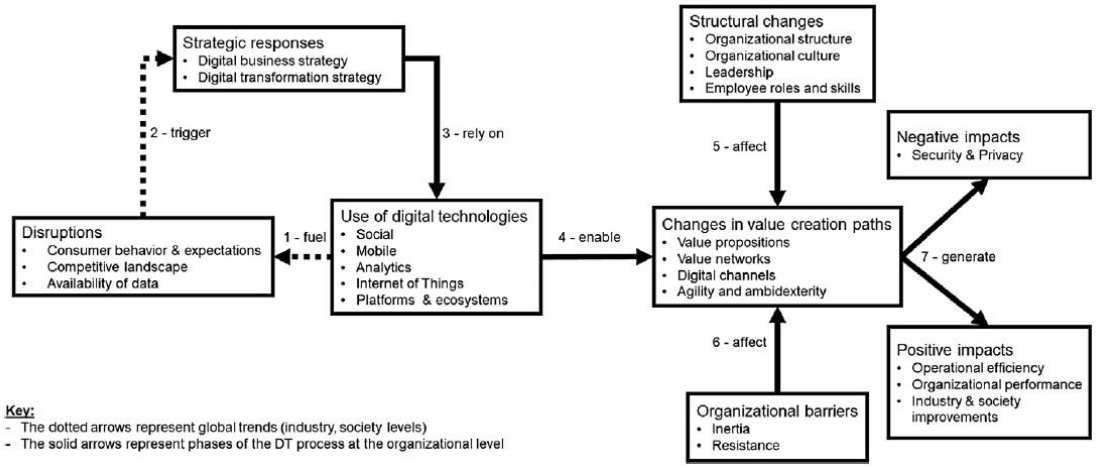

Figure 1. Framework for describing DT (Vial, 2019)

Despite the focal organizational perspective, the framework does provide a summary on what constitutes DT based on contemporary research. First, and as established, SMACIT technology, in addition to platforms and ecosystems form a baseline for external changes in the business, socio-technological and/or the societal environment (Vial, 2019). In addition to realized changes, fear of a potential threating changes might also cause a disruption in an organization's environment (Kotter, 1995). These changes in the environment trigger strategic actions to be taken, that on an organizational level are dependent on digital technologies. Subsequently, the strategic response opens avenues for new value creation (Vial, 2019). Value creation, in turn, is an outcome of digital innovation, in accordance to the DT definitions presented above, which refer to creation of new products, offerings, business processes, or models through new combinatorial aggregations of digital technologies and physical components (Yoo, Henfridsson and Lyytinen, 2010; Nambisan *et al.,* 2017). At last, in order to realize the value creation paths, structural changes and organizational boundaries need to be addressed and overcome, while the outputs can have both negative and positive effects (Vial, 2019).

An alternative approach for describing DT is to view it through digital strategies and its four key dimensions, namely *scope, speed, scale* and *sources of value creation* (Bharadwaj *et al.,* 2013). *Scope* refers to diminishing functional barriers, *scaling* to increased collaborative abilities and IT leveraging, *speed* to the increased rapidness of new product launches, decision making, coordination of supply chains and value network formation, and *sources of value creation* to myriad new ways of setting up value propositions.

II THEORETICAL FRAMEWORK

In order to examine the difference between IT enabled business transformation and DT, an overview of the former is established. First, IT enabled business transformation is regarded as an established concept to review organizational change induced by information technology (Heilig, Schwarze and Voß, 2017). As mentioned, it has been introduced by Venkatraman (1994) and entails the development, implementation, and use of IT while revealing five potential levels of change, as illustrated in Figure 2.

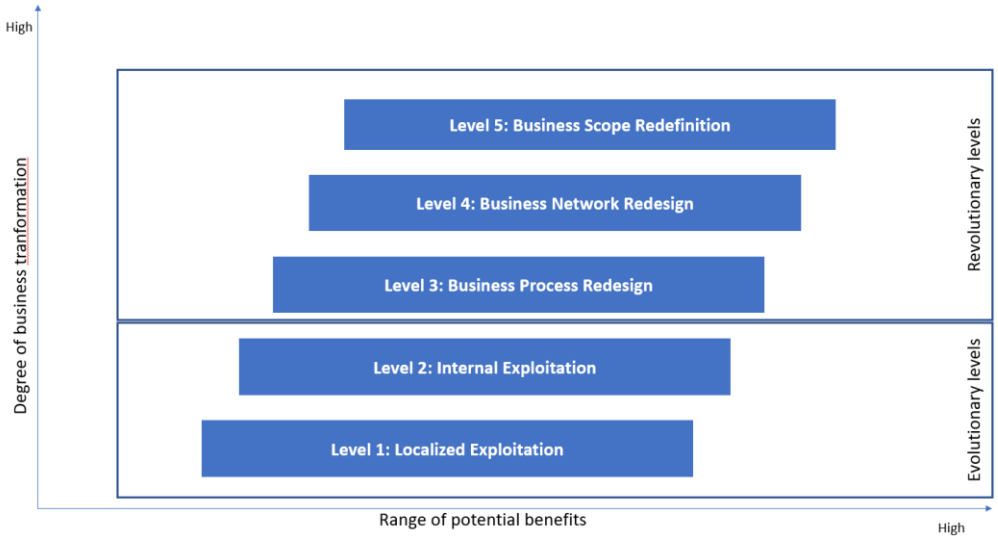

Figure 2. Five levels of IT enabled business transformation, (Venkatraman, 1994)

The lowest level, localized exploitation, represents the deployment of basic functionality for supporting individual business activities. This results in minor organizational changes. At this stage, organizations do not exploit the full possibilities of IT and are likely to fail in developing competitive advantages against competitors due to the limited impact and probable imitations. The second level, internal integration, involves technical and organizational integration, meaning improvements by opening internal information silos and supporting business-IT alignment. The third level relies on achieving more sufficient information by the second level integrations, forming a base for business process improvements. (Venkatraman, 1994) Overall, the third level is comprised of Davenport and Short's (1990) guidelines for exploring aspects to consider when improving business processes. The fourth level takes inter-organizational dimensions into consideration and focuses on business network improvements through data exchange, cooperation, and knowledge transfer. Triggered by the fourth level, the final level means changes in business models or new business extensions. (Venkatraman, 1994)

IT enabled business transformation is thus perceived as a means for support in value creation by operational efficiency improvements, focusing mostly on process innovation. It is a bottom-up approach (Skog, 2019) that can have impacts on the immediate value network, while from the focal organization's perspective it can potentially and gradually result in a business scope redefinition (Vial, 2019). In contrast, DT is a top-down approach (Skog, 2019) that targets a broader entity than that of the internal aspects of an organization while having implications beyond the immediate value network of said organization (Hess *et al.,* 2016; Vial, 2019).

3.2. THE HOW & THE EXISTING GAPS IN LITERATURE

While an overview of what DT is has been provided thus far, including the broad strokes of triggers and enablers of the concept, the details of *how* to undergo a digital transformation has not yet been touched upon. First, it is to be noted that finer details of a long term transformation process remain a largely blind spot in existing scholarly works (Skog, 2019; Vial, 2019), while a diminutive amount of research papers presents instead aspects of and requirements for DT that should be addressed on a high level. These aspects and requirements include innovation collaboration (Chesbrough and Schwartz, 2007), dimensions that can be affected by DT (Imgrund *et al.,* 2018; Matt, Hess and Benlian, 2015), potential success factors and managerial aspects (Tabrizi, Lam and Irvin, 2019; Sebastian *et al.,* 2017), specific impact of a distinctive technology on value creation (Skog, 2019), and potential pitfalls (Kotter, 1995; Davenport and Westerman, 2018). Despite the lack of comprehension on the actual process, paradoxically as a concept DT has been emphasized as being imperative for organizations ability to remain competitive and survive (Korhonen, 2015; Davenport and Westerman, 2018; Fitzgerald *et al.,* 2014)

Whereas a lack of knowledge remains in regards of exactly how a DT should unfold, within the realm of IT enabled and general business transformation more precise guidelines are available. As established, for both DT and IT enabled business transformation, technology should not be the spearhead that leads a transformation and determines its direction. Instead, whether the objective is a business process redesign (Davenport and Short, 1990), a general organizational (Kotter, 1995) or supply chain transformation (Lavikka *et al.,* 2017), the first step is to establish the *status quo*, assemble an appropriate ensemble of relevant stakeholders, and create a shared vision on intended objectives. Secondly, processes and process bottlenecks are to be explored and analyzed. According to Davenport and Short (1990) as well as

Venkatraman (1994), the availability of IT sources that can be leveraged should be evaluated only at this point and thus alignment of IT and business is secured. The last phase of a transformation is actual implementation.

Indeed, the knowledge gap of how DT unfolds does not mean a complete oblivion in regards of supporting guidelines for the phenomenon. Within the realm of digital strategies, especially in managerial literature, high level roadmaps and considerations have been presented. For example, Berman and Bell (2011) recognize three paths for undergoing a transformation. The first path showcases a strategy, whereas operations are first enhanced through digital technologies. Afterwards, a customer value creation is redefined. This path resembles thus Venkatraman's (1994) IT enabled business transformation model in a sense that it takes a bottom-up approach by focusing at the beginning on internal efficiency improvements, with an exception that it afterwards actively seeks to address new value creation and business scope redefinitions. The second path, in turn, starts with addressing new value propositions and then initiates a digital integration in order to realize the value proposition. The last path mixes these two approaches by simultaneously building digital capabilities that ensure value creation. Evidently all paths lead to new value creation, while incorporating both operational efficiency improvements as well as building new capabilities utilizing digital technologies. (Berman and Bell, 2011)

Similarly as Berman and Bell, Sebastian *et al.* (2017) highlight the need of operational improvements. The strategy provided by the authors leans on creating a firm vision and strategy, followed by investing in an operational backbone in order to achieve operational excellence. In this strategy, a platform on top of the operational backbone is an imperative feature needed to be created. The purpose of the digital services platform is to enable stakeholder engagement. The last step, entails a cultural transformation whereas focus should lie on adapting a service mindset.

3.3. DIGITAL TRANSFORMATION IN RELATION TO ECOSYSTEMS

When it comes to ecosystems and digital transformation, the current literary landscape provides little knowledge beyond how digital ecosystems emerge, the potential impact of DT on to the business environment from the perspective of a digital platform provider or an organization (Skog, 2019), or the need of organizations to collaborate within an ecosystem in order to innovate (Vial, 2019). Yet, how ecosystem wide DT

unfolds has been recognized as a meaningful domain to explore, including how collaboration and innovation can actually take place (Skog, 2019; Vial, 2019). A few exceptions are found that strive to accomplish this.

First, Heilig *et al.* (2017) study the port industry's ecosystems and examine past and current digital transformations, utilizing an extended version Venkatraman's IT enabled business model transformation model illustrated in Figure 3.

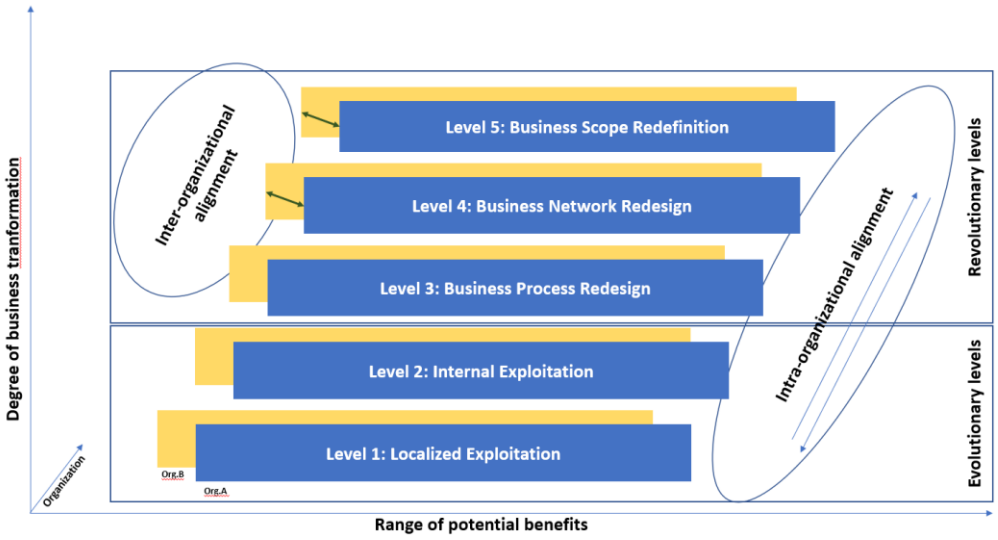

Figure 3. Extended model IT enabled business transformation (Heilig, Schwarze and Voß, 2017)

The ecosystem extension is provided by acknowledging inter-organizational alignment on the top two levels. Three distinctive generations of transformation outcomes are identified, from digitization of paper documents to automating processes and an ongoing transformation towards smart procedures. The study provides a contribution, in relation to inter-organizational coordination challenges, by proposing a utilization of game theory-based alignment approach that supports a balancing of contradicting aims within an ecosystem in transformation, in addition to offering a detailed overview of a digital evolution within the port industry. (Heilig, Lalla-Ruiz and Voß, 2017)

Lavikka *et al.* (2017) in turn provide concrete transformation roadmap. While the research aims to address how a digital ecosystem emerges by studying a supply chain's evolution, it simultaneously follows a methodology that provides insight into digital transformation on an ecosystem level. Through facilitating an intervention from a "lens of organizational coordination" (Smeds *et al.,* 2015), a temporary governance

structure is created that supports an alignment of goals and thus creates a shared logic for the ecosystem (Lavikka *et al.,* 2017).

There are two primary aspects to the process: knowledge sharing and coordination. The former stresses the importance of revealing the *status quo* of an ecosystem, while emphasising the need to provide differing individual viewpoints through knowledge sharing for the larger entity. The shared knowledge can then function as input for creating aligned goals for the future.

Lavikka's *et al.* (2017) proposed DT process is illustrated in Figure 4.

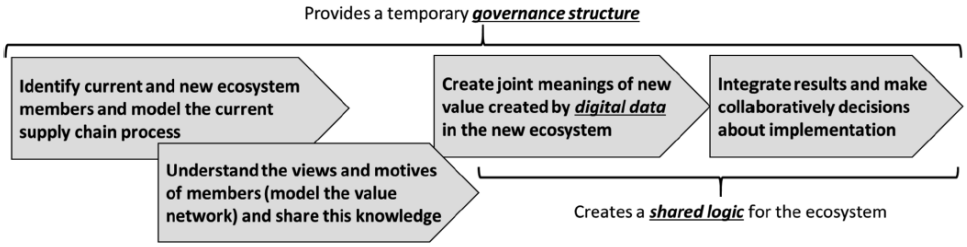

Figure 4. Digital transformation through interventions (Lavikka *et al.*, 2017)

The latter aspect, in turn, relates to the essence of process innovation: the revision of inter-organizational process coordination (Smeds *et al.,* 2015). Task interdependencies can be pooled, sequential, or reciprocal, each requiring a different coordination mechanism. Reciprocal interdependence, characterized by non-linear interdependencies between different tasks, requires the most expensive coordination mechanism: constant information sharing and mutual adjustment during task execution (Thompson, 1967). A key driver for process innovation is striving to decrease these reciprocal interdependencies through novel process structures and the enabling ICT solutions. (Smeds, 1994)

4. INTER-ORGANIZATIONAL DATA SHARING

Inter-organizational data sharing is recognized as one of the key drivers of reaping a wide array of benefits and generating business value through the Internet of Things. Such benefits include development of new business models, improved stakeholder relationships and communications in addition to establishing new connections, process optimization, and an increased competitive advantage. However, in the case

of new business models, research suggests that these have not been identified yet. (Panetto *et al.,* 2016; Jernigan, Kiron and Ransbotham, 2016; Rüßmann *et al.,* 2015; PwC, 2017). Also, aggregated data from a multitude of external sources provides a more comprehensive view of one's own products/services operational environment while offering deepened opportunities for inter-organizational collaboration (Metso and Kans, 2017; Jernigan, Kiron and Ransbotham, 2016). In parallel, academia recognizes several realized benefits from opening scientific, healthcare and governmental data (Strom *et al.,* 2014; Wallis, Rolando and Borgman, 2013; Janssen, Charalabidis and Zuiderwijk, 2012). Meanwhile, in recent decades, several enterprise information systems that enable inter-organizational data and information exchange have been widely adopted. These systems have by large been focusing on vertical supply chain integration, although recently they have become more complex by catering a wider range of business processes (Romero and Vernadat, 2016), in order to support more collaborative business networks beyond that of the supply chain (Jagdev and Thoben, 2001). However, information systems aimed specifically for collaboration has not been implemented yet on a large scale (Agostinho *et al.,* 2016).

Despite the great potential of sharing data in the private sector, it is regarded as one of the main challenges within the domain of enterprise information systems (El Kadiri *et al.,* 2016; Jernigan, Kiron and Ransbotham, 2016). Governance issues is one area that causes the challenge. For instance, distributing responsibilities, such as technical management of the infrastructure and monitoring data exchange can result in problems for collaborating organizations (Jernigan, Kiron and Ransbotham, 2016). Also, as enterprises operate in multiple dynamic ecosystems, characterized by simultaneous collaboration and competition (Bosch-Sijtsema and Bosch, 2015), the infrastructure needs to accommodate dynamic rules as well. Among technical issues, data security is in turn an important aspect to be considered (El Kadiri *et al.,* 2016; Jernigan, Kiron and Ransbotham, 2016). As data is considered an experience good (value is unknown, until one has experienced it), the ability to produce sufficient meta-data is another obstacle to overcome (Koutrumpis, Leiponen and Thomas, 2016). Furthermore, integrating existing information systems to a data sharing system can also result in problems (Metso and Kans, 2017). On yet another note, the development of a data sharing systems is also influenced by social barriers. Unwillingness to share data, either because of reluctance to expose operational knowledge or because unfamiliarity of the potential benefits of data sharing and data combining, hinders organizations to partake in data sharing (El Kadiri *et al.,* 2016; Jernigan, Kiron and Ransbotham, 2016;

Metso and Kans, 2017). Figure 5 illustrates the key benefits and challenges of data sharing.

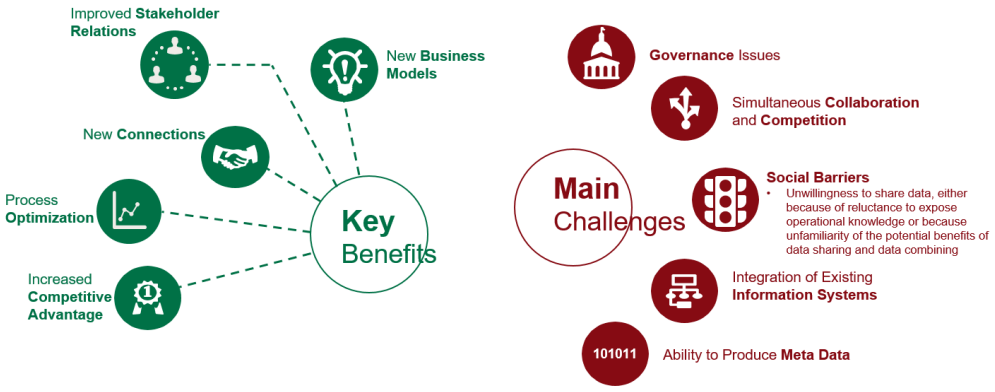

Figure 5. The benefits and challenges of inter-organizational data sharing

5. THEORETICAL SYNTHESIS

This chapter outlines the prominent findings from the literature review. The literature review examines topics from the inter-organizational and IS research literature, providing thus a socio-technological overview of the phenomenon this thesis explores. This synthesis discusses the findings and aims to tie them together, in order to frame the research problem of this thesis.

Ecosystems, digital transformation, and inter-organizational data sharing are all contemporary subjects that have received wide interest among researchers as well as practitioners (Panetto *et al.,* 2016; Vial, 2019; Jacobides, Cennamo and Gawer, 2018; Adner, 2017). Simultaneously, each of these topics are not completely understood as concepts.

While ecosystems have been differentiated into several types, the majority of research within the field approaches the concept through an *ecosystem-as-affiliation* approach, whether focusing on platform, innovation, or business ecosystems. This approach provides decent means to study inter-relations between ecosystem participants, yet falls short in terms of exploring *how* value is created (Adner, 2017). As value is a central theme in digital transformation and Adner's proposition of studying *ecosystems-as-structures* sets value creation as a focal point, it is appropriate to consider this ecosystem perspective in the context of DT. Thus, this thesis defines ecosystems as:

> *"the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize"* (Adner, 2017, p. 42).

DT, in turn, can be described as a strategic attempt to undergo a socio-technological transformation through continuous digital innovation, due to external forces. Contrasting the inter-related concept of IT enabled business transformation that follows a bottom-up approach focusing mostly on internal operational improvements, DT is a top-down approach (Skog, 2019) that targets a broader entity than that of an organization while having implications beyond the immediate value network of said organization (Hess *et al.,* 2016; Vial, 2019). The definition of DT in this thesis is:

> *"processes that aim to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies"* (Skog, 2019, p. 9)

Hence, value in DT is created through digital innovations, which is referred to in the definition by combinations of ICCC (Information, Computing, Communication, Connectivity) technologies. In order to foster the coordination of value creation both from a digital transformation and an ecosystem perspective, inter-organizational data sharing provides a prospecting avenue as it is identified as an enabler of collaboration. Yet, a myriad of social challenges need to be overcome, in order to enable this type of sharing (El Kadiri *et al.,* 2016; Jernigan, Kiron and Ransbotham, 2016).

Digital transformation is also tainted by a challenge, namely a lack of knowledge regarding *how* these transformations should unfold, especially on an ecosystem level (Skog, 2019; Vial, 2019). Two studies aim to address this, where the first (Heilig, Schwarze and Voß, 2017) utilizes Venktraman's (1994) business transformation model as a baseline. The study reveals certain pitfalls, however. In the study, particular events have both re-aligned networks and resulted in business scope redefinitions from a focal organizational perspective (Heilig, Schwarze and Voß, 2017), suggesting transformations exceeding mere implementation of technology. Yet few, if none, of the proceedings in the port industry's past showcase impacts that go beyond innovations directed towards making internal port efficiency improvements. This is in line with Skog's (2019) and Vial's (2019) observations in regards that both IT enabled business transformation and DT are interrelated, yet two distinctive phenomena where

the former is focused on internal development. Furthermore, Heilig et al. (2017) provides little insight into nuances of *how* to actually transform.

The study by Lavikka *et al*. (2017) presents a concrete process for undertaking a digital transformation, by creating a governance structure and shared logic. The research focussed on the transformation process and its governance, not on the outcomes of the transformation, *i.e.* the structural solutions in the ecosystem or the renewed business scope. The value creation that the intervention aimed at was both completely new value to end-users, and value through business process improvements. Thus, it is impossible to assess if the study resembles more closely IT enabled business transformation or digital transformation in the form that these have been illustrated in literature. However, the study provides a solid base to build on, while there certainly are aspects of the process that can be detailed out.

In concluding remarks, the theoretical synthesis connects literature from three distinctive fields: ecosystems, digital transformation, and inter-organizational data sharing. Illustrated in Figure 6, these three concepts share a set of common features. First, all three strive or successfully manage to deliver value. Secondly, they are all characterized by coopetition. Inter-organizational data sharing relates to the term indirectly through ecosystems, as data sharing is expected to happen between both competitors and collaborators. In terms of ecosystems, they are *per definition* characterized by coopetition, while DT's connection literature implies that it can potentially impact actors with coopetitive relations. Coordination in turn is regarded as an open question when studying ecosystems. Thompson (1967) provides input for comprehending coordination. Data sharing is regarded as a means for fostering coordination, whereas within the realm of DT, coordination is paramount for managing a successful transformation. Coordination is related to coopetition as it increases the complexity for ensuring fruitful coordination, when competing entities willingness to collaborate can be low.

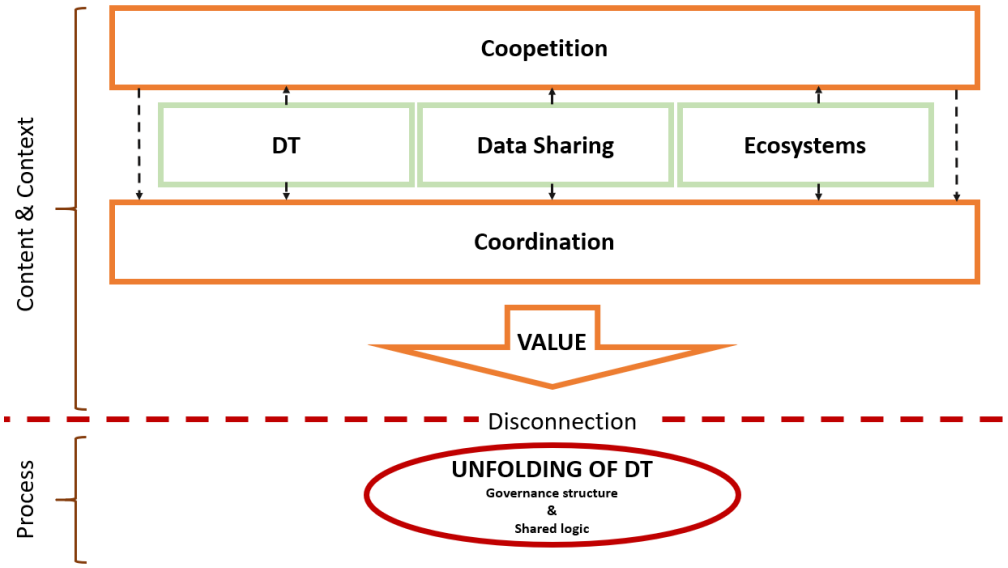

Figure 6. Theoretical synthesis

There is a prevailing gap in literature regarding how a digital transformation should unfold, yet literature suggests that by creating a governance structure and a shared logic an ecosystem transformation can be achieved. There is thus to a certain degree a disconnection between the how and the what.

Furthermore, to what degree digital transformation on an ecosystem's level shares similarities with organizational DT is not addressed at all in literature. Thus, whether an ecosystem DT follows the same top-down trajectory as organizational DT has been characterized with, remains unknown. Furthermore, should value creation be viewed through the lens of how the ecosystem innovates as an entity towards external sources, or as internal innovations that from the entity perspective create value through ecosystem wide operational improvements, where from the individual participants' perspective transformations that fit the DT description are carried out? At last, reasons for undertaking an ecosystem wide transformation remain un-validated beyond that it can foster innovation through collaboration.

III EMPIRICAL STUDY

In this part, the empirical study of the thesis is presented. Chapter 7 describes in detail the research paradigm, research design and methods, and the case description, in addition to data collection processes and the analytical steps conducted in the data analysis. Chapter 8, in turn, presents the key empirical findings from the case study.

6. EMPIRICAL RESEARCH QUESTIONS

The theoretical framework of this thesis has explored digital transformation as a concept, in relation to inter-organizational data sharing and ecosystems. The theoretical synthesis reveals a prevailing gap in literature in regards of a lack of comprehension on detailed guidelines for how digital transformation can unfold, especially for an ecosystem. Research suggests, however, that interventions for co-creation can result in a governance structure, as well as shared logic to undergo a digital transformation. This thesis aims thus to uncover a process for undertaking an ecosystem wide digital transformation, based on an intervention. As the scope of this thesis does not allow exploring the complete lifecycle of a transformation and how it unfolds, the emerging model will remain tentative yet potentially it can provide useful insight into how ecosystems can initiate digital transformations.

In order to successfully design the model, one empirical research question emerges:

ERQ 1: How can an ecosystem wide digital transformation process be organized (based on revelations of an innovation intervention)?

The empirical innovation intervention process studied in this thesis in turn follows two streams of explorations, both spawning a set of sub-questions.

Stream 1 aims to build an understanding of a generic value creation goal of the ecosystem, by utilizing a value network analysis. Simultaneously stream 1 aims to understand the current value network and how it can evolve through inclusion of new potential ecosystem members. Hence, two sub-questions are formulated for stream 1 as follows:

S1Q 1: What is the collective value proposition of the value network?

S1Q 2: What is the role of new entrants providing supporting infrastructure technology?

Stream 2 in turn examines the port ecosystem and how inter-organizational data sharing could potentially form a catalyst for ecosystem wide DT, while spawning new business models. However, due to the multitude of challenges associated with the data sharing concept, the author of this thesis has laid out a hypothesis that the social barriers of data sharing could more easily be overcome, when instead of exploring it "technology first" it can be attached to the real-world proceedings within the ecosystem. Hence, stream 2 starts by uncovering the *status quo* of the ecosystem's operations, in addition to its generic characteristics and challenges, as well as identified innovation opportunities. In this order, inter-organizational data sharing can be reviewed through actual problems, providing a more grounded sense of whether it generates viable solutions. Furthermore, a lucrative enough opportunity could ensure increased effort in resolving the barriers of data sharing. To summarize, stream 2 examines a business ecosystem, its characteristics, processes and corresponding challenges, and based on this evaluates whether a data sharing business model can be recognized or the challenges of data sharing be resolved. The following four sub-questions are formulated for stream 2:

S2Q 1: What are the industry characteristics and how are inter-organizational business processes organized?

S2Q 2: What are the corresponding challenges within the ecosystem?

S2Q 3: What opportunities can be identified?

S2Q 4: Are the solutions/opportunities corresponding to the challenges based on data sharing practices?

Finally, by merging research stream 1 and 2, a final sub question can be answered:

Merged SQ: How well does the collective value offering complement the identified innovation opportunities?

7. RESEARCH DESIGN AND METHODS

7.1. RESEARCH PARADIGM

In addition to determining a relevant topic of interest to be studied, a research process, that is a methodology, has been chosen with an intent to lend credibility to the research. The choice of methodology rests on the researchers own assumptions on the nature of reality (ontology), the grounds of knowledge (epistemology) (Chilisa and Kawulich, 2012; Guba and Lincoln, 1994), and the personal ethics and value judgements that guide the researcher (axiology). Together, these three assumptions and set of basic beliefs forms a research paradigm. (Chilisa and Kawulich, 2012)

This thesis is built on a constructionist/interpretive research paradigm. Thus, the thesis follows the assumptions of an interpretive ontology, where multiple mind dependent realities co-exist based on social and personal constructions of said realities, and constructivist epistemology, in which knowledge is considered subjective. Consequently, the purpose of this approach is to understand personal experiences in their natural settings. (Chilisa and Kawulich, 2012) As this thesis studies digital transformation of an ecosystem, it is imperative to examine the phenomenon through the experiences of members within this ecosystem.

A further consequence of the assumption that reality is subjectively constructed through human interaction with her surroundings is the researchers own role in the construction of knowledge. The chosen research paradigm highlights that the researches own values influence the choice of topic to study, methods used for data collection and analysis, and how the findings are interpreted and reported. (Chilisa and Kawulich, 2012) Hence, the author of this thesis recognizes the possible impact of how biases can affect the neutrality of the overall research. This notion is addressed in the upcoming chapters, where the research strategy, data collection, and data analysis are explained in further detail.

7.2. RESEARCH STRATEGY AND DESIGN

As the research paradigm directly influences the choice of methodology, in this thesis qualitative abductive research methods have been applied in line with the constructivist/interpretive paradigm. Qualitative research can be defined as “a set of complex interpretive practices” (Denzin and Lincoln, 2011) that aim to build a

comprehension of the meaning of concepts in social or human problems (Creswell, 2002). Furthermore, the qualitative researcher relies on the interpretation of data, that in contrast to quantitative studies cannot be measured in terms of amount, intensity, or frequency (Denzin and Lincoln, 2011). This thesis was approached through an initial research problem within a contemporary topic with limited existing research and as such, a qualitative approach is considered favorable in order to explore the topic in further depth and identify the key variables to examine (Creswell, 2002). The qualitative method used in this thesis is a single case study.

Despite having made an effort to ensure choosing a suitable case to study the initial research problem, the author of this thesis recognized that an uncertainty existed in obtaining sufficient results to address the problem at hand in a satisfactory manner, due to the novelty of the phenomenon. Thus, adapting abductive reasoning was perceived as an appropriate approach to conduct the research. Abductive reasoning relies on the researcher to iteratively jump back and forth between empirical findings and theoretical frameworks, allowing the focus of the study to evolve, and aiming to reach a normative ideal of a best explanation (Ketokivi and Mantere, 2010; Dubois and Gadde, 2014). It is especially useful for building knowledge on a novel phenomenon (Kovács and Spens, 2005; Dubois and Gadde, 2014) and refining, elaborating, and developing existing theoretical models (Ketokivi and Choi, 2014; Dubois and Gadde, 2002). In line with the axiological assumption of this thesis, the normative ideal of finding a best explanation is influenced by the researcher. Hence, descriptive evaluation should be emphasized over the normative (Ketokivi and Mantere, 2010).

As explained, the initial research problem of this thesis was a novel phenomenon advocating for an abductive reasoning approach. Furthermore, to reduce the uncertainty of obtaining sufficient results to address the initial research problem, abductive reasoning offered flexibility to redirect the focus of the study in relevant directions. Within the initial research problem, research gaps were identified through a literature review, which in turn offered a useful guide to initiate the study. However, merely addressing research gaps can limit the researcher in allowing the research to evolve in accordance to unanticipated empirical findings (Dubois and Gadde, 2014). The abductive reasoning approach supported thus the emergence of new themes in the data analysis stage.

Single-case study

III EMPIRICAL STUDY

As stated, the method of this thesis is a single case study that is conducted within an operational business ecosystem. A case study as a research method strives to address questions requiring an in-depth comprehension of an organizational or social phenomenon, while typically providing explanations for "how" and "why" the phenomenon occurs (Yin, 2017). The approach is in particular suitable for research topics demanding novel insights and for which little empirical evidence is available due to immaturity of research conducted on the phenomenon and when current theories do not provide answers for the research questions (Eisenhardt, 1989; Eisenhardt and Graebner, 2007). As this thesis explores a contemporary subject distinguished by many unknowns while proven to be an important phenomenon lacking a firm theoretical foundation, the case study approach is well suited.

Theory building, theory testing, or phenomenon description based on case studies can rely on qualitative, quantitative, or mixed methods (Eisenhardt, 1989; Yin, 2017). While quantitative data can offer support for the qualitative evidence (Eisenhardt, 1989), this thesis relies solely on "soft" data. In order to increase validity of the findings, several data sources – public and private organizations, in addition to actors from different hierarchical levels – and data gathering methods – informal discussions, interviews, and a workshop – are utilized, helping to triangulate data and forming an encompassing perspective of the phenomenon increasing scientific quality. Additionally, having multiple investigators participate in data gathering at different stages can result in increased quality by providing a wider range of complementing perspectives to enrich data (Eisenhardt, 1989).

Case studies can be based on single cases or multiple cases, whereas the choice of each approach should be dependent on intended outcome (Eisenhardt, 1989; Yin, 2017). A single case study in particular provides a means to explore a phenomenon in greater detail compared to multiple cases, thus allowing elaborated insights to form more effortlessly. While multiple case studies are considered to provide a means for a "stronger base for theory building" (Eisenhardt and Gaebner, 2007), this thesis utilizes research access in a single case for revelatory purposes within a unique environment in the grand scheme of the research phenomenon. The argument of single case studies being inferior compared to multiple cases in theory generation has neither been universally accepted for a multitude of reasons (Dubois Gadde 10,2014). Furthermore, in line with abducting reasoning, this thesis follows the methodology called Systematic Combining by Dubois and Gadde (2002), who advocates deep diving into single cases.

III EMPIRICAL STUDY

Case selection

The case selection was based on an open discussion about the initial research problem area with a global-leading industrial equipment manufacturer and service provider. The overall aim of the discussion was twofold: understanding the organizations views on the initial research topic and identifying a suitable ecosystem to study the problem, while ensuring an ample access to ecosystem stakeholders.

Based on the first meeting, leading members of the chosen case environment was contacted and a second meeting was organized. The purpose was to ensure willingness to participate in the study, discuss the initial suitability of the ecosystem to address the research problem, and to further establish which stakeholders should be included to ensure comprehensive representation of the ecosystem. A list of 15 organizations was provided with different relations to the case context, which in turn were approached through e-mails and phone calls. All in all, 12 out of 15 organizations replied and further 10 individual face to face meetings were arranged in addition to one phone conference whereas the author of this thesis presented the study and probed the organizations willingness of participation. All ten organizations that were met in person decided to take part in the study and additionally one organization immediately signed up through email. Unfortunately, the phone conference did not yield envisioned results. Albeit the 11 participating organizations forms a thorough representation of the ecosystem, it should be noted that stakeholders providing supportive yet important services, such as banking, insurance, and certain maintenance services, were not included in this study.

In addition to the core ecosystem included in this thesis, the author utilized the network of his affiliated research project and four further organizations from the IT sector were invited to join the research as co-creators of knowledge, providing their unique viewpoint on the matter. At last, in the final data collection phase, University staff including professors and researchers as well as one additional authoritative and one software organization collaborated, each with their own insights.

Case description

This thesis studies the digital transformation of the Port of Helsinki ecosystem, within the cargo traffic and shipping sector. The aim is to examine current ecosystem level processes, value networks, and inter-organizational data sharing opportunities in order to evaluate how the ecosystem could carry out a digital transformation. The

participating stakeholders range from small and medium sized local organizations to large global enterprises with over 100 000 employees. More precisely, two organizations employ between 80000-102000 people globally, one employs approximately 20000 people and has global operations, two employ between 3500-4000 people in Europe, and the remainder fewer than 500 employees with operations in Europe. The overall ecosystem composition of the case study is illustrated in Figure 7.

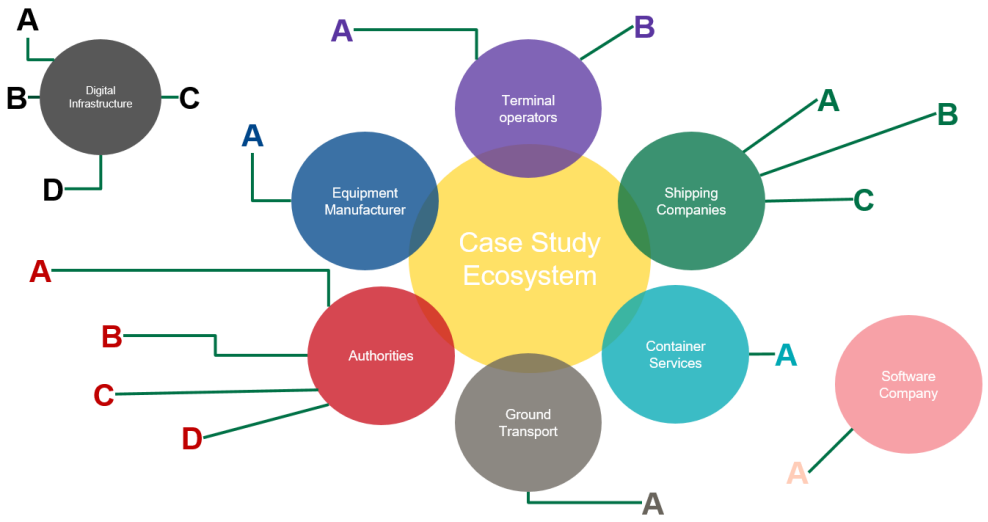

Figure 7. Case study composition

The Port of Helsinki manages in total eight separate harbors and is the busiest passenger port in Europe, in addition to being Finland's leading port for foreign trade. While the port is set up as a private limited company, it is owned by the City of Helsinki. In this thesis two harbors have been examined: the West Harbour and Vuosaari Harbour, whereas greater focus have been directed towards the latter. While West Harbour mainly serves passenger traffic, a significant volume of Roll On Roll Off (RORO) heavy traffic passes through the port as well. The West Harbour functions as a connection to Tallinn and has been one of the fastest growing routes in Europe, partly due to it being used as a trade route between Finland and Eastern Europe. Vuosaari Harbour in turn serves both container and RORO traffic. It is described as a throughput port, meaning it offers limited storage space in relation to traffic volumes and is mainly designed to support fast flow of goods to nearby situated end customers. Vuosaari Harbour offers operational space for both competitors and collaborators.

As illustrated in Figure 7, the core ecosystem involved directly with the flow of goods consists of terminal operators, shipping companies, companies offering container

services, ground transport or trucking companies, different authoritative organizations, and equipment manufacturers. An additional group of freight forwarders could have complemented this ecosystem, however unfortunately no such company responded to participation requests to the study.

In this thesis, three shipping companies are included, denoted as company A, B, and C. Both companies A and C operate in the container cargo segment and offer intermodal freight transport services, whereas only A offers such services in Finland. Company B focuses in turn purely on RORO and passenger traffic. Company B operates in the Baltic Area, A in Europe, and C on a global level.

For the next category, this thesis includes two port operators. A port operator manages the movement of cargo between ships and other means of ground transportation. Both companies A and B work with containerships, however company A also handles RORO traffic.

Container service companies, also known as container depot companies, are responsible for managing, storing and maintaining empty containers. Vuosaari Harbour has several companies offering this kind of service, however only one is included in this thesis. Similarly, only one ground transport company is included, yet as explained shipping company A offers intermodal freight transport in Finland, meaning shipping company A indirectly fits in this category as well. Likewise, port operator company A in turn offers container services, overlapping the depot category.

The authorities represented in this thesis are the port owner, Finnish Customs, Finnish Transport Agency, and the Ministry of Transport and Communications.

The equipment manufacturer, in turn, is a global leading manufacturer of equipment used by stakeholders in the logistics industry.

The additional organizations included as co-creators of knowledge are comprised of three teleoperators, one software developer specialized in port management systems, and one provider of digital infrastructure.

The Port of Helsinki ecosystem is particularly interesting to study the potential of a digital transformation, as it is an established yet complex ecosystem. The ecosystem boasts a multitude of actors doing business individually yet operating on a limited physical area as a shared resource, requiring the actors to simultaneously compete and

closely collaborate in order to execute daily operations. Thus, a point of interest is to examine how digital transformation could create collective benefits for the ecosystem.

7.3. DATA COLLECTION PROCESS

In order to successfully reach the overall aim of this thesis, the author recognized a need to divide data collection into three separate phases: initial informal discussions with prospecting participating organizations, an interview round, and a workshop. The data collecting process is illustrated in Figure 8.

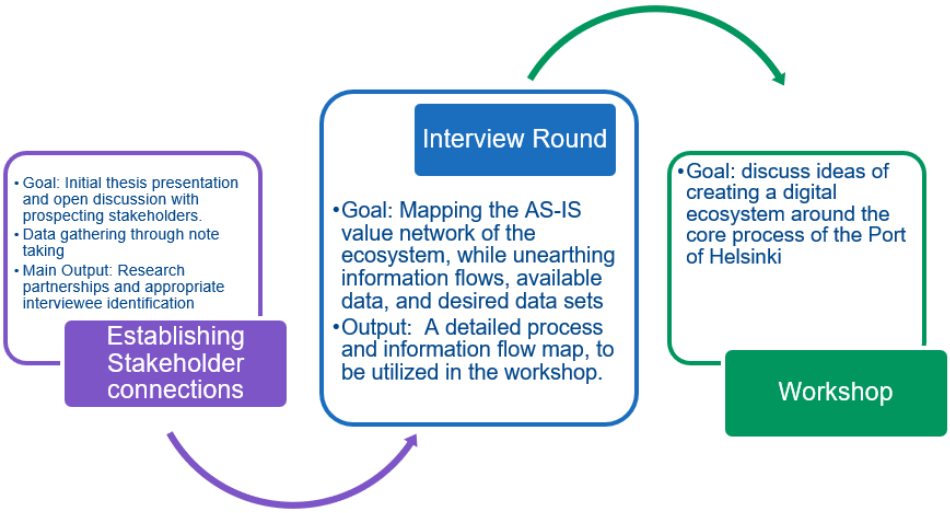

Figure 8. The data gathering process

The goal of the first phase was to primarily introduce the thesis topic to potential participants of the research and inviting them to join, while simultaneously identifying suitable candidates for interviewing following a snowball sampling approach (Kvale and Brinkmann, 2009). A secondary goal was to gather initial information on the participant's perception of the initial research dilemma as well as possible problem descriptions through informal discussions.

The second phase of the case study design consisted of a semi-structured interview round with each participating stakeholder. The goal of the second round was to map and establish the AS-IS value network of the ecosystem and the state of information flows and current processes. In addition, each stakeholder's perception on inter-organizational data sharing was unearthed. Furthermore, complementary interviews were conducted with the co-creators of ideas, namely companies from the telecommunication industry. The goal of this process was to inquire in what way the

companies could support in the transformation of a digital ecosystem and uncover the views of the organizations on the research problem.

The final phase of the case study was a workshop, designed and organized as a joint effort between Aalto University and Cornell University. The overall goal for this phase was to facilitate the ideation and creation of a digital ecosystem, by using the findings from the second stage interviews and identify better utilization of data within the ecosystem in addition to co-creating knowledge and ideas with between the participants.

First phase: Establishing stakeholder connections

As explained earlier, a list of potential participants was delivered by the port owner and subsequently meetings were arranged with nine separate organizations face to face and one through a phone conference. Referring to Figure 7 (ecosystem composition figure), shipping company C and digital infrastructure companies A, B, C, and D were not included in this first phase, as all decided to participate in the study based on email exchanges. Suitable candidates were allocated for the interview round through email as well. Furthermore, software company A and public authority organization D, on the other hand, participated only in the last phase of the data collection process, the workshop.

The author coordinated and attended the meetings alone. Depending on the organization, the number and hierarchical level of the attendees varied. In general, however, the attendees had managerial positions within their organization. The duration of the meetings were approximately 1-1.5 hours, apart from one that lasted for 20 minutes.

During the meetings, the research problem was briefly introduced and the phenomenon at hand was discussed informally. The author collected notes of specific topics of interest raised during the meeting, such as current problem statements and improvement desires. The meetings also yielded suitable candidates to be interviewed.

All organizations the author met face to face had a positive attitude towards participating in the research. Furthermore, as mentioned one phone conference was arranged with an equipment manufacturer. Despite sharing an interest in the research topic, misaligned expectations on the thesis proceedings and outputs were experienced. Thus, after a thorough discussion between the author and the thesis

supervisor and instructor, further proceedings with the equipment manufacturer in question were concluded.

Second phase: Interview round

The purpose of the interview phase was to function as an intermediate milestone, providing the necessary background information to be utilized in the workshop. The technique utilized in this thesis was semi-structured thematic interviewing. The technique follows closely the interview guidelines provided by Patton (2005) and it allows a researcher to follow a pre-determined thematic guide containing open-ended questions as support for maintaining focus during an interview. Yet simultaneously it allows new perspectives to emerge by not setting barriers for the researcher to redirect focus during the interview.

Interview protocol and theme formulation

Interview themes for the interview protocol were formulated in a three-stage process. First, the author constructed the initial themes and supporting questions through a reflection against the initial research problem and desired findings that could be utilized in the final data collection phase of the case study. In line with abductive reasoning, the initial research problem that was formulated through a literature study provided useful support in the construction of themes. Furthermore, the initial meetings yielded meaningful insights in this construction as well. Secondly, the themes and questions were discussed and refined in collaboration with the thesis supervisors and colleagues. At last, the themes were tested and honed by conducting a pilot interview with a colleague new to the research.

In order to provide the prerequisites for the workshop, the ecosystem was examined from two perspectives; first, the role of each participant in terms of the collective core process of the harbor and secondly the data status of each actor. Based on these perspectives, two main themes emerged, where the second was divided into separate entities. In addition, an introduction theme aimed to function as an icebreaker during the interview was formulated. The themes and respective guiding questions are found in Appendix 1 and summarized below:

Table 1. Interview themes for the core ecosystem

Background information of the interviewee and the organization.

Process and ecosystem mapping.
Data and information flows *Core process data/information* *Additional data* *Data possessed by other stakeholders*

Additionally, in the interviews with the participants in co-creator of knowledge roles, a second thematic protocol was constructed following a similar formulation process. The complete protocol is found in Appendix B and the core themes are illustrated in Table 2.

Table 2. Interview themes for the providers of digital infrastructure

Background information of the interviewee and the organization.
The organization's role in the port context.
The organization's role as a supporter in digital development of the port ecosystem
Uncovering the As-Is situation

Conducting Interviews

After the identification of suitable interviewees in the first phase of the data collection process, the interviews were coordinated by the author. First, the interviewees were contacted by e-mail, containing a short description of the study, the purpose of the interview, and the expected length of the interview. Thereafter interview schedules were agreed upon. In order to prevent unnecessary preliminary biases to be formed, information about the themes and the interview were deliberately kept minimal. An exception was shipping company C, as the first phase meeting was not organized. Thus, a more thorough description was provided in order to better prepare the interviewee. Another exception was shipping company B, who explicitly insisted in acquiring the thematic guide in advance, in order to prepare for the interview.

The beginning of each interview started with a brief introduction of the interviewer(s) and the purpose of the interview was repeated. The interviewers also emphasized the anonymity of the interviewees, as well as the researcher's neutral affiliation with the participating organizations. The latter point proved to be important at an early stage, in order to reassure the participators that results would not be examined in favor of any particular stakeholder.

Interview data was captured with tape recorders. In addition to the thematic guide, the interviewers had prepared a representation of a high level inter-organizational process of cargo flow as a timeline on a large sheet of paper, as seen in Figure 9. The researchers decided to use incoming cargo based on first phase discussions, as it would include more complex operations especially for customs services, compared to cargo export. The timeline was further limited by starting with cargo leaving the last port before arriving Helsinki, neglecting prior proceedings of cargo flow such as trans-oceanic- or ground shipping. Despite the limited snapshot view of the overall cargo journey, the timeline did not limit the discussions, and both export processes and proceedings prior to cargo leaving the last port before Helsinki were contemplated during the interviews. Rather, the purpose of the process timeline was to function as a supportive boundary object, providing a useful guide to the interviews (and more importantly support the construction of a detailed to-be inter-organizational process representation to be used during the workshop stage). In general, boundary objects are used to facilitate knowledge transfer between people (Smeds, 2005). Findings were written directly on the paper sheet, fleshing out the role of the organization, information flows, and additional data possessions of the stakeholder. Furthermore, additional notes were written by hand as a supporting practice to guide follow up questions.

Figure 9. Inter-organizational process timeline and interview boundary material

Interviewee Categorization

During 10 out 14 interviews, the author and the supervisor of the thesis were present, supporting a wider range of perspectives to emerge during the interviews. The author conducted the four remaining interviews alone. In total 20 representatives were interviewed and the average length was 1 hour and 35 minutes. The interview specifics are summarized in Table 3 below.

Table 3. Interview data

Company Pseudonym	Role(s)	Experience			Number of interviewers	Number of interviewees	Length
		0-4 years	5-10	> 10 years			
Container Service A	Terminal Manager			x	2	1	1:54:31
Infrastructure A	Innovation Manager			x	2	1	1:23:51
Infrastructure B	Senior Development Manager			x	2	1	1:28:26
Authoritites A & B	Expert			x	2	2	1:29:28
	Senior Customs Officer			x			
Terminal Operator A	HSEQ Manager				1	1	0:48:57
Terminal Operator B	Terminal Manager		x		1	1	1:33:47
Infrastructure C	Investor/Advisor	x			1	3	1:02:40
	Sales Manager	x					
	Sales Manager	x					
Shipping Company A	Operative Development Manager			x	1	2	2:16:35
	HSEQ Manager		x				
Ground shipping A	Traffic Manager			x	2	1	1:40:07
Authorities B	Expert			x	2	1	2:05:49
Infrastructure D	Manager, IoT connectivity solutions		x		2	1	0:55:55
Shipping Company B	Sales manager			x	2	2	2:02:55
	IT Development Manager			x			
Port Owner	Traffic Manager		x		2	1	1:49:47
Shipping Company C	Country Customer Service Manager			x	2	2	1:44:08
	Operations Coordinator		x				
					Total:	20	22:16:56
						Average:	1:35:30

Third phase: The Workshop

The last phase of the data collection process was organized as co-creative intervention with an aim to create knowledge on digitalization of the port across organization boundaries by examining the inter-organizational business processes and value network. In order to create a holistic understanding of digital transformation on an ecosystem level, it is imperative share the development responsibility between the members, thus advocating for a workshop to be organized with the participating organizations of this thesis. This thesis utilizes an intervention scheme developed by Aalto University's Simlab research group.

The method strives to unveil the interdependencies of the participants, while simultaneously coordinate the knowledge creation between the stakeholders. It relies on three basic elements. First, the participants form the base of knowledge to innovate upon and thus including all participants in the intervention is crucial. Secondly, use of visual boundary objects provides a bird's eye view of the subject under development,

mediating knowledge gaps, revealing interdependencies, and supporting a creation of common objectives. At last, external facilitators are responsible in coordinating the above-mentioned elements. (Smeds, 2005)

The workshop was designed and organized by SimLab, led by the instructor of the thesis. It started with an invited talk on data sharing, given by professor Aija Leiponen from Cornell University. Thereafter the co-creative discussion of the digital ecosystem started, facilitated by the author of this thesis. In the facilitation, the author used two boundary objects, that he had constructed based on the findings from the interview round. First, the detailed inter-organizational process map was discussed, followed by the value network of the developing port ecosystem.

Altogether, 27 invited representatives from the organizations of the port ecosystem and from universities took part in the workshop. The instructor and the author had planned the workshop together. The author acted as facilitator of the discussion the of the workshop. Four researchers from Aalto SimLab functioned in assisting roles, helping with video recordings and note taking. During the workshop, the facilitators main task was to coordinate the discussion during the sessions, while the assistants helped with video recordings and note taking. Referring to Figure 7, equipment manufacturer A and port operator B were not able to attend the workshop. Data was captured through video recordings, yielding approximately 2 hours and 48 minutes of video material for analysis.

At last, a questionnaire was used at the end of the workshop, whereas participants were asked to reflect about benefits and challenges of inter-organizational data sharing, as well as providing general feedback.

7.4. DATA ANALYSIS

In accordance to the abductive reasoning approach of this thesis, data analysis was conducted and theoretical literature was examined iteratively throughout the three phases of the data collection process. Overlapping data collection and analysis increases the quality of the research (Patton, 2005, p. 437) and the abductive approach supports achieving a deeper understanding of a case in case studies (Dubois and Gadde, 2002). Similarly, as data collection, the analysis can be divided into three stages.

In the first stage, written notes were analyzed, with an aim to build a general understanding of the case environment, as well as to provide an input to the construction of the thematic interview guide. Furthermore, the first stage assisted in creating the boundary material used in the interviews. In the second stage, interview recordings were listened to, while the second stage boundary materials were examined. In order to construct the detailed process map and value network for the workshop, the interviews were cross compared and process overlaps were identified. After the workshop, a more comprehensive and thorough data analysis was conducted.

First, all tape and video recordings were transcribed using a self-developed selective transcription method. Traditionally in qualitative research, verbatim transcription, *i.e.* "word for word reproduction of verbal data", has been the primary method of transcription. While verbatim transcription is considered an important element of data reliability, validity, and veracity, it is an intensely time-consuming process and thus the cost should be weighed against gained benefits. (Halcomb and Davidson, 2006) Considering the relatively large amount of data gathered for the scope of a Master's Thesis, in addition to tape recordings being analyzed at several stages, the author opted for selective verbatim transcription in order to optimize time utilization by allowing the author to allocate increased focus on more value adding tasks in the research process. The selective transcription used, entailed transcribing only passages of interest neglecting certain repetitions and general jargon. Non-transcribed passages were however timestamped and short discussions descriptions were constructed by the author. The author recognized that the abductive reasoning approach could potentially result in non-transcribed passages becoming relevant at later stages. Thus, the timestamps and description ensured potential re-discovery of such passages. Despite using a selective transcription method, it resulted in 106 pages and 48759 words of interview data (including the descriptions). At last, the author wants to point at out that in line with the axiological assumption of this thesis biases could have influenced the choice of passages that were transcribed.

The main approach to data analysis is based on a computer assisted NCT (noticing, collecting, and thinking) method (Friese, 2019). The method is characterized by a cyclical approach to data analysis, whereas the first stage, noticing, refers to interesting bits in the collected data and assigning initial high-level codes. During the transcription phase, "noticing" was done in parallel and the researcher was able to identify high level themes of interest. The most prominent observation was a hierarchical level of concepts, which influenced the construction of deductive code

grouping at later analysis stages. After transcribing, the transcriptions were transferred to Atlas.ti, read through, and open codes were developed.

The second stage of the analysis method referred to as collecting, relates to the practice of identifying common themes, while merging and organizing existing codes accordingly with an aim to add structure to the code list. At this stage, the hierarchical groupings were applied, in accordance to themes being related to internal organizational, port related, international, European, or global concepts. Furthermore, categories according to descriptive characteristics of the shipping industry, challenges and barriers, opportunities, processes, data sharing related themes, and value network related themes were developed.

The last phase of the cyclical method entails reflecting on codes and code structures developed in the bigger picture. As the iterative approach suggests, the cycles were repeated several times in this thesis, yet the significant thinking part to highlight in this thesis is the practice where the author examined dependencies and linkages between the different concepts identified. After identifying the hierarchical level of themes, the need to approach the analysis through systems thinking emerged. Utilizing Atlas.ti's network view, the author examined the hierarchical structure as inter-related independent systems and inspected how different concepts related to each other, while drawing links between concepts. The approach borrows ideas from Soft System Methodology (Checkland & Scholes, 1990), by utilizing rich pictures, acknowledging that problems and solutions does not exist in isolation, and thus attempting to conceive potential feasible actions that can take place within the case study of this thesis. Rich pictures are represented by the Atlas network view, while the inter-dependencies assist in finding feasible solutions.

Figure 10 provides an illustration of the analysis process of research stream 1 and 2 in relations to research questions and the timeline of the research process.

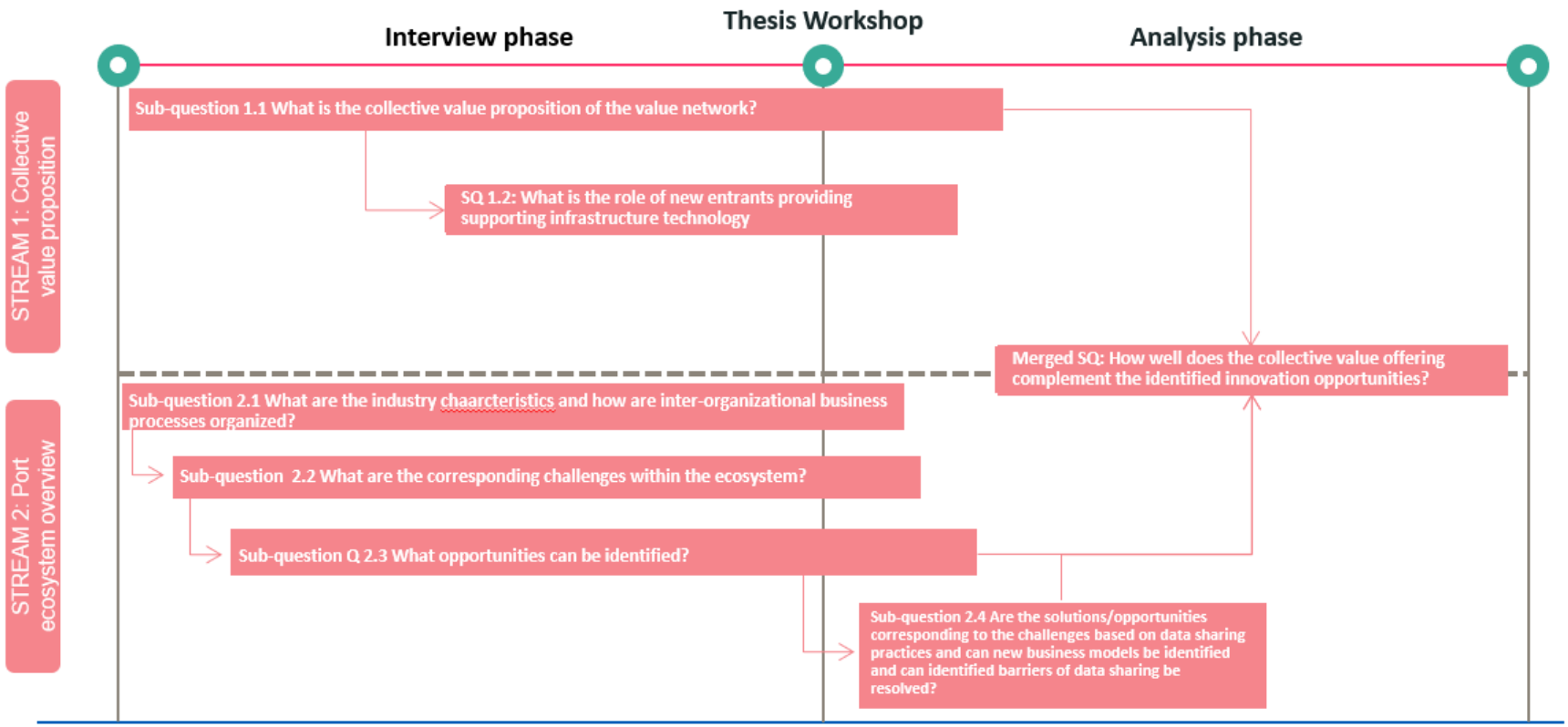

Figure 10. Research analysis in relations to research questions and the timeline of the research process

8. FINDINGS

In this chapter, the findings of the research are presented. The focus of the analysis is to understand value proposition of the ecosystem in the case context, map the inter-organizational processes within the ecosystem, uncover characteristics, challenges and opportunities, and analyze the inter-dependencies of these attributes.

8.1. THE VALUE NETWORK OF THE SHIPPING INDUSTRY

The current value network

The shipping industry is comprised of complex inter-relations between a multitude of actors, in addition to a myriad of trade configurations. Yet, two main business logics were identified in this thesis and a simplified synthesis of a value network is presented in Figure 11. Respective stakeholders of the ecosystem are represented by the different colored squares. Furthermore, trucking companies, shipping companies, port operators, and container depots have been grouped together. Shipping companies are in turn divided into two main groups, namely container shipping and RORO shipping companies. The intersection of container shippers and RORO shippers represents container shipping companies who are direct customers of freight forwarders. The figure describes the flow of money, value offerings and information flows of the network. The aim of this chapter is to introduce the roles of the actors, the common business logics of the port ecosystem, and the collective value proposition of that ecosystem offers. In addition, potential future offerings by providers of digital infrastructure are presented, in relation to how the value network could evolve.

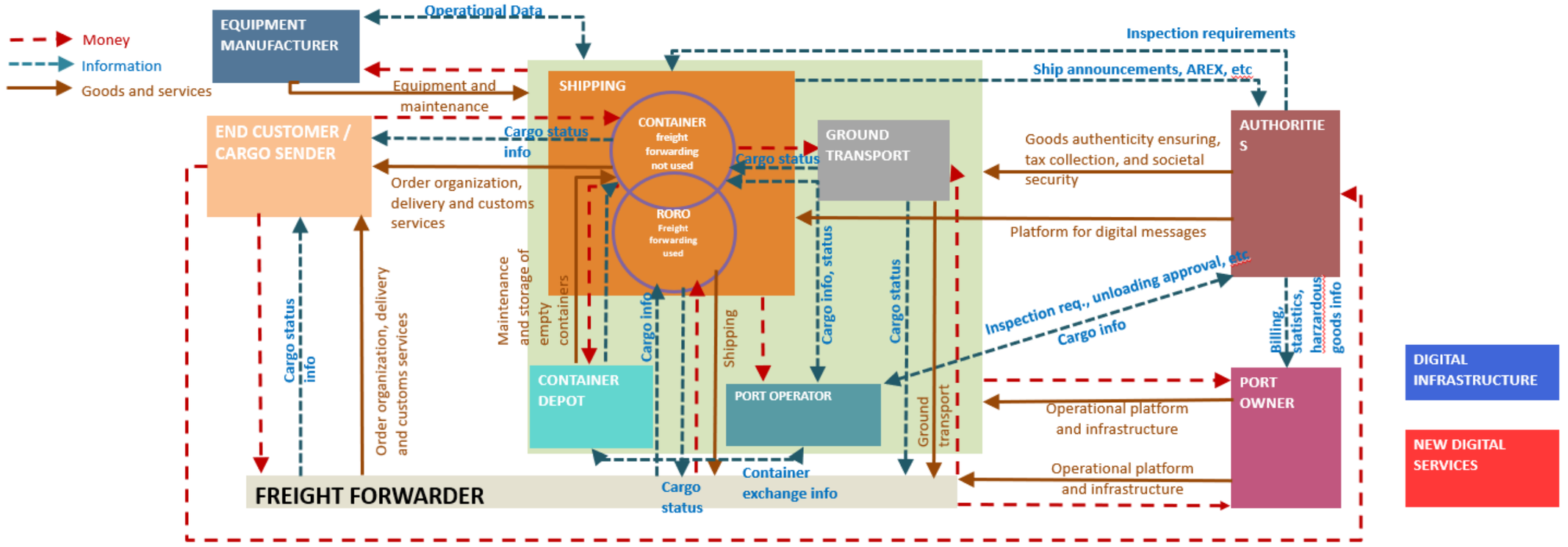

Figure 11. The value network of the port ecosystem

Starting by describing the end customer in the Figure, it is to be noticed that the final recipient of goods and the transportation-acquiring customer are commonly different parties, yet alternatives exists:

”Asiakassuhteita on monta eri tyyppiä. Asiakas joka ostaa suoraan tavaraa esim. Kiinasta, niin on monia eri scenarioita mitä tapahtuu seuraavaksi, mutta yleisesti tavaran toimituksen buukkaus tapahtuu tällöin tilauspäässä…”	*“Several different types of customer relationships exist. For a customer who buys goods directly from China, for example, different scenarios exist for what's going to happen next, but generally the order of the delivery of goods takes place at the order end…”*
”… Kuitenkin poikkeuksia on etenkin Euroopassa, missä tavara on saatettu myydä niin että loppuasiakas itse tekee kaiken kuljetustilauksen ja käy hakemassa tavaran myyjän tehtaalta.”	*“… However, there are exceptions, especially in Europe, where goods may have been sold so that the end customer itself carries out all the shipping orders and retrieves the cargo from the vendor's factory.”*

(Shipping company C)

Furthermore, highlighting the complexity of trade arrangements, several intermediaries can be involved in between the flow of money.

”Meriliikenteessä puhutaan remburssikaupasta ja konossementista. Remburssikaupassa välissä on pankkeja, joille maksetaan. Konossementti on se paperi jolla se lopullinen asiakas sen tavaran saa. Tämän saa vasta kun kaikki on maksettu kaikille näille pankeille siinä välissä.”	*“In the shipping industry [we] talk about reimbursement trade and bills of lading. In reimbursement trade, banks function as intermediaries between payments. The bill of lading is the paper with which the final recipient can claim the goods. This will be done only after all these banks have been paid in the middle.”*

(Shipping company C)

Regardless of the arrangement, three types of money flows from the end customer/recipient can be identified, in the simplified value network of this thesis. To begin with, the recipient of goods is responsible for paying taxes, assuming the imported goods are taxable, and thus money flows from the end customer to the authorities in Figure 11. The two other types of money flow from the end customer are dependent on the above mentioned two types of business logics, reflected directly in the value offering of the shipping companies. First, using an intermediary freight forwarder, the responsibility of organizing and delivering the cargo lies on said freight forwarder, who consequently acquires services from RORO or container shipping companies. Additionally, the freight forwarder organizes ground and other modes of transport, acquiring consequently transport services accordingly. On the other hand, as seen in Figure 11, certain container shipping companies do not deal with freight forwarders and instead offer door-to-door services to the end customer, thus taking the role of the freight forwarder and cutting out other possible intermediary agents. As the business model suggests, the value offered lies in organizing the entire chain of delivery. The end customer acquires this service directly from the shipping company, who in turn either utilizes an own fleet of ground transport vehicles or alternatively subcontractors.

In addition to direct customer/buyer relations, shipping companies practice collaboration with competitors by offering shipping services for containers owned by the competitor on trans-oceanic routes, with an intent to optimize capacity utilization. Collaborative relations with authoritative figures are also present.

In terms of information flow in the freight forwarder case, they distribute necessary cargo information for operations to both shipping and transport companies, receiving in turn status updates, that can be forwarded to the recipient. Within the door-to-door business segment, the shipping company holds all necessary operational information needed by subcontractors, while directly receiving status updates from these that is turn forwarded to the recipient. This means shipping companies can be considered as primary value creator, as information is the business of other stakeholders.

In order to manage port operations, shipping companies acquire services from port operators. The extent of services offered, depends on the operator yet the core value created lies in having:

”järkevästi resursseja että laivat pysyvät aikatauluissa.”

“sufficient resources to ensure ships remain on schedule.”

(Port operator A)

The basic operations of the port operator to achieve this value offering is aim to ensure timely unloading of the ship. As explained, it is highly dependent on information exchange from shipping companies, resulting in the need of close collaboration ties between the two parties, as well as efficient port operation systems. Information is generally provided in the form of a ship manifest, which is explained in further detail in the upcoming chapter.

”... manifesti tiedon perusteella rakennetaan operaatiota niin että kaikki on valmista kun laiva saapuu, niin että materiaali voi vain virtaa sataman läpi.”

”Toi kaikki data mitä liikkuu tuolla [viittaa manifestitietoihin], niin sehän on tavallaan meidän business.”

“... based on manifest information, we plan our operations, so that everything is ready when a ship arrives and goods can simply flow through the port.”

“All that data [referring to the information in the manifest], it is in a way our entire business.”

(Port operator A)

Port operators commonly offers also additional services, such as customs handlings. Furthermore, port operators need to serve ground transport stakeholders when retrieving cargo. Although not being direct customers, port operators can offer added value to these by:

”kerrotaan milloin voi tulla hakemaan traileriaan[/konttia].”

“reporting when a trailer[/container] can be retrieved.”

(Port operator A)

Shipping companies specialized in container traffic uses another sort of sub-contractor as well, namely container depot service providers, who takes care of the following:

” me toimitaan konttien varastoijana ja korjaajana, elikkä ”hotellivarastoidaan” eri merilinjojen kontteja, mitä meillä on omina asiakkaina ja me tarkistetaan ne siisääntullessa ja korjataan ne tarpeen vaatiessa eri korjausvaatimusten mukaan ja sit annetaan ne ulos kun ne buukataan erikseen.”

“we operate as container storage and repairer, so we function as a “container hotel” for different shipping lines, whom are our customers and we check them [containers] when they come in and repair them, if necessary, according to different repair requirements and at last hand them out when they are booked separately.”

(Container Depot A)

Container Depots support shipping companies by assisting in selling old empty containers to customers, hence providing added value. Similarly to port operators, container depots are also in direct collaborative contact with ground transport services.

Competitors among port operators and container depot companies furthermore exchange loaded and empty containers between each other and thus further collaboration, or coopetition, ties exist in the network, visible through information exchange in Figure 11.

In addition to the obvious core value offering of ground transport companies, added value is provided by offering timely deliveries to end customers going beyond the initial planned route of cargo.

“Että joskus jos on erittäin kiire toimittaa tavara loppuasiakkaalle, niin feederillä se merikuljetuksessa menee 4 vuorokautta, jolloin me voidaan itse yhteistyökumppaneiden kanssa tuoda tavaran 2 päivässä, eli rekalla ja RORO laivalla”

“Sometimes if the end customers are in a hurry to receive their cargo, transportation with feeder ships can take 4 days and instead we can ourselves use our collaboration network and bring the cargo in two days with trucks and RORO ships.”

(Ground Tranport A)

In Figure 11, shipping companies, port operators, depot service providers and ground transport have been grouped together inside a green box for two practical reasons; both utilize some sort of heavy equipment provided by equipment manufacturers, while also having direct relations with the port owner and the authorities. In addition to acquiring operational equipment from equipment manufacturers, these also offer maintenance services. Added value in turn is offered by:

" Tarjotaan asiakkaille prosessien parantamista, sekä pyritään datan avulla parantamaan palveluja"	*"Providing clients with process improvements services, and seeking ways to use data to improve our own services."*

(Equipment manufacturer A)

The port owner offers a physical platform and infrastructure for the separate organizations to operate. More precisely:

"Sataman tehtävä on rakentaa, omistaa, ja ylläpitää tätä infrastruktuuria, eli näitä valtavia liikenneväyliä ja asfalttikenttää laitureiden välissä."	*"The task of the port is to build, own, and maintain the infrastructure, that are these huge traffic lanes and asphalt areas in between the docks."*

(Authorities C)

The port owner receives compensation for their services through rent and cargo payments based on cargo volumes. Added value is offered by providing supportive services.

" Satama tarjoaa palveluja kuten tankkaamisen hoitamista, pilssiveden tyhjennystä ja muuta tukipalvelua"	*"The port offers services, such as fueling, bilge water collection, and other supportive services."*

(Authorities C)

The customs are responsible, in addition to already mentioned fiscal obligations in the form of tax collection, for ensuring cargo authenticity and societal security. Thus, the customs officers conduct risk analyzes and attempts to hinder the entrance and export of illegal goods, however a prominent aspect of the customs value offering is on the contrary to enhance legal trade. Other authoritative bodies offer digital platforms, designed for smooth information exchange, while receiving statistical data of foreign trade. Albeit, collecting taxes from end customers, the relationship should not be considered as customer/buyer. Rather all authoritative figures are naturally collaborators in the value network.

The evolving ecosystem

While the current value network in Figure 11 does not reveal the purpose and roles of digital infrastructure providers in the light of the port ecosystem, the potential future offerings were presented and laid out by respective stakeholders. The providers of digital infrastructure perceived traffic nodes, such as ports and the maritime industry in general, as growing and lucrative business areas. The number one reason being increasing data exchange needs in such settings and hence emerging opportunities for new business.

” Me haetaan aika aktiivisesti mitä pystytään tekemään ja tietenkin vähän itsekkäästi et löytyykö sieltä joku business meille muuta kun sitä perusjuttua, josta ollaan nähty et satamat on yksi kohta. Yleensäkin tämmönen et niin kuin tämmönen hahmotelma semmosesta että, kun on logistiikkatietoja tai ihmisvirtoja et jossain ne kohtaa, niin siellä todennäköisesti siirtyy paljon tietoo, tehdään paljon toimintoja, tapahtuu paljon asioita, nii niistä tavallaan tulee semmosia hubeja et tossa todennäköisesti tulee syntyy paljon businesstä.”

“We are looking quite actively what we could do and from a selfish perspective, if we can find some business area outside of our usual offerings, whereas ports are one such area. In general, this sort of vision, where there is logistical information or flows of people, there is a great possibility of vast information exchange, a lot is happening and these become sort of hubs, where lots of business is created.”

(Digital Infrastructure A)

” Meillä on meriteollisuuteen kaiken näköisiä ajatuksia, mitä voitaisiin tarjota sinne.”

“When it comes to the maritime industry, we have several ideas of what offerings we could make”

(Digital infrastructure D)

Furthermore, all digital infrastructure providers had either started or planned on starting port projects.

” Emme näe että olisimme tällä hetkellä ammattilainen meriteollisuudessa, mutta se on jo nyt kasvava osa-alue toiminnassamme.”

“We do not perceive ourselves as professionals in the maritime industry, however it is a growing area in our business.”

(Digital infrastructure D)

” Satama kontekstissa IoT puolella meidän toiminta on melko olematon, mutta kehitteillä on pilootteja ja joitakin on jo tehty.”

“From the point of view of IoT, our activity in the port context is pretty much nonexistent, however pilots are being developed and some have already been conducted.”

(Digital infrastructure B)

” ... tätä 5G murrosta mikä on tulossa ja sehän on semmonen että nyt aletaan laittamaan ensimmäisiä paikkoja ja lähetään kokeilemaan. Satamat on hyviä paikkoja.”

“... this 5G disruption that is on the way is in a state whereas we are setting up the first places for testing it. Ports are good places for that.”

(Digital infrastructure A)

Despite a shared apparent interest among the providers of digital infrastructure in the maritime and port industry in addition to offering similar core values in the form of data transferring capabilities, uncertainty about the composition of added value

offerings existed, differing views on technological solutions, and possible routes to initiate pilot cases.

Offering core value in the form of data transfer:

” ... me ollaan datan siirtäjiä, me kyetään se tallentamaan, prosesssoimaan, ja tällai.”	*“... we transfer data, we are able to store it, process it, and so forth.”*

(Digital Infrastructure A)

” ... me tarjotaan connectiviteettiä.”	*“... we offer connectivity.”*

(Digital infrastructure B)

” Meillähän on tällä hetkellä tarjota sellainen 5G pohjainen verkko, sekä satamille että laivoihin.”	*“We can currently offer a 5G based network to both ports and shipping vessels.”*

(Digital Infrastructure C)

Similarities and differences in added value services:

” Meillä on myös datan hyödyntämisessä jonkinmoisia kyvykkyyksiä. […] Meil on kyky löytää jonkin verran sensoreita, meil on kumppaneita ja tämmösiä ja tehdään projekteja ja tällai. Mehän ei itse tehdä sensoreita, löytyykö se just paras juttu meidän kautta on yks kysymys?”	*“We also have some capabilities in data utilization. […] We are able to find sensors, we have a network of partners for this, and we do projects etc. We do not provide sensors ourselves, so a question becomes if we can offer the best possible solution?”*

(Digital infrastructure A)

”IoT puolella tarjotaan data analytiikka, mutta sensorit ovat tapauskohtaisia emmekä tarjoaa niitä tällä hetkellä.	*“We offer data analytics on the IoT side, however sensors are situationally dependent and we*

Etsimme kuitenkin yleissensoriratkaisuja.”	*don’t offer them currently. We are trying though to find basic sensor solutions.”*

(Digital infrastructure B)

” Meillä on myös eri paikannusteknologioita joita kehitellään jotka ei suoraan liity siihen tiedonsiirtoverkkoon, vaan tavallaan erillinen systeemi millä päästään parempaan paikannukseen	*“We also have different kinds of positioning technologies, which are not directly related to data transferring networks, but rather a different system with which better positioning can be reached.”*

(Digital infrastructure D)

Different solutions, different routes, and a degree of uncertainty:

”Jos mä katon niin kuin ihan tästä meidän kulmasta, niin on oikeastaan kaksi tapaa lähtee liikkeelle, jos mä sanon niin kuin connectiviteetistä. Toinen on se et me ruvetaan rakentaa kokeilua, nykyisen LTE verkon mukaan, esimerkiksi tämmöst että näitä IoT sensoreita ja tällai. […] Sit on toinen connectiviteetti puoli mikä tulee 5G kautta. Sehän tavallaan se juttu on että tuodaan paljon paljon kapasiteettiä ja alkuun se lähetsymiskulma ois se että, olettaen että meil ois jonkun näköinen keissi mitä lähetään rakentamaan, joka todennäköisesti käyttökeissi ois rakennettu videoalvonnan/videoseurannan avulla, tai suuren datamäärien siirtämisen alueelle, voi olla tulevaisuudes tai ehkä heti jonkun	*“From our perspective, there are two routes to go forward, in terms of connectivity. First, we can create a test project on top of the current LTE network, bringing in for example IoT sensors and so forth. […] The other connectivity possibility derives from 5G. The core is that we bring lots and lots of capacity and the approach would be, assuming we have some sort of case to build, that could be in the form of video monitoring/tracking, or transfer of large sets of data, or perhaps right away some sort of automation test project.”*

näköisen automaatio liikkumisen kokeilun alue.”

”Suomessa puhutaan paljon privaattiverkoista, eli omalla taajuksilla toimiva oma verkko. Satama on kuitenkin sellainen alue että laivat tulevat ja menevät, eli siinä mielessä se ei ole täysin eristetty. Tästä syystä näen slicing teknologian paljon mielenkiintoisempana.”

“There’s a lot of talk about private networks in Finland, that is a dedicated network functioning on own dedicated frequencies. Ports are however an area where ships come and go, so it is not fully isolated. Therefore, slicing technologies are in my view much more interesting”

(Digital Infrastructure A)

” Tulevaisuudessa rakennetaan ratkaisuja jotka voivat pohjautua slicing teknologiaan tai johon muuhun. Privaattiverkot on toinen vaihtoehto. En osaa vielä sanoa mikä tulee ja privaattiverkkojen puolella mikä operaattorin rooli on.”

“Solutions will be in the future based on slicing technologies or something else. Private networks is another possible solution. I can’t say what will come and what the role of the operator will be for private networks.”

(Digital Infrastructure B)

Part reason for the uncertainty stemmed from an ongoing evolution of ecosystems, resulting in undivided roles between stakeholders in this transformation. All digital infrastructure companies agreed that the ecosystems are changing. Furthermore, both the provider of digital infrastructure B and equipment manufacturer A confirmed that business networks are under development among equipment manufacturers, with an intent to build new capabilities catered for the maritime industry. Equipment manufacturer A perceived building partnerships with tech companies as a lucrative opportunity, in order to test new technology and create “smart machines”, while providing increased capabilities in data analytics. Digital infrastructure provider D also confirmed that they are looking for new partners.

” ... me ollaan nähty et asiat vähän muuttuu ja asiat muuttuu nopeammiksi ja

“... we’ve noticed that things are changing and becoming faster

vauhdikkaammiksi… niin, niin… sanotaanko ympärillä oleva ekosysteemi muuttuu."

and faster… so, so… we can say that the surrounding ecosystem is changing."

(Digital Infrastructure A)

" Kun meriteollisuudessa tapahtuu tällä hetkellä paljon, etsimme aktiivisesti yhteistyökumppaneita jotka lähtis meidän kanssa mukaan."

"As a lot is happening in the maritime industry, we are constantly looking for partners to join us."

(Digital Infrastructure D)

" Paljonhan on noitten yritysten takana [viittaa laitevalmistajiin], eli on omat ekosysteemit, et paljon on niitä Hackathoneja tehty ja siellähän haetaan jatkuvasti sitä uutta juttua et mitä pystyy tekemään. Start-uppeja tulee kovaa vauhtia tuohon ympäristöön."

"There's a lot in the background of those companies [referring to equipment manufacturers], they have their own ecosystems and a large quantity of Hackathons have been organized, whit goals of finding new ways to do things. Start-ups are flocking with high speed to that environment."

(Digital infrastructure B)

Despite the increasing interest in the industry, and emerging specialized companies that can offer value through new technologies or capabilities, digital infrastructure provider A and B emphasized a responsibility among the port stakeholders.

" Mutta loppupäässä asiakkaankin pitää ymmärtää siitä jotakin mitä he tekee siitä [datan] hyödyntämisestä."

"When it all boils down, the customers need to understand something themselves about [data] utilization."

(Digital Infrastructure A)

” Sanotaan että 5G on mahdollistaja, se ei ole ratkaisija. […]kun puhutaan koneoppimisesta, on aina se puoli et ”garbage in, garbage out”. Millä tavalla tunnistetaan se olennainen tieto ja kuinka sitä hyödynnetään? Se vaati sitä oman tietyn alan tuntemusta”

”Yks seikka vielä tuohon tiedon oikeellisuuteen ja siihen liittyy yks tietorurva[asia]. […] kaikkien noitten toimijoitten [viittaa satamatoimijoihin] täytyy ymmärtää mitä tietoturva on. Joka tapauksessa se on erittäin merkittävä tekijä ja sit tuomosseen ekosysteemiin tulee varmaan paljon erilaisia tietomurtoiskuja ja estohyökkäiksiä.”

“5G can be seen as an enabler, not a solution. […] when it comes to machine learning, one thing is “garbage in, garbage out”. How can one identify the relevant information and how to utilize it? It requires knowledge of one’s own field.”

”One thing about the correctness of information, which is related to cyber security. […] all those actors [refers to port stakeholders] needs to understand what cyber security is. It is a prominent aspect and in that type of ecosystem several information breaches and denial of service attack probably happens.”

(Digital Infrastructure B)

Summary of findings

This part has provided an overview of the value network, the roles and relations as well as the value propositions of the participants, and how the network can potentially evolve over time with new entrants.

Although the value network distinguishes between recipient of goods and service acquiring customers, henceforth this thesis refers to final recipients as end customers.

Table 4. summarizes the findings of this chapter.

Table 4. Summary of findings in relations to the value network

	Customer of	**Collaborator with**	**Core value**	**Added value**

Shipping companies	-Freight forwarders -End customers	-Shipping companies -Customs	-Order organization, delivery, and customs services -Shipping	
Port operators	-Shipping companies	-Ground transport -Port operators -Depot -Customs	-Ensuring ships stay on schedule	-Customs handling -Depot services -Cargo status information to collaborators
Container Depot	-Shipping companies	-Port operators -Ground transport	-Maintenance and storage of empty containers	-Organizing selling of old containers
Ground transport	-Shipping companies -Freight forwarders	-Port operators -Depot -Customs	-Ground transport of cargo and empty containers	-Fast delivery if cargo is late
Equipment manufacturer	-Shipping companies -Port operators -Ground transport -Depot	-Providers of digital infrastructure	-Heavy equipment	-Services, analytics, new capabilities
Port owner	-End customers -Shipping companies -Ground transport	-Authorities	-Physical infrastructure	

	-Port operators -Depots			
Authorities		-Port owner -Shipping -Ground transport -Port operators -Depot -Customs	-Information platforms -Societal security -Ensuring authenticity	-APIs to information platforms, intended for external innovation

8.2. INTER-ORGANIZATIONAL PROCESS MAP

The inter-organizational process map of Vuosaari Harbor is illustrated in Figure 12. This chapter presents the processes of incoming cargo, starting from the departure port before reaching Helsinki and ending with ground transport companies returning cargo and/or empty containers to the port. In Figure 12, time moves from left to right, while dedicated lanes are allocated for the involved stakeholders and proceedings related to these stakeholders can be read within the lanes. Moreover, proceedings linked to direct handling and movement of physical artefacts is colored with orange, while blue is used for tasks, decisions, and flows related to information.

The purpose of this chapter is to reveal the current inter-dependencies between processes and organizations of the port actors in a chronological manner.

III EMPIRICAL STUDY

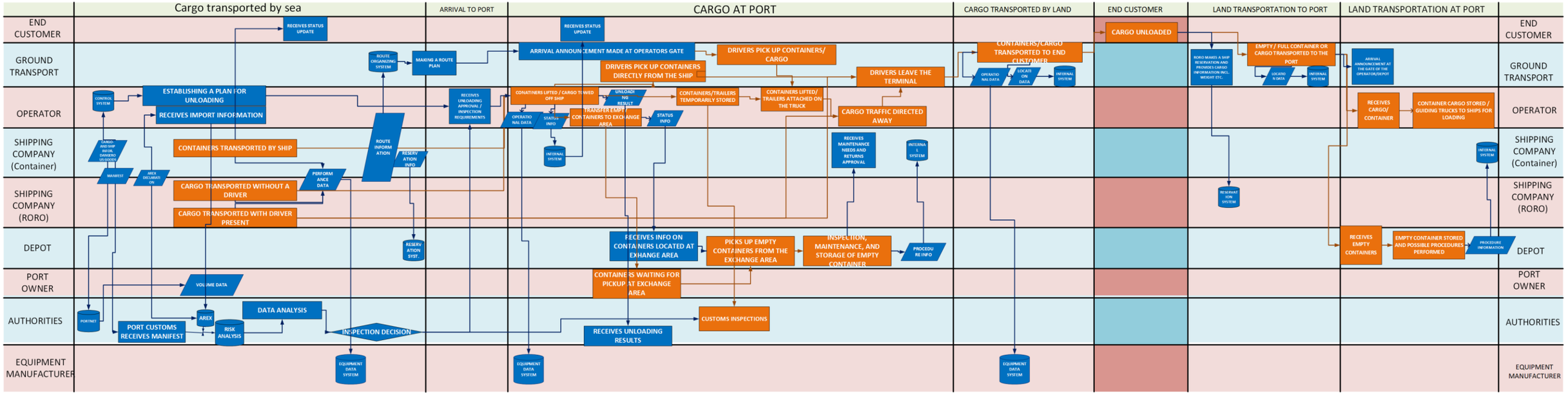

Figure 12. Inter-organizational process map

Cargo transported by sea

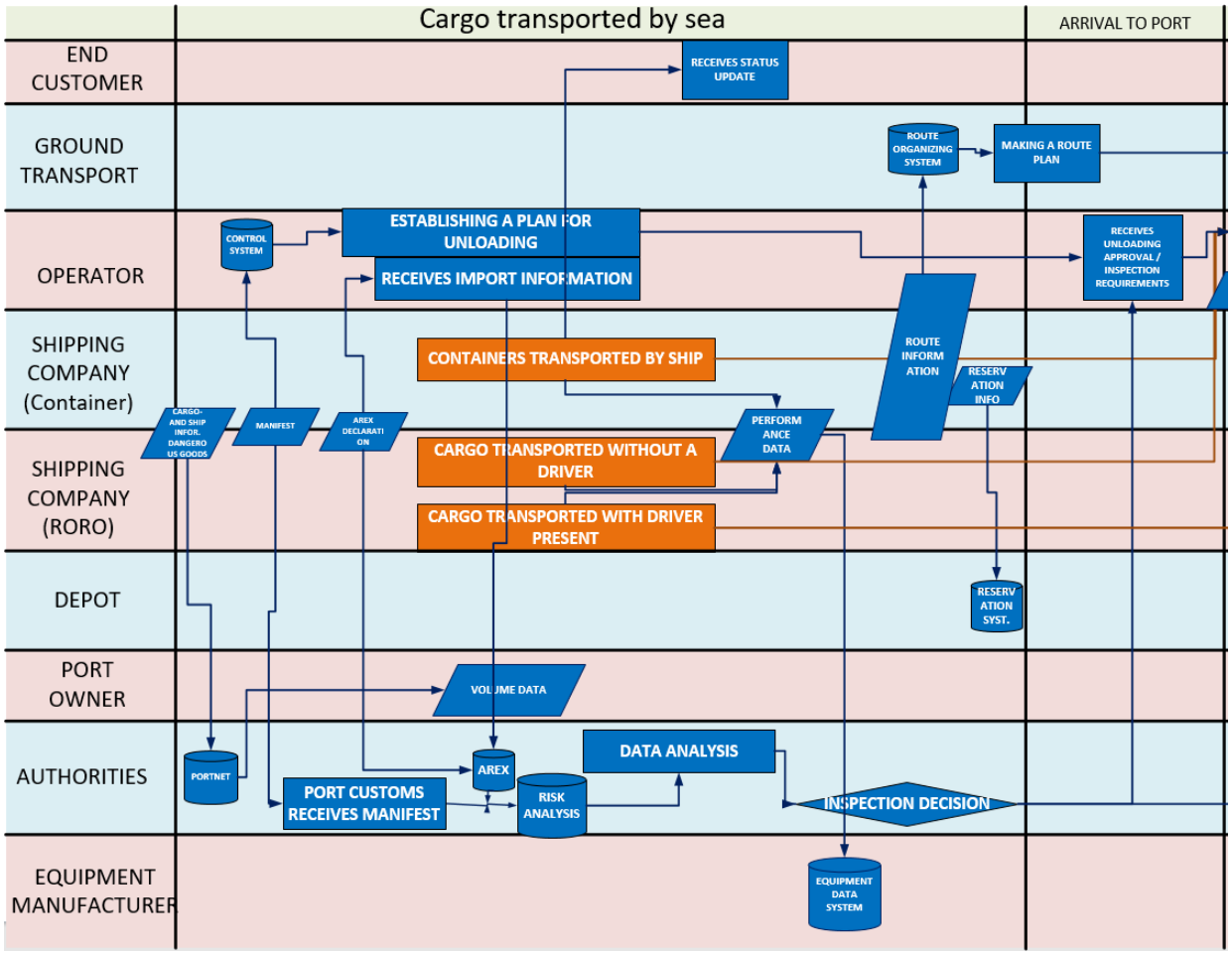

Figure 13. Inter-organizational process map at the stage whereas cargo is at sea

During the first stage of the inter-organizational process map, the movement of physical artefacts is relatively straightforward. On the container transportation side, ships have been loaded with an intent of easy unloading by the port operators at the departure port, while containers can either contain cargo or be empty. Furthermore, containers are placed in the ship to a limited extent according to end customer needs in regards of delivery time. In general, however, ship safety drives the placement of the containers. Safety is ensured through container weight regulations, set by the International Maritime Organization (IMO), which restricts containers to be loaded on board unless the unit has been weighed to generate a Verified Gross Mass (VGM). This in turn, affects the loading plan of containers and hence the physical placement onboard.

” Puhutaan siitä että laiva on lähtösatamassa lastattu niin (ja laivaa lastataan) että se olisi mahdollisimman helppo purkaa. Jotkut asiakkaat voivat pyytää nopeaa purkua, jolloin nämä kontit otetaan ensin laivasta. Kuitenkin enintään 2 voidaan purkaa samaa aikaa ensimmäisenä, joten asiakkaalla pitää olla perustelut miksi haluaa tätä palvelua.”

“We talk about containers being loaded on board at the departure port, to ensure as easy unloading of the ship as possible. Some customers might desire fast unloading and then these containers will be the first ones taken out. However, no more than two containers can be unloaded immediately at the same time, so the customer needs have a good reason for this requirement.”

(Shipping Company A)

” VGM konseptina on tärkeä. Se sisältää tavaran paino ja kontin painon. Tämä on olemassa turvallisuussyistä, eli vältetään sitä että kontin painot olisivat vääränlaiset. Toimeksiantaja on vastuussa ja punnituksen tehdään joko satamassa tai sitten lähettäjällä jos on olemassa laitteistoa tähän. […] Tärkeää että tehdään tämä ennen laivan lastausta, suunnittelua varten.”

“VGM as a concept is important. It depicts the weight of the container and the cargo. It exists for safety reasons, or in other words to avoid false container weights. The customer is responsible for this and the weighing is either conducted at the port, or alternatively the sender possesses equipment for it. […] It is important however, that it is done before loading the ship, in order to make loading plans.”

(Shipping Company C)

On the RORO traffic side, two scenarios take place in turn. Cargo is either transported with the truck driver on board the ship, or alternatively solely trailers have been loaded on board, requiring truck drivers to retrieve them from the arrival port. On ships transporting both passengers and cargo, passengers are prioritized and space is allocated for trucks dependent on how much room is available. Thus, ground transport companies reserve the space at a relatively late stage before departure.

Whilst physical cargo handling is simple at this stage for obvious reasons, information related tasks, decisions and flows are in contrast more complex and extensive. It is in addition, the most data intensive stage in the inter-organizational process, presented in this thesis. The intent is to ensure fast cargo throughput at later stages.

" Datan prosessointi ja asioitten hoitaminen tapahtuu laivamatkalla."	*"Data processing and general organizing tasks are done during shipping."*

(Shipping Company A)

The first information exchange to highlight is shipping companies' notifications delivered to an authoritative electronic information system called Portnet. The notifications are mandatory, set by law, and consists of information regarding the vessel, the crew, and cargo.

" Alusten lähtö- ja saapumisilmoitukset liitteineen, eli siinä on lasti-ilmoitukset ja vaarallisten lastien ilmoitukset, ja matkustaja/miehistöluettelot, alusten varastoluettelot, miehistön omaisten luettelot."	*"Notice of arrival- and departure along with appendices, so it consists of cargo declarations, declaration of hazardous goods, passenger/crew lists, the ships equipment list, and a list of relatives of the crew."*

(Authorities A)

The EU sets the requirements for the information exchange. While the system is administrated by the Finnish Traffic Agency, the responsibility to control the information is done by the Finnish customs. On the other hand, the Finnish Traffic Agency is responsible to forward statistical information from Portnet to an EU level system called Safenet. It is to be noticed that these before mentioned responsibilities and tasks has not separately been illustrated in Figure 13. However, the port owner utilizes the information source to gather data on cargo volumes flowing through the port *e.g.* for billing purposes, which in contrast is illustrated in figure 13.

The shipping companies are required to submit the Portnet notifications at least 24 hours before arriving in the port, or alternatively as soon as possible if the route is shorter than 24 hours.

The authorities, more precisely the Finnish customs, has another information system named AREX. The purpose of the system is enabling electronic declaration of goods. As can be seen in Figure 13, there are two options for submitting the mandatory declarations. The shipping company can make the declaration themselves, or alternatively forward the necessary information to port operators who subsequently performs the declarations. AREX declarations are a standardized and the requirements similarly as VGM's are set by the IMO, whereas information exchange is based on EDI messages.

In addition to being used as a platform for declarations, AREX information is also utilized for inspection purposes by the customs, by extracting the information to a separate risk analysis system.

"meille tarvii antaa tiettyjä ilmoituksia tiettyjen aikataulujen mukaan… ja sit..siihen tavaraan liittyen ja sen jälkeen sit riskianalyysiin ja sen perusteella sitten katotaan tarkastellaanko."	*"We require certain declarations according to certain schedules… and then… related to the cargo, which after risk analysis is conducted and we make decisions about inspections."*

(Authorities B)

The risk analysis system is on its own not enough for making inspection decisions, however, which leads to the document called the manifest in Figure 13.

First, it is to be noted that both the AREX and Portnet declarations share information found in the manifest. That includes information about cargo, such as the nature, quantity, value and destination, as well as information about people and the vessel similarly as laid out in the Portnet notification description above. The reason behind the separate systems is based on the separation of authoritative bodies setting the regulations, namely the EU and the IMO, and consequently the slight differences between the level of detail and format of the required information.

“ Jos oon oikein ymmärtänyt nii ton Portnetin, se tilastotason tieto siit tavarasta se on pikkaisen eri luokittelua, mitä meille annetaan AREXiin.”

“If I have understood Portnet correctly, the statistical level of the cargo information is a bit different compared to what is given to us in the AREX system.”

(Authorities B)

In addition, the original intent when developing the systems has been to serve different stakeholders, as shipping companies are responsible for Portnet declarations and the end customer for declarations of goods. Despite the AREX declaration responsibility division and original intent, the port operators and the shipping companies according to current practices are the parties making the declarations based on the manifest as illustrated in Figure 13. At last, while the manifest holds the necessary information for both AREX and Portnet declarations, it is not a standardized document, but rather company dependent and might differ between competitors.

“ … sitten täytyy ottaa huomioon, että jos puhutaan lastin selvityksestä, niin siinä on eri osapuolet kun tässä aluksen selvityksessä. Aluksen puolen selvityksessä on varustamot/laiva/laivanedustaja ja sitten tota lastin selvityksessä on rahdin antaja ja rahdin vastaanottaja.”

“... it has to be taken into consideration, when we are talking about the declaration of goods, that different entities are involved in ship declarations. On the ship declaration side, we have the shipping company/ship/ship representative, while declaration of goods we have the cargo sender and recipient”

(Authorities B)

“ Voidaan sanoa että tällä hetkellä niin, meille tulee niinkun tuonne Arexiin niin saapumis ja yleisilmoituksia, mutta se on hyvin pitkälti samoja tietoja kun manifestissa, mutta ei välttämättä ihan kaikkea tietoja ja jotain ylimääräistä mitä

“We can say that currently we get arrival and general notifications to the Arex system, yet they are by large very similar to the information in the manifest, although not everything

manifestissa [ei saa selvää]… Tietosisällöt tulee tuolta tullikodexista alta, että ne on määritelty sielt hyvin tarkkaan, mut hyvin pitkälti samoja ku manifestitiedot. Mut ei rakenne, ku manifesti on vähän niinku yrityskohtasia, nii ne ei oo nii standardimäärämuotoisia

and the manifest holds some extra [passage that can't be heard]. The information contents derives from the customs codex, yet they are very similar to the manifest. Not the composition, as the manifest is dependent on companies, so they are not standardized."

(Port Operator A)

As the basics premises has been explained regarding the AREX system, a return to previously acknowledged inadequacy of conducting risk analysis solely based on AREX declarations can take place. As Figure 13 illustrates, shipping companies provide the manifest to the port customs through email. The intention is to maintain uptime of processes if the electronic systems fails and to provide additional information in order to ensure adequate inspection decisions and knowledge creation. The need for additional information is based on risk analysis systems being pre-programmed, thus being limited to only identifying threats that are known.

" Manifesti menee Vuosaareen Excel tiedostona, nii se on varatoimenpitenä niin että prosessit ei pysähdy, jos sähköiset yhteydet katkee."

"The manifest goes to the port customs as an Excel file, as a backup if electronic systems fail, so that processes do not stop"

(Shipping Company A)

" Meillä on siis sähköiset riskianalyysijärjestelmät jotka tietyin sinne asetetuin kriteerein nostaa manuaaliseen käsittelyyn lastiyksiköitä ja sit jonkun pitää tehdä päätös että mitä niille tehdään. Mutta me ollaan tavallaan tällainen human touch tässä liikennevirrassa, koska ne systeemit ei

"We have these risk analysis systems, that picks units for manual inspection based on certain assigned criteria, while someone has to make a decision what to do with the unit. We maintain a human touch in this flow of goods, since the system

poimi sinne mitään muuta kun semmosta mitä jo tiedetään. No voi olla että jos on joku trendi Euroopassa niin voidaan syöttää sinne jotain toimijoita tai kuvioita, jotta se nostais niitä käsittelyyn mutta mielestäni on erityisen tärkeätä että jos me epäillään savukesalakujetusta ja mennään tarkastamaan niin voidaan löytää jotain muuta. Se että sinne mennään ja sieltä voi löytyä muuta niin vaikka se ei kanna tuloksia se alkuperäinen syy miksi sinne mentiin, niin voidaan tehdä havaintoja ja kerätä informaatiota […] Jos pelkästään tehtäis töitä päätteellä ja pyydettäis muita mennä tarkistamaan ja tehtäis niitten palautteella tai miten osataan lukea heidän palautteen päätöksiä, niin osattaisimmeko ollenkaan ymmärtämään sitä todellisuutta?"

does not pick up anything we do not already know. Okay, there might be some trend in Europe and we can provide certain actors or schemes as inputs, but I believe that it is important that if we suspect cigarette smuggling and make an inspection, we can find something else. The fact that something else can be found, which might not be the original reason to perform an inspection, allows us to gather information […] If our job would be to merely monitor systems and having others to do inspections, would we be able to understand reality according to only feedback from the field?"

(Authorities B)

To sum up, customs inspection decisions illustrated in Figure 13, is thus based on both automatic computer aided analysis, as well as local expertise and human intuition.

In addition to the manifest being provided to the customs officers, it also provided to the port operators in general 3-4 days before the arrival of the ship. It allows the operators to execute all essential preparatory work, to serve the ships efficiently upon arrival. Furthermore, port operators require naturally additional information about the containers, their placement on board, and potential special storage.

"Tarvitaan kontin tunnuksen, painon, määränsataman ettemme ota jotain joka ei kuulu meille, ja

"We need the container ID, weight, destination port so that we do not unload anything that does not belong

sitten tietenkin positio laivassa. Tarvitaan myös tietoa erikoisvaatimuksia, kuten lämpösäädellyistä konteista, jotta tiedetään miten säilytetään niitä."

to us, and of course the position on board. We also need info about special requirements, such as thermo regulated containers, in order to ensure proper storage."

(Port Operator B)

" ... vastaanotetaan manifestitiedot merikuljettajalta, niin sanotulta varustamolta ja sitä kautta me lähetään purkamaan sitä asiaa, et paljon siin on töitä. Paljon..paljon sitä työstettävää löytyy siit laivasta? Sit me saadaan tietysti lastipiirrokset, mitkä ovat tuotannon kannalta vähän tärkeempiä kun tuommoset dokumentit, koska niistä me pystytään menemään sisään sit siihen et miten se työ järjestellään. Paljon siihen tarvitaan väkeä töihin, minkälaisia työkoneita, tarvitaaks jotai nostureita vai pikkutrukkeja, vetomestareita? Siel on niinku hyvin laaja skaala erilaisia työkoneita millä töitä tehdään. Paljonko sitä väkeä tarvitaan niihin, minkä taitosia, ja sitten yks iso kuva, me Vuosaaressa ajetaan pääasiassa aikataulutettua linjaliikennettä, eli se et se saadaan pysymään siin aikataulussa se laiva? [...]sit siel tehää tietysti hirveesti taustatyötä, just siel dokumentaatio puolella aletaan jo tarkastamaan sitä et saako sitä lastia luovuttaa, jos ei saa niin minkä takia ei ja näin tehdään se asia mahdollisimman valmiiksi ettei

"we receive the manifest from the skipper, that is the shipping company, and according to this we start to dissect how much work is required. How much… how much work does the ship cause? We naturally receive the cargo drawings, which are a bit more important in terms of processes, since they reveal how to set up the job. How much people do we need, what type of equipment, large lifting trucks or smaller trucks, towing experts? There's a large scale of different machines, which we use. How much people do we need for each, what level of skill, and then the large picture in Vuosaari is the fact that ships run on schedule, so how can we ensure they stay on them? [...] then there's of course a large amount of background work, especially on the documentation side where we start to check if we're allowed to hand over the cargo and if not, then why? By doing this we try to do everything as ready as possible, so that things need

siinä vaiheessa ku asiakas on siinä yksikön kanssa portilla nii aleta selvittämään sitä hommaa”

not be done at the point when the customer is at our gate.”

(Port Operator A)

Despite utilizing supportive IT systems during preparatory tasks, port operators have not automated the planning stage entirely.

“ ... tietysti toiminnan kannalta on järjestelmiä jotka tukee sitä, mutta sen joutuu sen päivän rakentaa ihminen vielä ja miettimään et missä vaiheessa tapahtuu mitäkin. Mis vaiheessa me tarvitaan mihinkin hommaan väkeä? No, siit ei oo hyötyy et me nostellaan niitä kontteja sinne kentälle jos ei ole ketään palvelemassa sitten esimerkiksi autoja. Autot tulee hakemaan, niin ne tarvii tiettyyn aikaan…se prosessi täytyy miettii miten siel on miehii ja työkoneita. Samoiten ROROssa, vedetään yksiköitä kentälle ja asiakas palvelee kyllä itseään, mutta meillä pitää olla joku portti joka niitä luovuttaa ei niitä voi kuka vaan hakee sieltä kentältä ja ajella tonne maakuntiin.”

“... of course there are systems supporting operations, however a human is still needed to construct the working day and think about what happens at each phase. When do we need people at what job? Then there’s no point in lifting containers to our field, if no one’s there to serve truck drivers. When trucks arrive, they need service at a specific time… that process needs to be planned, in terms of people and machines. Same thing with RORO traffic, we tow units to our field and despite the customers serving themselves, we need people at our gate who hands the units over so that not anybody can come and start driving trailers off to the suburbs.”

(Port Operator A)

The remaining information flows in Figure 13, consists of providing job orders to ground transport companies typically one day before ship arrival, collecting operational data from the ship to both internal systems as well as equipment manufacturers, providing status updates to end customers regarding the shipment, and making reservations for empty containers with the depot companies.

The ground transport companies receive the job orders either from the port operators or the shipping companies depending on business arrangement agreements, after which ground transport companies creates route plans for its drivers. Depot companies in turn, requires a pre-reservation to be made in order to accept empty containers for storage and maintenance. Operational data is used for process and product development.

“ Pääkonttorilla kerätään hyvinkin paljon operatiivista dataa. Panostetaan ympäristöasioihin ja kehitetään laivoja ja moottoreita jne.”	*“We collect a large amount of operational data at our headquarters. We focus on environmental aspects, while developing ships, engines, and so forth.”*

(Shipping Company C)

Regarding end customer status updates, currently discreet-time track and trace is provided as systems allows the customers to check whether cargo has been loaded on board a ship or not. Regardless, real time monitoring is possible by utilizing open data on ship traffic.

“Konttia voi kuitenkin seurata katsomalla heidän sivuilta että kontti on jossakin tietyssä laivassa ja sitten katsoa avoimesta datasta että missä itse laiva on milläkin hetkellä.”	*“Containers can be tracked, by checking from our website on what ship the container is and then checking open data, where the ship is at any given time.”*

(Shipping Company C)

Finally, when the ship is arriving to the port, customs officers provide either inspection requests or in contrast a green light for further hand-over to port operators, as is illustrated in Figure 13.

Cargo at the Port

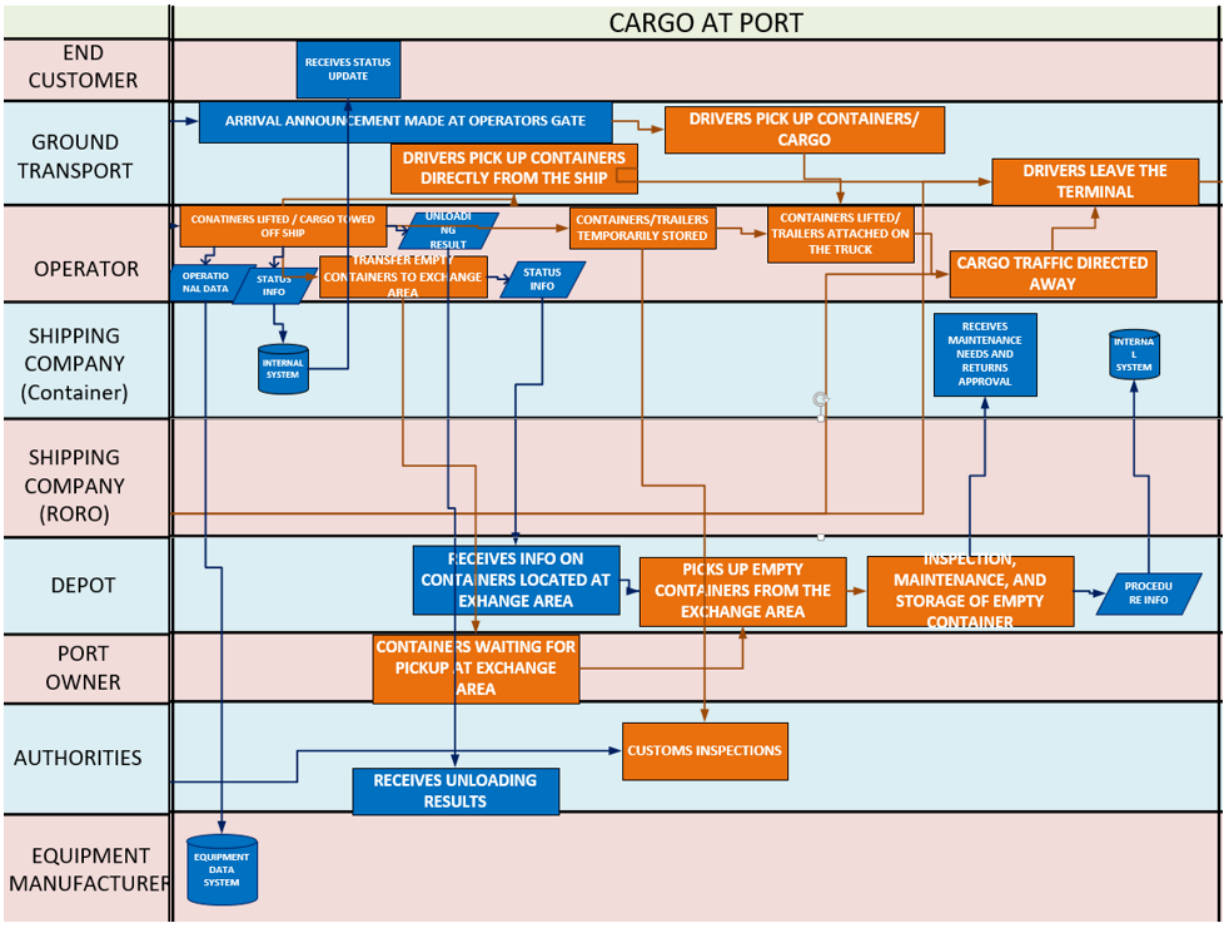

Figure 14. Inter-organizational process map at the stage whereas cargo is at the port

As the ship has arrived at the port, the preparatory work in the last stage should have resulted in unambiguous proceedings. Starting with containers and trailers transported without a truck driver on board, port operators lifts containers off the ship, or alternatively tows trailers. During these proceedings, operational data is created and transferred to the equipment manufacturer's equipment data system. Furthermore, the shipping companies receives status updates about the unloading of the ship, which subsequently results in tracking updates for end customers.

"Siitä lähtee myös tieto laivalle et nyt kontti on purettu. Reaaliaikanen seuranta laivan purusta, mikä auttaa	*"Information is provided to the shipping company, that a container has been unloaded. Monitoring happens in real-time, which supports ground transport in*

maakuljetusta tulla hakemaan tavaran pois.”

terms of providing information when cargo can be retrieved.”

(Port Operator B)

There are three possible scenarios for containers following unloading. In case the container is empty, the container depot has received a reservation for an empty container relocation to their field. The port operator is responsible for passing possession of the container, to the depot company. However, due to *e.g.* safety reasons, the depot company nor the port operator can enter each other’s dedicated areas. Thus, the port owner has established a neutral shared resource called the exchange area.

“Mutta sitten just kun operaattorit vaihtavat kontteja nii on perustettu vähä niin kuin tämmöinen no mans land, joka on siis sataman hallinnassa tää nii sanottu vaihtoalue. Joo ja tota, vaihtoalue on tosiaan […]vaihdetaan kontteja, tyhjiä ja täysiä.”

“So, when operators exchange containers, this kind of no-man’s land has been established called the exchange area, which is managed by the port owner. And so, the exchange area […] is used for exchanging containers, full and empty.”

(Authorities C)

Port operators moves the empty containers to the exchange area and afterwards sends information by email, confirming the containers are ready for pick up. The containers are picked up at a suitable time by the depot, transferring the empty containers to their own field for inspection. Inspection requires a human entering each container and as such, they are placed at this point on ground level.

“ Ne on [kontit] fyysisesti katottava. […] Sinne on mentävä yksikköön yksinkertaisesti sisään […] ja silloin se vaatii sen maatason.”

“They (containers) needs to be inspected physically. One needs to enter the unit simply […] and thus they need to be placed on ground level.”

(Depot Company A)

After inspection, the depot companies provide information about possible maintenance needs to shipping companies, who either approves or disapproves required procedures. Upon approval, maintenance is performed, and a procedure report is provided to the shipping companies. The containers are placed in stacks, which are divided according to container ownership and quality.

“ Depotissa lajitellaan kontit, riippuen laadusta ja kunnosta (food grade, paper grade kontteja jne.), tekevät siis estimointeja…”	*“The depots sorts containers according to quality and condition (food grade, paper grade containers), so they make estimations...”*

(Shipping Company C)

At last the containers are stored until further notice by shipping companies, when they are either transferred to another stakeholder internally at the port, or to another port entirely.

In terms of containers containing cargo, certain units are directly lifted from the ship onto a truck. The trucks have prior announced their arrival at the port operators gate and as a requirement, cargo is not up for inspection by the customs, allowing the responsibility of the cargo to be exchanged between the stakeholders. Afterwards, the drivers are directed away from the port.

Most cargo containers and trailers are however temporarily stored at the operator’s fields.

“ Kun kontit on nostettu laivasta, ne viedään pihalle ja kuljettaja laittaa tiedon järjestelmään että kontti on nyt laitettu paikalle x, y, z”	*“When containers have been lifted off the ship, they are driven to the field and the driver enter information that the container is now located at place x,y,z.”*

(Port Operator B)

If the customs have requested an inspection, the custom officers perform them at the operator’s area, with a few exceptions. One exception is unit x-rays, for which customs officers retrieves units from the operator and drives them to their own area, where the

x-ray machine is located at the port, and subsequently returning the unit afterwards assuming no irregularities have been found.

The following process phase begins, when ground transport drivers announce their arrival and the unit, they are picking up at the port operators gate. The container is allocated from storage and lifted on the truck, after which drivers leave the port. New IT system developments has enabled pre-announcement by truck drivers, using a mobile application. However, the application has not yet been highly adopted.

“ Ei, näähän [applikaatiot] on aika uusia satama-alalla, et vähän vielä niin kuin lisäpalveluita et ei kaikki edes käytä näitä”	*“No, these [applications] are quite new in the port industry, so they are kind of additional services and not everyone uses them.”*

(Port Operator A)

On the RORO side for cargo travelling with a driver present on the ship, the proceedings are much simpler. The port operators need only to direct the truck drivers away from the port. Not visible in Figure 14, customs officers can perform inspections for these unit by simply waving them aside and furthermore occasional stick sampling inspection are also performed.

Cargo transported to end customer and ground transport companies returning to the port

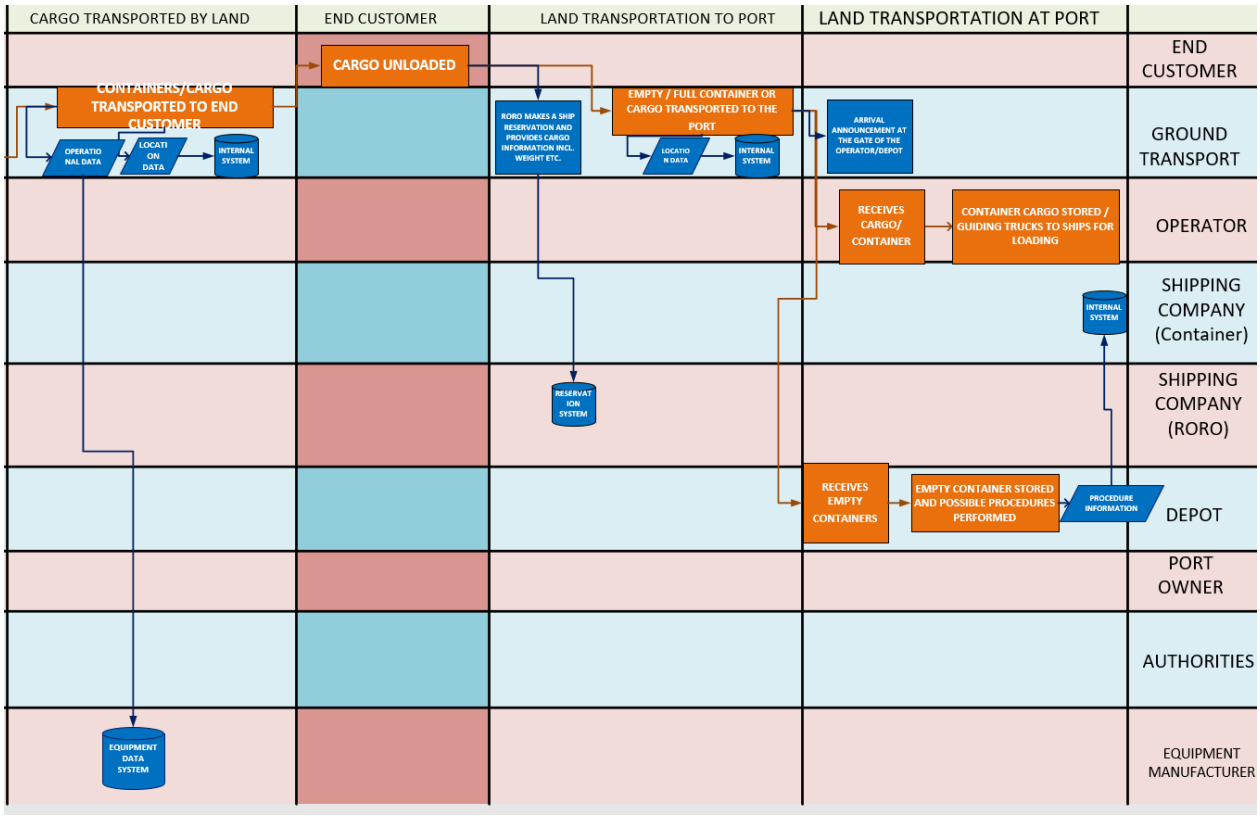

Figure 15. Inter-organizational process map at the stage whereas cargo is transported to the end customer and returns to the port

During ground transportation from the port to the end customer, operational data is being transferred to the equipment manufacturer. Further location data is internally accessible by the ground transportation companies, as trucks are equipped with GPS.

Once the cargo reaches the end customer, they are themselves responsible for unloading the container or trailer.

A truck does not return to the port without any load, thus drivers either returns the same containers they drove out, full or empty, or they pick up new full or empty containers on the way. Of course, in the case of trailers, trucks can either load the trailer before returning or drive an empty trailer back.

Similarly, as on the way to end customers, operational and location data is being collected. Furthermore, RORO traffic makes reservations for RORO ships during the return trip, even as late as an hour before departure. Frequent departures allow truck drivers to postpone reservation.

“ … koska lähtöjä on useampi ja kun käyvät lastaamassa ja rekka on lastattu niin tietävät sillä hetkellä mille lähdölle ehtivät.”	*“As there are several departures and while they go to load the truck, afterwards they know what ship they will make it too.”*

(Shipping Company B)

When ground transportation finally reaches the port, they announce their arrival at the port operators or depot companies’ gates, subsequently being guided by operators on board in the case of RORO traffic, dropping off empty containers for maintenance and storage at depot companies, or by dropping off full or empty containers at port operators in order to be exported.

Summary

This part of the thesis has presented a detailed inter-organizational process map of the port proceedings, including information exchanges and physical movement of goods.

The process map reveals inter-relations as well as a high dependence on information exchange across multiple partners.

8.3. CHARACTERISTICS AND CHALLENGES IN THE PORT ECOSYSTEM

This chapter presents characteristics, challenges and barriers in the port ecosystem, while dividing these into different hierarchical levels. The hierarchical division strives to embody the port ecosystem and the actors involved as parts of a larger entity. More precisely, the hierarchs are intended to represent systems within systems, as illustrated in figure 15.

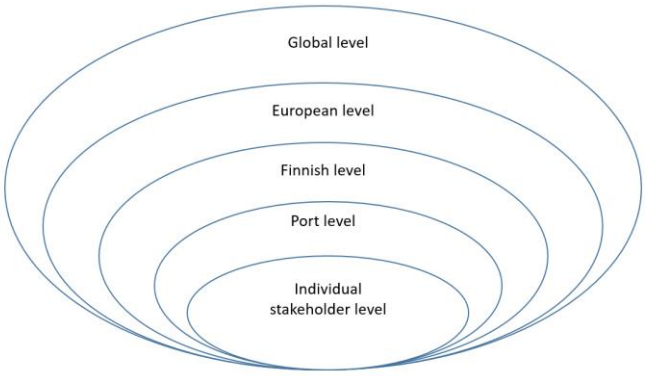

Figure 16. The hierarchical levels utilized in the analysis characteristics, challenges and opportunities

The purpose of this chapter is to construct an overview of the port ecosystem, utilizing the findings to explore inter-dependencies between these attributes in the next chapter.

8.3.1. CHARACTERISTICS

Global Characteristics

In order to examine the maritime industry thoroughly, the importance of recognizing shipping as a non-isolated independent activity was emphasized. Rather, shipping and port activities are invariably part of other means of transport, or *multimodular chains,* collectively creating a larger systemic entity.

" … merenkulkukaan ei ole mikään "hermeettinen pullo" […] Pitää ottaa huomioon että kyse on multimodaalisesta ketjusta ja kyse on kaikista liikennemuodoista ja kaikista ketjuista. Me ei voida tarkastella, vaikka on niin mukavaa tarkastella meriliikennettä omana asiana, mutta se kytkeytyy aina kaiken maailman hinterland tarnsporttiin ja kaikkiin muihin kuljetusjärjestelmiin."	*"... maritime transport is no "hermetic bottle" […] That it's a part of a multi-modular chain needs to be taken into consideration. Even if it would be nice to examine maritime traffic by itself, it is always related to different hinterland transportations and other transportation systems. "*

(Authorities B)

The industry is further characterized by *long-established trade arrangements and documents*, as partly discussed in the chapter on the value network of the port. The trade documents in particular were perceived as complexity inducing, due to causing an involvement of multiple intermediaries. Furthermore, they were regarded as tedious, and outdated. A prominent reason behind these documents however, is a general *lack of trust* as was observed by Shipping Company C. Shipping Company C mentioned however, that exceptions exist.

“ … konossementtihan on kaikkien äiti ja sehän kirjoitetaan silloin kun tavara lähetetään jonnekin ja se on ainoa joka osoittaa sen että kenellä on oikeus tavaraan ja kuka sen omistaa. […] Siis tällä hetkellä kun lähetys lähtee, niin konossementti kirjoitetaan vielä koneella tai printataan varmaan, mut sen jälkeen tilataan lähetti paikalle jolle konossementti annetaan ja yleensä se lähetti vie sen remburssin pankkiin ja sit aletaan käydä kauppaa. […] sitähän voidaan diilata päivän mittaan viis kertaa sitä samaa lappua, eli se lähettiparka juoksee nyt pankista toiseen hakemassa sitä lappuu”

“... the bill of lading is the mother of all information and it is written when cargo is shipped somewhere and it is the only document which addresses who is entitled to the cargo and who owns it. Currently when a shipment is sent, the bill of lading is written on a computer, printed, which after a courier is ordered who delivers the reimburse to a bank, which after trade begins. […] The paper can be traded up to five times in a day, so the poor courier runs from one bank to the other retrieving the document.”

(Port Operator A)

“Merenkulku on muutenkin sellainen vanhollinen, et vieläkin kun on näitä konossementteja, bill of laidingejä, nii ne lähetetään jollain postilla ne alkuperäiset bill of laidingit. Ilman sitä alkuperäistä sä et saa sitä konttia itteles.”

“Maritime transport is anyway old school, in the sense that we still have these original bills of ladings, which are delivered by mail. Without the original one, you can’t get the container to yourself.”

(Port Operator B)

“ Täähän on business jossa ostaja ja myyjä ei luota toisiinsa,.”

“This is a business, where buyers and sellers do not trust each other.”

(Shipping Company C)

To further increase complexity, the study participants recognized that the distribution of data necessary for running operations is *scattered* along the cargo journey. As noted

in the last chapter, at a certain time the shipping company possesses the necessary information for port processes, yet the participants highlighted that data changes hands between and cumulates by different stakeholders along the logistical chain.

"Tieto voi tulla jonkun toimijan Puolan konttorista suomalaiselle huolitsijalle, joka antaa tiedon suomalaiselle paperitehtaalle, joka sitten täyttää terminaalitiedot rekkayrityksen järjestelmään joka välittää sen eteenpäin."

"Information can stem from some actor's office in Poland, who delivers it to a Finnish paper factory, who in turn fills in terminal information to a trucking companies IT system, who in turn forwards the information."

(Shipping Company A)

In contrast to the complexity of data distribution and trade document arrangements, an effort to utilize *standardized and simple information exchange formats* has been made, as interest organizations such as the IMO strives to promote universal declaration formalities.

"EDI viestithän on mun käsityksen mukaan ihan ASCII tiedostoja. Et kun konttiliikennettä on kehitetty, niin sitä konttiliikennettä on Suomessa ja sit sitä on Mosambikissa. Ehkä tällainen ASCII pohjainen on ajateltu että se toimii maailman ympäri eikä mene liian monimutkaisesti."

"EDI messages are to my knowledge ASCII files. When the container business has been developed, then there's container traffic in Finland and in Mozambique. Perhaps this type of ASCII based thinking is perceived to work globally without becoming too complex."

(Port Operator B)

In terms of containers, they are generally *owned by the shipping companies*, yet leasing containers are partly used in order to decrease maintenance costs. Furthermore, the shipping companies emphasized that container ownership secures capacity utilization. On the other hand, Port Operator B noted that the container ownership results in containers exceeding the real needs in terms of quantity.

"[Me] halutaan omistaa kontteja itse. Lupaamme asiakkaille että pystytään shippaamaan tietyn määrän kontteja vuodessa ja tätä halutaan varmistaa, eikä riidellä kilpailijoitten kanssa konteista. Osa kuitenkin on liisattuja kontteja. Näitä sen takia että konttien kunnostus on aina kuluerä ja halutaan näitä tietenkin vähentää."

"[We] want to own our containers. We promise our customers we are able to ship a certain amount of containers per year and we want to ensure this and not quarrel about containers with our competitors. Some our however, leased containers. This is because maintenance is always a cost and we naturally want to minimize this."

(Shipping Company C)

"Tämä tarkoittaa tietenkin että kontteja on paljon enemmän liikenteessä kun mitä tarvitaan."

"This means naturally that there are far more containers in traffic than is needed."

(Port Operator B)

As a last global characteristic, big global ports was described as having *dense ship arrival frequency*, causing a requisite for ships to queue for docking and unloading.

European characteristics

In similarity to the global efforts by the IMO to standardize authoritative declaration practices, the EU was described as having established legislations with strict guidelines of information gathering requirements. However, each member state has interpreted the legislation in their own way, resulting in 25 *independent authoritative information systems.*

"Tässä on tää alusliikennelaki, mikä on Suomen sovellutus tästä EU:n direktiivistä, jolla säädellään näitä ilmoitusjärjestelmien rakentamista. Ne on hyvin standardoituja, eli direktiivi edellyttää et kaikilla jäsenmailla pitää

"here we have this ship transport law, which is Finland's interpretation of this EU directive, which in turn adjusts the development of information systems. They are highly

olla järjestelmä jossa keräätään just nämä tiedot, mitä Portnetissa kerätään. Ne ei ole missään maassa samanlaisia, vaan meillä on 25 erilaista ympäri eurooppaa."

standardized, so the directive depicts that each member state needs to have a system that gathers exactly the information that the Portnet system gathers at the moment. No system is alike and we have now 25 different ones in Europe."

(Authorities B)

Despite the lack of coordination of the information systems, *authoritative collaboration* between customs officers was mentioned to be a common practice. Moreover, the industry's *high exposure to criminality* has resulted in a perceived necessity for the collaboration efforts. Criminality, while being a global phenomenon, was described on a European level and the high monetary returns of crime has enabled novel and expensive methods of smuggling that are difficult to discover. Collaboration efforts was described as taking form through information exchange, shared training, and, as presented in the quote below, requests for allowing suspicious cargo through customs, while pleading for support in shadowing activities.

"Rikollisuus on tavallista erityisesti hollannissa ja tämän kaltaisissa satamissa missä volyymit ovat todella suuria. Niissä satamissa tuodaan kiloittain huumeita, siellä varastetaan kontteja ja lahjotaan ihmisii, joilla on kulkulupa satamiin. […] Suosittu menetelmä tällä hetkellä on tällainen Rip On Rip Off, jossa kontin sinetti väärennetään. Eli siis niitä avataan, laitetaan salakuljetettava tavara konttiin ja väärenetyn sinetin ovien päälle, jonka jälkeen tavara tyhjennetään tulosatamassa. Tätä on vaikeaa havaita sähköisillä menetelmillä, kun voidaan

"Crime is common, especially in the Netherlands and similar ports where the volumes are really great. In those ports, drugs are smuggled in kilograms, containers are stolen, and people are bribed to gain access to the ports. [...] A popular method at present is called Rip On Rip Off, where the container seals are forged. That is, containers are opened, the goods to be smuggled are put into the container and the fake seals on the doors, after which the item is cleared at the outlet port. This is difficult to detect by

laittaa tavara konttiin jossa on esim menossa nuudeleita keskolle. Tällainen lähetys ei herätä minkäänlaista epäilystä. Se ei ole helppoa mutta kun on paljon rahaa pelisse voidaan tällaista kehittää."

" On myös yhteistyökuvioita euroopan tullien kesken, jolloin hollanti voi pyytää että yksikköä päästetään läpi."

electronic systems when it is possible to put the goods in a container that is e.g. *transporting noodles to Kesko. Such a shipment does not wake any suspicion. It's not easy, but when there's a lot of money involved, you can develop things like this."*

"We collaborate also with European customs, so that the Netherlands can ask us to let a unit pass."

(Authorities B)

Finnish Characteristics

The first Finnish characteristic to highlight is the container *ship type* used for cargo flow to and from the country. The interviewees described the large European ports as mandatory intermediary stops for containers arriving to and leaving Europe, as smaller vessels called feeders handle the traffic between central Europe and Finland, in addition to the Baltic area in general.

" Meriliikenteessä suuret laivat tulevat keski-eurooppaan, josta kontit ahdataan pienempiin laivoihin jotka sitten puolestaan tulevat esim Suomeen."

"In maritime transport, large vessels come to central Europe, whereas containers are loaded on to smaller ships, which then comes to Finland."

(Port Operator B)

Finland was further characterized by the interviewees as experiencing *cyclical fluctuations* on a daily to yearly basis. First, from a yearly perspective, certain spring months were considered as slower in terms of cargo volumes, while during autumn and the end of the year volumes grow. On a weekly base in turn, beginnings of weeks were described as import heavy with large incoming volumes, the middle of the week calmer, while the focus shifted towards export and larger volumes again at the ends of

weeks. Additionally, Port operator A and Ground transport A emphasized a cyclical desire among end customers to receive trucks at an even pace along the day. Furthermore, shipping company A and ground transport company A had experienced an increasing adaptation of *Just-In-Time production* among end customers, resulting in stricter requirements for cargo delivery.

“ helmikuu-maaliskuu taiteessa on esimerkiksi sellainen et se on tosi hiljainen. Silloin ei oo kauheen paljon liikennettä kun on joulu just menny. Ja sitten taas loppuvuodesta ennen jouluu ja uutta vuotta nii tulee kaiken näköistä myyntiin tavaraa, niin silloin taas konttiliikenne kasvaa, et se menee ihan kuukausittain.”

“February and March are really quiet. There’s not much traffic as Christmas has just passed. At the end of the year before Christmas and New Year, it is again busier as a lot of stuff is coming for sale, then the container traffic grows, so it varies from month to month.”

(Container Depot A)

“Alkuviikot on kovia purkupäiviä ja maanantai on semmonen tällä hetkellä jolloin on hirvee kuhina Vuosaaressa. Sit se alkaa kohti viikon keskiväliä se alkaa rauhoittumaan. Sit loppuviikosta käännytään vientien puolelle aika kovaakin, et torstai, perjantai on kova kysyntä.”

“At the beginning of the week, there’s a lot of off-loading and there’s a lot going on Monday’s in Vuosaari. It starts to ease up on Wednesday. At the end of the week it shifts to export, so Thursday and Friday mean big demand.”

(Port Operator A)

“Meillä käy aika paljon autot illalla vaihtaa kontteja, et se helpottaa niitä ensimmäisiä aamuajoja ja ollaan heti aamu 7 loppuasiakkaalla. Kuljettajillahan on monta ajoa päivässä ja tahti on aika tasaista, et käydään hakemassa kontteja

“We have quite a few trucks retrieving containers in the evening, so it helps the morning runs and we can be at the end customer at 7 o’clock. The driver has several routes to drive per day and the pace is quite even, so the

sen jälkeen klo 9-10 koska pitää olla asiakkaalla seuraavan kerran klo 12."

truck retrieves containers again at 9-10 o'clock so it can be at the customer at 12."

(Ground Transport A)

" Automaatiotehtaissa tavaran oikea aikainen toimitus on kriittinen. Esimerkkinä Uudenkaupungin autotehdas."

"Timely delivery is critical for automation factories. As an example, the car factory in Uusikaupunki."

(Ground Transport A)

" Kyllä se on lisääntynyt koko ajan [just-in-time], huomaan ainakin tossa meidän toiminnassa, et se että saa olla puoli tuntia aikaisemmin ja minuuttia myöhemmin et saa olla siitä sovitusta ajasta, eli silloin on se puolen tunnin aikaikkuna jolloin se rekka pitää saada sinne asiakkaalle."

"It has increased [just-in-time], I have at least noticed in our operations, that you're allowed to be half an hour early, but one minute late is not permitted from the agreed delivery time, so that means half an hour window that the truck has to reach the customer."

(Shipping Company A)

Moreover, the workshop triggered an intense discussion whereas the port stakeholders emphasized the end customer's ability to *dictate delivery* times. This was not a universally accepted claim, as the ground transport company addressed the characteristic by providing feedback from the field, whereas the end customers' interest in delivery times was exaggerated.

Ground transport A: " Mut se että pitääkö asiakkaalla aina olla aamulla klo 8 tai 9, nii tää on kyllä hyvin pitkälti meidän välikäsien keksintöä. Se lopullinen asiakas mitä tuolta kuljettajilta kentältä kuuluu, nii ei sillä

Ground transport A: "But if we have to be at the customer at 8 or 9 o'clock in the morning is something we intermediaries have invented. The end customer, from what we hear from the drivers, there is no

asiakkaalla ois ollut mikään kiirettä olla kaheksalta vaa kuhan on vaa sen päivän aikana joskus, iltapäivä ois voinu olla parempikin. Et se keskustelu pitäis käydä sillä sektorilla. ”

hurry to be there at eight, as long as its there at some point during the day, the afternoon could even have been better. So that conversation should be held on that sector.”

Shipping Company A: ”Kyllä se käydään”

Shipping Company A: “We do hold that conversation”

Shipping Company C: ”Kyllä se käydään asiakkaitten kanssa ihan keskustelua”

Shipping Company C: “That conversation is held.”

Shipping Company A: ”Se on tarkat ajat mitä sovitaan. Jos se on klo 13, nii se on klo 13 ja sit jos myöhästyt 5 minuuttia siitä nii sitten seuraavana päivänä tai sit uus aika tilataan, mut se aika ikkuna meni ja ne on hyvinkin tiukkoja tietyillä asiakkailla”

Shipping Company A: “We agree on strict times. If it’s at one o’clock, then it’s at one o’clock and if you are five minutes late, then on the next day or a new time is agreed upon, but that time slot expired and some customers are extremely strict.”

Shipping Company A further explained that delivery and loading times fall in between normal working hours and that end customers sets these desires.

“ Asiakkaat haluu ne klo 9. Ne puretaan silloin. Tai sit lastaus on klo 16. Ne on tiettyihin aikoihin. Et kyllä ne on virka-aikaan.”

“The customers want them at 9 o’clock. Or then loading is performed at 4 o’clock. This happens at certain given times and it happens during office hours.”

On a related note, Authorities C and Ground Transport A provided a complementary insight on *contradicting interest among stakeholders,* as a possible explanation for the disaccord.

"Varustamolla on joku intressi, ne haluu optimoida laivojansa, mutta ne haluu myös ajaa sinne minne asiakas haluu. Tiedän että [laivayhtiö] on siirtänyt liikennettä Hankooseen, kun polttoainekulut vähenee. Lähettäjällä on myös joku oma intressi ja sitten se on balansointia näitten välillä. Isot metsäyrityksetkään, joilla on suuri sanavalta ei välttämättä nekään aina pysty päättää mistä ja minne tavaran pitäisi tulla ja mennä."

"Shipping companies have their own interest, they want to optimize their ships, but at the same time cruise where the customer wants. I know that [name of a shipping company] has transferred their traffic to Hanko, as fuel costs decrease. The sender has their own interest in turn and these must be balanced between each other. Even the big forestry companies with high degree of say cannot always demand where from and to cargo should be hauled"

(Authorities C)

Interviewer 2: "Loppuasiakashan on se joka vetää tätä hommaa ja milloin ne tarvitsevat sen toimituksensa."

Interviewee: "Sanotaan et niin sen pitäis olla, mutta itselläkin kun on huolintaliiketausta niin se on niin helppoa että sanotaan loppuasiakkaalle että tullaan huomenna aamulla klo 8. Oikeasti heillä voi olla tarve saada se vasta viikon päästä. […] Siihen on monta syytä, ensinnäkin huolitsija saa sen keikan pois käsistä. […] Hän ei pysty laskuttamaan ennen kuin se tavara on toimitettu. On ihan luonnolista että han haluu sen äkkiä toimitettua."

"Interviewer 2: "It's the end customer who drives this thing and when they need their delivery."

Interviewee: "Let's say, that's the way it should be, but as I also have background from the freight forwarder business, it is quite easy to just say that we will be there at 8 o'clock the next day. The real need might be a week from that. […] There's plenty of reasons, one being that they get the job out of their hands. […] They can't bill anything before the cargo has been delivered. It's

natural that they want to deliver it fast…"

(Ground Transport A)

Even as the majority agreed on the dictated delivery times, the end customers were described as having in *general low interest in port proceedings,* meaning their focus lies merely on the delivery time.

"Monelle vastaanottajalle on yks ja sama, onko se kontti purettu klo 1 vai kello 3. Milloin on luvattu toimittaa tietenkin vaikuttaa myös siihen. Eli jos on luvattu klo 4 niin sillä ei ole mitään merkitystä puretaanko se laivasta klo 8."

"Many customers do not care, if a container has been unloaded at 1 or 3 o'clock. Of course, the promised delivery time plays it part too. So, if we have agreed to deliver the cargo at 4, it does not matter if the container has been unloaded at eight o'clock."

(Shipping Company A)

Regarding *volumes*, interviewees perceived Finnish transportation volumes to be *low*, especially after the financial crisis in 2008. Furthermore, trade restrictions against Russia in addition to a newly opened container port in St Petersburg, was described as a further cause for low volumes. In contrast, the recent years had been experiencing some growth according to the interviewees. Prior to these Russia related issues, import and export was balanced, however currently import and export was considered *unbalanced,* in favor for export. This in turn directly influences the need to allocate empty containers, to ensure continuous export.

"Suomessa on niin pienet volyymit." *"The volumes in Finland are so low."*

(Port Operator B)

"Nyt kasvua on ollut. Kuitenkin venäjä rajoitteet haaste. Toisaalta venäjällä avattu konttisatama, eli ne [kontit] menee suoraan sinne. Samalla

"There has been some growth now. The Russian restrictions is a challenge however. On the other hand, a container port has been

tarkoittaa että Suomeen ei enää palaudu tyhjiä kontteja automaattisesti."

opened in Russia, so they [containers] go straight there. This means that empty containers do not return to Finland"

(Ground Transport A)

"Suomessa enemmän vientiä kun tuontia, eli tyhjiä kontteja tuodaan jonkin verran takaisin suomeen."

"There is more export than import in Finland, so not enough containers are brought here."

(Port Operator B)

Finland was further described as having certain *valid yet old laws* dating back to the 19th century aimed at the maritime industry, partly restricting development attempts.

Politicians in turn, was considered to have *misconceptions* about port proceedings, despite being responsible for crucial decisions affecting the ports.

"[…] yleensä minulla on sellainen käsitys että viranomaiset ja politiikot ei tajua kuinka suuri osa ulkomaankaupasta kuitenkin kulkee matkustaja-aluksella. Päättäjät eivät ole tajunneet sitä, koska täältä Länsisatamassa kulkee matustajaliikenne, jolloin kaikki päätökset on tehty niin että rekkaliikenteellä ei ole tilaa."

"In general, I have the perception that public officers and politicians do not understand that a large portion of foreign trade is transported with passenger ships. Decision makers have not realized it, since the West Harbor focuses on passenger traffic, which in turn has resulted in decisions making it difficult to find space for truck traffic."

(Shipping Company B)

Authorities C confirmed the *division of traffic type*, causing a suboptimal standpoint for decision making.

"Vaikka lastiliikennettä tällä hetkellä menee myös muualta kuin Vuosaaresta, tällä hetkellä jako on sellainen että on tavaraliikennettä ja matkustajaliikennettä. Toisaalta voisi katsoa asiaa sillä kantilla että kaikki olisi yksikköliikennettä."

"Even though cargo traffic goes from other ports than Vuosaari at the moment, the current division depicts that there's cargo and passenger traffic. On the other, all could be treated as unit traffic."

(Authorities C)

Port unions was in turn perceived as particularly strong, while *Finnish wage rates* was considered high.

A trend was also laid out whereas shipping companies' administrative offices have been *off-shored*. At last, Finnish *weather conditions* were mentioned as a factor having a direct impact on the port proceedings. Finnish *ports* were also claimed to *collaborate* with an intent to develop operations.

Port characteristics

Vuosaari harbor was described as fairly new port, designed for *throughput operations* and growing volumes, resulting in *limited space* and current *excess capacity.*

"Tää on suunniteltu läpivirtaus-satamaksi."

"This has been designed to be a throughput port."

(Authorities B)

"Operaattorit antaa 4 päivää vapaata kenttävuokraa konteille, jonka jälkeen hinta lähtee progressiivisesti kasvamaan. Tää on suunniteltu näin, että saadaan kontit pois koska tilaa on rajallisesti."

"Operators offer 4 days free field rent for containers, after which price increases progressively. This has been designed in this manner, to quickly get rid of containers as space is limited here."

(Ground transport A)

"Vuosaaressa ainakin tällä hetkellä, tiedätte varmaa kaikki et Vuosaaren satama on verrattaen uus kuitenkin, 2008 avattu, ja tota se on tietysti silloin kun se on suunniteltu ja rakennettu niin on otettu huomioon että liikenne tulee todennäköisesti ja toivottavasti kasvamaan, elikkä tällä hetkellä vielä kapasiteettia on kyllä ihan riittävästi."	*"At the Vuosaari Harbor, you all probably know that it's a relatively new port (opened in 2008), and it's been designed and taken into consideration that volumes will hopefully grow, so currently capacity is not an issue."*

(Authorities C)

Despite the limited space, the port was considered large in the context of Finland, yet *small on a global scale.* The number of competitors in relation to the port size was, however, perceived as high.

"Ilman muuta on niin, että vaikka Vuosaari on Suomen mittakaavassa iso satama, niin eihän se ole jos vertaa muu maailmaan niin ei Vuosaari ole mikään iso. Mutta sillä on kuitenkin kolme operaattoria, meillä on paljon operaattoreita."	*"Definitely Vuosaari is a big port in Finland, however if you compare it the rest of the world, it's small. There are three operators, though, so we have a lot of operators."*

(Authorities C)

Furthermore, in comparison to global ports, Authorities C found the port owner to have a more *central role* in port proceedings, while questioning the continuity of the chosen position.

"Globaalisti kun katsoo, niin satamaoperaattoreilla on paljon isompi rooli kun mitä täällä meillä on. Otetaan vaikka [iso varustamo] taas esimerkkinä, et niillä on siellä terminaali ja ne tekee sen. Siellä satamaviranomainen on oikeasti viranomainen. Katsoo että lait seurataan ja	*"Viewed globally, port operators have a much large role compared to us. Let's take [large shipping company] as an example, they have their terminal and the terminal does the work. There, the port owner*

siinä se sitten onkin. Operaattori on periaatteessa se integraattori. Että pitäisikö meidän pyrkiä enemmän siihen suuntaan?"

is genuinely an authority. It ensures laws are obeyed and that's about it. The operator is the integrator. Should we move towards this?"

(Authorities C)

The port was further described as a highly *competitive environment,* providing both benefits and drawbacks.

"Kyllä sen huomaa selkeesti et ne on kilpailijoita keskenään, aika verisiä kilpailijoita, ja siinä tulee… ne ei keskustele toistensa kaa. Se on välillä jopa lapsellista. Ne tekee jäyniä toisilleen, ilkeämielisesti jopa. […] Asiakkaan, tässä tapauksessa varustamon näkökulmasta, on positiivista että on näin paljon operaattoreita koska pystyvät kilpailuttaa sopimuksia. Yksi esimerkki, noston hinta on Vuosaaressa halvempaa kuin Hampurissa ja se on kuitenkin maailman luokan satama, mutta hinta on silti täällä halvempi. Se tarkoittaa että kilpailu toimii. Sit kolikon kääntöpuoli on että meneeks operaattoreilla ehkä liikaa rahaa kilpailuun, et jääks heille tarpeeksi toiminnan tehostamiseen?"

"It can clearly be seen that they are competitors, bloody as well, and it leads to… the don't talk with each other. They conduct mischievous acts, mean ones even. […] From the customer's perspective, the shipping company in this case, it's positive that there's so many operators, so they can bid contracts against each other. An example, the price for one lift in Vuosaari is cheaper than in Hamburg, which is a world-class port, but price is still cheaper. It means that competition works. On the other hand, does the costs get too large for operators, so they nothing remains for efficiency development?"

(Auhtorities C)

“ Meillähän on niin et nää asiakkaat välillä tekee myös sitä et jos jostain syystä saa halvemman tarjouksen joltain toiselt depotilta, nii ne voi siirtää koko linjansa sinne, mitä ei aina ikinä toivota että näin kävis.”

“For us, the customers can sometimes get a cheaper offer for some reason from one of our competitors and they move all business over there, which we never wish for.”

(Depot Company A)

The competitive environment could be seen as having a direct impact on *low collaboration between competitors*, as was described for instance by the Container Depot company A, who emphasized that collaboration efforts are driven by customer requests.

“ei välttämättä auteta muita mut se asiakas haluu et näin tehdään. Mutta semmosia varsinaisia, muuta yhteistyötä depoteilla ei oo vaan hoidetaan ne omat asiakkaat.”

“We don’t necessary help each other, but the customer wants that we do it. Otherwise, collaboration between depots does not exist, we rather deal with our own customers.”

(Depot Company A)

From the perspective of a competitive environment, further increase in competition across stakeholder boundaries was experienced, due to port operators’ recent *horizontal integration* into depot service offerings.

“Operaattorit ovat alkaneet integroitua depotin toimintasuuntaan. Aikasemmin tämä on tapahtunut toiseen suuntaan, eli operaattorit eristäneet depottia.”

“Operators have started to integrate towards depot services. Formerly this has happened in the other directions, so that operators have excluded depot services.”

(Container Depot A)

Yet, competitors among shipping companies participating in the study on the other hand was described as having *specialized business models,* meaning in turn reduced competition of end customers, as service offering are catered for different needs.

“ varustamot ovat hajautuneet hyvässä mielessä. Yksi edustaa matkustaja ja vähän rahtiliikennettä. Toinen kansainvälinen toimija, joka keskittyy shippingiin. Ja sit viimeinen yritys jossa door-to-door palveluja harrastetaan.”

“Shipping companies are quite nicely spread in this regard. One represents passenger traffic and a small amount of cargo traffic. Another is a global company, focusing on shipping. The last one focuses on door-to-door services.”

(Shipping Company A)

The competitive environment and low interest in collaboration have in turn resulted in *mandatory need for an exchange area,* which was explained in the last part. To repeat, the purpose of the exchange area is to transfer containers between port operators and depot companies. While being necessary, a drawback of the area was described as not providing real value for the stakeholders, in addition to causing tensions between port operators.

“vaihtarit ovat murheen kryyni. Se on pakollinen paha, koska toimijat eivät ole tietääkseen ikinä päässeet yhteisymmärykseen miten kontteja voitais tuoda suoraan toisen pihaan. Vaihtarit ei kuitenkaan tuota mitään mutta vaativat tilaa, lisäksi operaattorit tietenkin haluaisivat että vaihtari olisi mahdollisimman lähellä heitä.”

“The exchange area is an endless agony. It’s a necessary evil, as in my knowledge the actors have never reached an agreement of how containers could be exchanged. The exchange area does not however produce anything and it takes up space and furthermore all operators want it to be located as near as possible to them.”

(Authorities C)

On a different note, Vuosaari Harbor is characterized by receiving mostly *scheduled arrival of ships.* The container side was described as being more prone to irregularities, yet in unison with the Finnish characteristic of cyclical fluctuations, Vuosaari Harbor receives in general ships in the morning and in the evening.

Port Operator A: "Yleisesti satamassa on reittiliikennettä mikä on aikatauluttain. Feeder puoli, eli konttilaivat on vähän enemmän haavoittuvia aikataulutukselle, eli siel saa varautuu siihen et ne voi tulla päivä kaks kolmekin, eli tän tyyppisellä se liikkuu "

Port Operator A: "Generally the port receives scheduled route-based ships. The feeder side, that is container traffic is a little bit more vulnerable for disruptions in schedules, so one has to prepare that they can come up to three days late"

Shipping Company A: "Meillä ei readyllä ole hirveesti laivoja, jotain yksittäisii mutta ei voida puhuu semmosta mitä maailman mittakaavassa on, et siel piisaa silmänkantamattomasti laivoja."

Shipping Company A: "We don't have many ships in queue, some singular ones, but not as in global ports where ships are queuing as far as the eye can see."

In addition to being more timely, the *ship turnaround time* was characterized as faster for RORO traffic compared to container traffic, due to requiring less complex operations in terms of unloading.

"Keskimäärin semmonen 8-9 tuntia, vois sanoo .. 10 tuntii. Se käännetään ympäri (purku että lastaus). Ja ROROhan voi pahimmillaan olla noin 2-3 tunnin käynti, riippuu. […] Et ROROssa tää on huomattavasti suoraviivaisempaa tää homma."

"On average 8-9 hours, you can say 10 hours. That is the turnaround (unloading and loading). RORO can at worst be 2-3 hours, it depends. […] RORO is considerably more straightforward."

(Port Operator A)

While ships arrive to Vuosaari on a scheduled basis, *operations* run around the clock. However, ground transport can *access* the port only between 6 AM to 22/23 PM restricting hinterland movement of goods. Ground Transport Company A expressed a desire to prolong the port gates active hours, despite noting the hours being sufficient for managing current cargo volumes.

"tällä hetkellä tavaravirrat ei ole tarpeeksi suuret, mutta siitä huolimatta sataman aukioloajat voisivat olla pidempiä. Eli siis että toimintaa satamassa on ympäri vuorokauden, mutta tavaraa ei voi liikuttaa sataman portista ulos tai sisään muuta kun klo 06-22/23."

"For the moment, volumes are not large enough, yet despite that the port open hours could be longer. To specify, operations run around the clock, but still cargo cannot be transported out from the gate more than between 06-22/23 o'clock."

(Ground Transport A)

All port operators participating in the study claimed offering services mainly to one or a few dedicated shipping companies, thus forming *pipelike relations between shipping companies and port operators.* Vertically integrated ownership relations occur among the stakeholders and contracts are generally made on a long-term basis. The practice is not inclusive to merely port operators, depot companies also forms similar relations with shipping companies. Yet, it is to be noted, as expressed earlier, that partnership exchanges can occur.

"Osittain muodostetaan siis yhteys jopa omistuksellisesti ja joskus laivat tulevat minne sattuu. Yleisesti ei kuitenkaan vaihdeta tuosta vain operaattoria vaan sopparit on pidempiaikaisia."

"Partly connections are established even through ownerships and sometimes ships go wherever. Generally port operators are not changed lightly and contracts are long-term based."

(Ground Transport A)

As a direct result of the pipelike relations, *increased use of and well-integrated IT systems* has been created to support business processes.

"Aikasemmin toimittiiin s-postitse, nyttemmin pystyy suoraan kääntää omaan järjestelmään. On ollut suureksi avuksi."

"Earlier e-mails were largely used, but now [information] can be directly transferred to internal systems. It has helped a lot."

(Depot Company A)

"Informaatiovirrat sinänsä toimii ihan hyvin, kun meil on niin läheinen suhde… kun heidänkin… varustamon käyttämä ohjelmisto on tän saman softafirman tekemä, niin meille se on ollut tosi helppoa kytkee näitä."

"Information flows works good, as we have such close relations… when their… the software used by the shipping company is developed by the same software company, so it has been very easy to integrate these."

(Port Operator B)

In contrast to the smooth information exchange between primary customers and suppliers, port operator B described that stakeholders have *adapted standardized information exchange diversely,* mitigating the purpose of standardization.

*"*V*aikka ne on ollut olevinaan kuinka standardoituineita nämä sanomat ja muut, nii silti jokainen tuntuu soveltavan niitä vähän eri tavalla. ja ainahan on joku serveri minkä kautta ne menee."*

"Despite being standardized these declarations etc., each actor seems to have adopted them slightly differently and every time there is some server through which it flows."

(Port Operator B)

At last, despite digitization efforts in the maritime industry, the *use of paper* was perceived as increasing, while the share of empty containers in relation to the overall flow of goods was described as high and growing.

"Nyt itse asiassa tuli yks juttu vielä mieleen, et mua aina naurattaa kun jotkut puhuu paperittomista konttoreista, niin hemmetti se paperimäärä tuolla rahtikonttoreilla vaan lisääntyy."

"Now that you mentioned it one thing comes to mind, the notion of paperless offices makes me laugh, damn it the paper amount in these offices are just increasing."

(Port Operator B)

"Tyhjien konttien suhteiden osuus liiketoimesta on aika paljon ja näyttää siltä että kasvaa jatkuvasti"

"Empty containers make up quite a large portion of the business and it seems to be growing."

(Authorities C)

Depot

Characteristics for depot companies included *job order bursts* and a *First in First Out (FIFO) business logic.* Whereas the FIFO proceeding is intuitive from a contractual point of view, job order bursts was described to be caused by shipping companies need to allocate empty containers and doing so in *large quantities* at a time.

Interviewee: "Kun meille tulee kontteja niin kaikki [asiakkaat] haluaa että kontit pyörii FIFONA, eli first in first out, kun toiselta puolelta täytetään niin toiselta puolelta menee ulos, eli silloin se vanhin menee aina ensimmäisenä, koska sitten taas nää maksaa meille kuukausvuokraa et me säilytetään näitä kontteja ja siel on tietyn näköisiä sopimuksia tehty. Paljonko on vapaa päiviä annettu kellekin asiakkaalle annettu ja sit kun se menee tiettyjen päivämäärien yli, niin sit ne asiakkaat haluaa et ne on seissyt niin kauan et pakko saada kontit ulos"

Interviewer 1: "Pystyykö niitten [konttien] tarvetta ennakoimaan?"

Interviewee: " No varustamot, ennakoi sitä et niillähän on tietoo et kun ne haluaa täällä esimerkiksi

Interviewee: "When we receive containers, customers wants containers to be treated as FIFO, that is first in first out, meaning when one container comes in, we forward another beginning from the oldest end, since they pay rent on a monthly basis and certain contracts have been made. How many free days have been given to whom and when certain amount of days have been surpassed, the customers want to get the containers out as they've been standing there too long."

Interviewer 1: "Is it possible to estimate the need [for containers]?"

Interviewee: "Well shipping companies estimates it in a manner that they know about one month in advance what containers will be loaded and approximately how

lastikontteja mitä täytetään, niin ne tietää jo kuukauden etukäteen et paljon ne suurinpiirtein niit kontteja tarvii. Ja sit jos niit ei oo tääl Suomes tarpeeks, eikä ole tulossa tuonnin kautta tyhjiä kontteja tarpeeks, niin silloin niitä ajatetaan tyhjinä laivalla tänne suomeen ja sit niit tulee monta sataa kerralla"

many containers they need. If there isn't enough in Finland and none is incoming through import, they are shipped empty to Finland and they arrive hundreds at a time."

(Depot Services A)

However, the frequency of the allocation in addition to the empty container inventory rotation remained unanswered. That is, a high demand of empty containers would requisite a constant need of large quantity allocations, following more closely "just-in-time" principles, whereas a low frequency of allocations would indicate shipping companies maintaining and building inventory. Yet, the depot company described a *rapid change of container placement* on their area, implying continuous container handling, whether the procedure entails container forwarding, maintenance, or inspection. More precisely, container pile and row compositions are dynamic.

"Se [kenttä] muuttuu koko ajan. Se saattaa… no sanotaan et kahes päiväs voi hävitä 200 konttii ja niitten tilalla on uudet kontit sitten kahden päivän päästä. Eli jos oot viikon lomalla, niin kaikki konttikasat on voinut vaihtaa paikkaa"

"The field changes all the time It can… well, let's say that in two days 200 containers can have disappeared and there are new ones in their place. So if you take one week off, all container piles can have switched places."

(Depot Service A)

On the other hand, Shipping Company C explained that they do not require depot services to apply a FIFO logic, but instead wants containers to be sorted based on grade of quality and thus reducing degree the complexity for depot services to forward and handle containers to a certain degree.

As became clear in the last chapter on the business process map, the container depot business requires a human touch, resulting in *high need of human labor.*

At last, *new applications* have been developed in order to serve trucking companies, whereas truck drivers have access to a mobile application that allows arrival announcements.

Port Operator

In similar to depot companies, also port operators described their business as *intensive in terms of human labor.* A distinction between European ports was mentioned on this front, whereas ports are already highly automated.

"No tässähän tulee se, että esimerkiksi tämä on työvoimavaltainen ala. Täällä edelleenkin vaikka tää on koneistunut nii tääl tarvitaan aika paljon ihmisiä tekemään."

" E*uroopassahan käytetään näitä ATV kärryjä. Siellähän ajaa akkukäyttöiset robootit, et ne menee jonnekin alle ja tuo sen… ihminen tekee täällä vielä kaiken käsin. Ei nyt IT puolella mutta suorittamassa portaassa. Euroopassahan siellä on RTG nostureita ja näitä miehittämättömiä ajoneuvoja ja niitä menee siellä kymmeniä. Ohjelma ohjaa et ne ei törmäile toisiinsa. No onhan automatisoituja varastojakin, et ihan sama idea vähän isommassa mittakaavassa"*

"It all comes down to this, that this is a high an industry of high human labor. Even if machines have been taken into use by large, it still needs quite a lot of people to do labor."

"In Europe, ATV truck are in large use. There are battery driven robots, that drives there and retrieves that… a human does quite a lot here by hand. Not on the IT side, but on the grassroot level. They use RTG lifting equipment in Europe and autonomous vehicles and there are dozens of them. A system controls them, avoiding collisions. Well, there are automated warehouses as well, so the same idea on a larger scale."

(Port Operator B)

Furthermore, the preparatory work for port operators being vital for business processes in terms of allocating appropriate skills at an appropriate time to the right place, as became evident in the process map, *resource management* in general was described as being conducted *using mean values*.

"Tällä hetkellä me mennään semmossa vakimiehityksessä, joka on tietysti vähän niiku keskimääräisesti, eli suunnilleen hyvä ja joskus huono"

"Currently we operate with level work force, which is based on an average, meaning approximately okay and sometimes poor."

(Port Operator A)

Port Operator B explained that current practices involve *manual information entries* in internal systems, while *equipment in use lacks IoT capabilities*, such as GPS. However, equipment is being replaced, resulting in more advance technology to support processes. Yet, the interviewee articulated some degree of uncertainty regarding new capabilities, implying *equipment manufacturer driven development*.

"Meillä ei ole minkään näköistä GPS paikannusta missään koneessa tai missää muualla. Meille on tilattu uus konttinosturi joka tulee meille ensi vuoden maaliskuussa ja siihen tulee tää Dynamic Position System, eli siihen ohjelmoidaan sitä meidän konttikenttää, niin kuin valmiiks positioita ja sitten jos täältä liikenneohjauksesta käsketää laittaa se johonkin paikkaan niin se vie sen itte niin kuin sinne"

"We do not have any GPS positioning in any of our machines or anywhere else. We've ordered a new container lifting truck, which will arrive next year in March and it has this Dynamic Position System, so we pre-program our container field and positions and then when we from our traffic control order to put it [a container] somewhere, it will do it by itself."

"Seillainen meille kait on tulossa, et sellainen nosturipäähahmontunnistus homma et se lukee sen kontin tunnisteen ja

"A thing like that is probably coming, that is a shape/pattern recognition thing, which reads a container ID and compares it to a job order and most likely gives a

vertaa sitä siihen mitä sillä on työjonossa ja varmaan varoittaa et hei nyt mä oon viemäs konttia mitä ei pitäis”

warning signal if a wrong container is moved.”

”Katsotaan kun tulee tää uusi laite mikä on tätä päivää, et onks siinä mitään toimintoja jota voidaan käyttää”

“We’ll see when the new machine arrives if it has any features that we can use.”

(Port Operator B)

The port operators described gathering KPI related data of operations, yet using *minimal data sources*. Perhaps the lack of IoT equipment can be a part reason, in addition to port operators stating that a most data sources have been cleaned up, striving to reach *purpose driven data gathering.* At last, in similar as to container depot’s n*ew applications* have been introduced to serve trucking companies.

Auhtorities

The business model of the port owner was compared to a *landlord* logic, whereas the main objective is to allocate and maintain operational space for the port actors, while providing supportive services and functioning as a neutral coordinator. Otherwise, the landlord should refrain from meddling with the actors’ doings. Authorities C further expressed that *cooperation* with the port stakeholders worked well in general. In contrast however, the port operator described an occurrence of an *interference paradox*, whereas remaining uninvolved becomes difficult.

“Vuosaaressa tehtävänämme on olla ”landlord”. Eli me yhteensovitamme liikennevirrat toiminta-alueella. Yleisesti mallia on suunniteltu niin että satama vaan rakentaa ja ylläpitää fyysistä infrastruktuuria ja muuten ei puututa asioihin. […] Operaattorit eivät halua että Helsa puuttuu

“We function as “landlord” in Vuosaari. We coordinate cargo flows on the operational area. In general the model is planned in a manner, so that the port owner builds and maintains the physical infrastructure and otherwise it doesn’t meddle with things. […] The operators do not want the Port

heidän asioihin, mutta heti kun jotain tapahtuu niin puhelin alkaa soida."

of Helsinki to interfere in their business, but as soon as something happens the phone starts to ring"

(Authorities C)

Finally, Authorities C described the port owner as having *minimal knowledge of flow of goods*, with an exception of hazardous goods and cargo volumes which forms a basis for billing purposes.

"Satamahan tuntee huonosti, mitä meidän sataman läpi menee tavaraa. Eihän me tiedetä ja eihän se ole meidän asiakaan tietää"

"The port owner knows very little what flows through the port. We don't know and it is not our business to know either."

(Authorities C)

Shipping

As already made evident, shipping companies are required to *allocate empty containers* to Finland. In addition to allocation, Shipping Company C described their cooperation with depot companies as requiring depot companies to *sort containers by grade of quality*, lowering the pressure of depot companies by avoiding container handling on a unit level, as mentioned previously.

"Depotissa lajitellaan kontit, riippuen laadusta ja kunnosta (food grade, paper grade kontteja jne.), he tekevät siis estimointeja ja lajittelevat kontit sen mukaan. Kun asiakas sitten tekee buukkauksen, niin ilmoitamme depotille että tällaisen kontin halutaan ja heidän pystyisi poimia oikeanlaisen kontin sieltä käyttöön. Ei kuitenkaan numerotasolla pyydetä mitään,

"The depot services sorts containers depending on quality and condition (food grade, paper grade etc.), they do estimations in other words and sorts containers accordingly. When a customer then places a booking, we inform the depot that we want a certain type of container and they should be able to pick one up. We do not work on a numbers level, but we allocate them

mutta tietystä laadusta ja ”pinosta” allokoidaan kontti”

in accordance to quality and “stack”.”

(Shipping Company C)

Summary

This part of the thesis examined characteristics of the port ecosystem in a hierarchical manner, ranging from global to individual stakeholder levels. Table 5 summarizes the findings.

Table 5. Summary of characteristics identified

Level	Characteristics
Global	*Multimodular Chains*
	Long-established trade documents
	Lack of trust between trading partners
	Scattered Data Across the supply chain
	Standardized Information Exchange formats
	Shipping companies container ownership
	Dense ship arrival frequency at large ports
Europe	*Independent authoritative systems*
	Authoritative collaboration
	Ecosystems' high exposure to criminality
Finland	*Feeder ships*
	Cyclicla flucutations
	Just in time production
	End customer dictated delivery times
	Contradicting interest among stakeholders
	End customers' low interest in port proceedings
	Low volumes
	Unbalanced import/export
	Politicians misconceptions
	Strong unions
	High wages
	Challenging wheater conditions
Port	*Excess capacity*
	Small port size
	Flow of people and goods
	Central role of port owner
	Horizontal integration among port operators
	Low collaboration among competitors
	mandatory need for exchange areas

	Specialized business models
	Scheduled arrival of ships
	Port operations and port access
	pipelike relations
	Increased use of IT
	Diverse adaption info exchange standards
	Empty container as prominent portion of the business
Depot	*Process logic*
	Job order bursts
	Human Labour
	New Applications
Operator	*Business logic*
	Equipment manufacturer driven development
	High need of human labor
	Resource management
	New application
	Purpose driven data gathering
Authorities	*Minimal knowledge of flow of goods*
	landlord business model
	Interference paradox
Shipping	*Container allocation*

8.3.2. CHALLENGES AND BARRIERS

Global

Despite talk of standardizing authoritative systems on a global scale, an emphasis on *interest misalignment* was brought up, while the *vast quantity of international stakeholders* and *political power structures* causes their own unique barriers for information system development within the maritime industry.

"Sitten on sellaisia voimia takana, merenkulku kun on maailmanlaajusta, et se ei rajoitu Eu:hun. Niin mä just luin aamulla enne tänne tuloa että tuota semmosta kommentointitaulukkoa, kun meillä on kesäkuun alussa semmonen IMO kokous. Siellä sit katottiin tuota

"There are that kind of powers influencing this, when the maritime industry is global, so it does not limit itself to the EU. I just read this morning before coming here a comment section, when we have in the beginning of July an IMO

taulukkoa että miten Suomi ottaa niihin kantaa niihin asioihin mitä esitetään, niin siellä käsitellään tätä maailmanlaajuista konseptia Single Windowsta. Ja kaiken maailman kaupan ja merenkulun etujärjestöt vastustaa sitä, et tehtäis tämmönen tulli ja merenliikenteen koskeva yhteinen single window. Niillä on omii järjestelmii tuol ympäri maailmaa ja ne ei haluu lähtee niitä purkaa. En usko että tää etenee kauheen hyvin. Me voidaan Eu:ssa ehkä saada jonkunlainen oma hiekkalaatikko, mutta se ei oo maailmanlaajuisesti realistista. Sit on kuitenkin Kiina maailmanlaajuinen kaupan jätti ja ne ei kannata tätä. Mä puhun nyt siitä että tullausprosessi ja alusselvitysprosessi yhdistyisi. Kyllä nämä voidaan varmaan harmonisoida nää alusselvitykset Eu tasolla, mut se et saatais kaikki alus ja tullausselvitykset harmonisoituu maailmanlaajuisesti, nii en usko ihan et se 7 [interviewees estimation for and EU single window] vuottakaan riittää. Merenkulussa täytyy ottaa huomioon että kaikki tapahtuu hitaasti"

meeting. We looked at the comment section how Finland is going to take a stance towards a concept such as a global Single Window. All sorts of international trade and maritime organizations are against it, developing a global single window for customs and the maritime industry. They have own systems around the world and they do not want to get rid of them. I don't believe this will advance very well. We can perhaps create within EU a sandbox, but on a global scale it simply isn't realistic. Then again China is a global giant and they do not support this. I speak about customs and ship declarations. We can surely harmonize these ship declarations on European Union level, but achieving a global harmonization, I don't believe 7 years [interviewees estimation for an EU single window] will even be enough. In the maritime industry one has to take into consideration that everything happens slowly."

(Authorities A)

A further notice on the same challenge was described as a *scaling issue* and *development orchestration*.

"Et se on ehkä enemmän tää skaala se haaste, et teknisesti ei oikeastaan

"It is perhaps the scale that is the challenge, technically it is not that

ole mitään vaikeaa, mutta kaikkien pitäisi yhtä aikaa päättää et tehdään nyt näin”

difficult, but everyone should decide simultaneously that this is how we should do it.”

(Authorities A)

Digital Infrastructure Provider C, while working with maritime projects had encountered a global challenge within logistics. Despite knowledge on container destinations and movements, a high degree of *manual work* prone for human errors is required to feed necessary information on the way.

“Merikontin, sen logistiikan puolelta se nykyisin toimii kohtalaisen hyvin ja logistiikka mielessä tiedetään missä se kontti on menossa, mutta siinä on hirveen paljon manuaalista työtä tänä päivänä, eli käytetään jotain viivakoodilukijoita, ehkä jotain lyhyen kantaman radioteknologia mihin pitää viedä se laite joka lukee siitä sen kontin tiedon. Siinä on se että on mahdollisuus virheisiin, koska ihminen tekee sitä työtä. Mitä tässä ketjussa halutaan ratkaista on se että kaikki halutaan siirrettävän langattomasti ja automaattisesti, ilman että ihmiset manuaalisesti tekee siihen yhtään mitään”

“From the container and the logistical perspective, it works pretty well currently, in the sense that we know where the container is going, however there is a lot of manual work today, barcode readers are in use and maybe some short-range radio technology where the equipment needs to be brought close to read the container information. There’s the big chance of errors as humans does the work. What the desire to solve in this chain is that everything is desired to be transferred wirelessly and automatically, without any manual human labor.”

(Digital Infrastructure Provider C)

Furthermore, Digital Infrastructure Provider C emphasized that *goods and containers have different dimensions in development efforts*, causing an additional challenge.

“Yks haaste mitä globaalisti mietitään on tämmönen merikontti.

“One challenge globally is when we think about a container. It

Siellä sisällä on jotakin, mutta jos ensin keskitytään pelkästään siihen merikonttiin, siihen tulee sit yksi lisähaaste jos halutaan miettiä sitä sisältöä”

carries something inside, but if we concentrate on the container by itself, adding the cargo brings another challenge forth.”

(Digital Infrastructure Provider C)

At last, the Digital Infrastructure provider C highlighted in regards of tracking systems, that there are *different technological needs depending on the stage of the containers journey*, adding yet another further dimension to the complexity of development efforts.

“On erilaisia tarpeita eri vaiheissa. Laivassa ei tarvitse tarkkaa tietoa. Satamassa tarvitaan etenkin kun tulevaisuudessa halutaan automatisoida asioita”

“There’s different needs during different stages. Onboard a ship, you don’t need precise information. In the port you do need it, especially in the future when automation comes into play.”

(Digital Infrastructure Provider C)

Europe

Shipping Company A expressed frustration regarding the multitude of authoritative systems in Europe, as the systems do not cooperate and thus requiring the same information to be provided numerous times to different systems. While not being a challenge per se by itself, lack of system communication was explained as a barrier caused by *collaboration disinterest for system development.*

“Yks mikä on, vaikka se on ihan pieni asia meidän liiketoiminnassa on, et tää Portnet osio ja se et EU:n sisällä ei ole mitään yhteneväisyyttä tässä kommunikoinnissa. Tai hyvin vähän, elikkä sitä tietoa mitä lähetetään eri paikkoihin, sitä joudutaan syöttämään

“One thing, that is small in our business, but still this Portnet system and the fact that there is no communication within the EU. Or very little at least, so we provide information to different places and it has to be provided in every port

joka satamassa erikseen. Siinä ei ole mitään yhteneväisyyttä. Se nyt on meidän liikennetoiminnassa ihan peanuts, mut se on ihmetyksen asia. […] Onhan siin tavallaan et kaikki teknologia ja kaikkia olisi olemassa, mutta kun tahto puuttuu. Jokainen maa haluu tehdä omaa juttua, niin minkä sille mahdat? Sit jokainen pitää kiinni siit omasta, koska se on paras"

separately. There is no unification. It is totally peanuts in our business, but it makes me wonder. […] In a way, all technology exists, but the will does not. Each country wants to do their thing and what can you do about that? Then every country wants to hold on to their own thing, because it's the best."

(Shipping Company A)

A vision to mitigate the overlapping information exchanges, has emerged as an effort to create an EU wide Single Window authoritative information channel, yet Authorities A described the *development* as *strikingly slow*.

"Tarkoitus muuttaa kaikkia 25:tä eri järjestelmää yhdeksi samanlaiseksi. Se on vasta kehitteillä ja käsittelyssä. Se tulee joskus, mutta ei tiedetä sen sisältöö ja vaikka se kuinka harmonisoitais mitä, niin se ei voi olla tätä päivää ennen kuin jonkun 7 vuoden päästä. Väitän et ei paljon aikaisemmin."

"The intent is to change all 25 systems into one. It is under development. It is under processing. It will come at some point, but the content is still unknown and even if one would harmonize everything, it won't be available earlier than 7 years from now. I would claim that not much earlier."

(Authorities A)

Finland

Despite information stemming from identical sources in the authoritative systems, *data quality* was described as unreliable as *data inconsistencies* occurs between the systems. One reason being, AREX declarations are partly made by outsourced third parties. This in turn was noted to being reflected directly in official national reports.

Researcher: "Käytetääks näitä tullin keräämiä tietoja että onko tilastotoimintaa tai tämmöstä? Mikä merkitys sillä datalla on? Periaatteessa tää on semmosta joka kiinnostaa vaikka tilastokeskusta, joka tekee ulkomaan kaupasta raportteja, että tostahan pystyis näkemään asioita jos se data ois laadukasta. Onks sillä semmosta käyttöö sillä datalla?"

Researcher: "Is this information gathered by the customs used for statistics or something similar? What's the significance of this data? This is in principal something that could be interesting for Statistics Finland, who makes reports on foreign trade, so that data could show something if it were of good quality. Is it used for something like this?"

Authorities C: "Mielenkiintoinen pointti. Käsittääkseni nämä suomen viralliset raportit tehdään Portnet tietojen pohjalta ja ainakin meidän osalta se eroaa aika lailla todellisuudesta"

Authorities C: "Interesting point. In my knowledge, the official reports are made based on Portnet information and at least in our view it differs quite a lot from reality."

Ground Transport A: "Arex tiedot voi olla mitä vaan kun niitä näpyttelee joku kolmas osapuoli."

Ground Transport A: "Arex information can be anything, when it is made by some third party."

When discussing negotiation possibilities during the workshop, the attendees were united that the port actor's negotiation positions was generally poor in the larger scheme of things, especially when dealing with large industry giants, revealing challenging *power balances* to organize processes around.

"No se, ei oo ohjattavissa mitenkään koska me ollaan tääl ravintoketjun häntäpäässä, me ollaan niinku isojen satamien ikään kuin työrukkasia, pienet satamat niinku suomalainen mittakaava. Ei me voida sanella et me ei oteta laivaa maanantaina, et ei me haluta

"It can't be controlled at all, as we are here at the end of the food chain, so to speak kind of tools for the bigger ports, small ports such as this in Finland. We can't say that we don't want ships on Mondays, we don't want export for Fridays, that we rather do it on

niitä vientejä perjantaina et me tehää ne vaikka lauantaina. Ei se käy. Se ei käy sille isolle ketjulle et meidän pitää vaa sinnitellä”

Saturdays. It can’t be done. It is not okay for the bigger chain and we just need to cope with it.”

(Port Operator A)

“Et se on just se et tavallaan ne isot toimijat on just ne tiukimmat toimijat ja nehän on tai tuo sitä volyymia. Se on se haaste”

“It’s kind of the big players who are the most strict ones and they are the ones bringing the volumes. That’s the challenge.”

(Shipping Company A)

At last, *implementing IoT based capabilities*, such as autonomous lifting trucks based on video input, has its own challenges due to Finnish weather conditions.

“Sit jos on lunta katolla, niin nää kuvantunnistusalgoritmit ei toimi, vaan silloin pitäisi olla jotkut RFID. Pohjoisen olosuhteet ovat vähän haastavia joo.”

“If there is snow on the roof, image recognition algorithms won’t work, but then one would need some sort of RFID. The Nordic weather conditions are a bit tricky, yes.”

(Port Operator B)

Port

Regarding information system development and information exchange within the port, several perspectives on challenges and barriers were raised. First, tele operator A highlighted a notion from a technical perspective on *legacy systems* and the potential challenge with their integration. Furthermore, Port Operator B emphasized the multitude of actors and thus the multitude of systems that in turn causes a need of integration, legacy or not.

“Täs on tää probleema kun täs on monta toimijaa ja ne menee yhteen ja sit täs on jotain tämmöstä toista

“Here’s the problem, when there are multiple actors and they come together and then there’s this thing

mikä näkyy teollisuudessa, etenkin vanhemmissa teollisuudessa jossa on se legacy; vanhat järjestelmät, kuinka niihin pääsee?"

that can be seen in industry, especially old industry, where there's legacy; old systems and how to access them?"

(Tele Operator A)

"Ulkopuolisten asiakkaiden kanssa, niin niitten kaa onkin ollut paljon vaikeampaa yhteensovittaa näitä järjestelmiä. Kaikilla toimijoilla on räätälöidysti tehtävä."

"Outsider customer have been more difficult to integrate systems with. You need to tailor solutions for all separate actors."

(Port Operator B)

From a non-technical perspective in turn, the port characteristic of *fierce competition* was described to cause a clear *barrier for development in addition to overall stubbornness*.

"Monta kertaa olen törmännyt siihen et ei mene eteenpäin kun he eivät suostu keskustelemaan keskenään. Siinä on semmosia persoonia ja yritysten historiat. Mä tiedän että satamaympäristö on aina ollut aika sellainen ronskea, että lyödään nyrkkiä pöytään ja korotetaan ääntä joka ei auta mihinkään"

"I have encountered several times that the actors are not willing to discuss with each other. There are certain people and the companies have their history. I know that the port environment has always been quite rough, fists are banged on tables and voices are raised, which does not serve anybody."

(Authorities C)

Interviewer 2: "Onko tässä kehitysmahdollisuuksia maakuljetus ja operaattoreiden välissä?"

"Interviewer 2: "Are there any development opportunities between ground transportation and port operators?"

Interviewee: ”Näin positiivisesti tulisi ajatella, mutta se ei ole aikaisemmin toiminut, kun toimija pitää niin lujasti kiinni omista ajatuksistaan.” Yhteistä säveltä on vaikeaa löytää.”

Interviewee: “One should think positively, but it hasn’t worked previously and actors holds quite strongly to their opinions. A common ground is difficult to achieve.”

(Ground Transport A)

Furthermore, in terms of developing an IS platform to support port proceedings, *platform ownership issues* were expressed. From the perspective of Authorities C, uncertainty regarding the governing party was raised. While Digital Infrastructure Provider A found large potential in such a platform, yet tensions were expressed regarding control desires and data sharing disinterests.

Interviewer 1: “Kenen pitäisi tällaista alustaa pyörittää? Viranomainen vai joku muu?”

Interviewer 1: “Who should run such a platform. An authority or someone else?”

Interviewee: ”Ei sen kuulu olla viranomainen, mutta jos sä pystyt tarjoo sellaista platformipalveluu josta kaikki hyötyy ja kaikki voi poimii mitä tarvii ja kokonaisuus muuttuu paremmaksi tämän myötä niin silloinhan myös satama voittaa. Mutta en tiedä kuka se voisi olla.”

Interviewee: “It shouldn’t be the authorities, but if you can offer a platform service which provides benefits for everyone and the entirety becomes better, then the port also wins. But I don’t know who it should be.”

(Authorities C)

“Tää on tavallaan se et ymmärretään niin kuin datan käyttäminen tämmösissä ekosysteemeissä, jotka on laajempia teollisia paikkoja, niin

“This is kind of the situation, that it is understood that data usage on an ecosystem level on a broader industrial scale, disruptive and research worthy aspects can be

siellä on myös niin kuin se oikeesti tutkimuksellinen, niin kuin murroksellinen asia. Kun on paljon toimijoita niin jokainen haluaa rakentaa sen oman ekossysteeminsä ja kun data on tärkee ne ei haluu sitä jakaa”

found. When you have several actors and everyone wants to build their own ecosystem and when data is important, a desire to share it does not exist.”

(Digital Infrastructure Provider A)

In order to make better use of data, the participants of the study saw potential in information exchange and utilizing data platforms. However, as was already mentioned, information in authoritative systems was perceived as unreliable, while manifests were considered holding substantially more consistent information. Yet, utilizing manifests to exchange data among stakeholders for process improvements was conceived problematic, as the *manifest* holds a great amount of *sensitive* data.

“On huomattu että manifestitedon ja Arexin välillä on myös ristiriitaisia tietoja. Syy on että arextietojen syöttö ostetaan palveluna”

“It has been noticed that there are differences between AREX and Portnet information. A reason is that AREX information is bought as a service.”

(Authorities B)

“Mutta miksi manifesti ei sitten avaudu ja psytysikö se avautumaan nii se on sit se seuraava tason niinku..mutta se on sit taas hyvin luottamuksellinen se manifesti”

“But the reason for why the manifest cannot be opened, that is a next level… but it is quite sensitive the manifest.”

(Authorities C)

Software Company A provided a complementary view on the topic the reason why statistical reports are based on Portnet information instead of more reliable manifest information.

"Sen takia toi satama käyttää uskoakseni…sen takia ne on lähteneet tohon et ne käyttää tota Portnetin tietoo, koska se on sit yks paikka mistä sitä tietoa sit tulee ja periaattessa kun se on semmoinen mihin se data tai tieto kerääntyy on toi Portnetti, kun nää taas manifestit on sit taas iha enempi vähempi toimijakohtasii ja pitäis tehä kaikki tiedonvälitys ja sopimukset jokaisen varustamon kanssa erikseen"

"That's the reason I believe the port uses... the reason they use Portnet information, as it is a place where you can get data and in a way a place where data accumulates, whereas the manifest are actor dependent and one would need to make all information exchange and contracts with each shipping company separately."

(Software Company A)

Strong unions were also raised as a barrier for automation efforts by Tele Operator A. The fear of automation was not merely restricted to the port unions, yet the strength of the union was emphasized. However, such factors should not hinder ideation.

"Eikä vähempänä voi pitää täällä varmaan vastaantulevaa ammattiyhdistysliikettä, joka on kyllä varmaan Suomen kuuluisin. […] Tavallaan voin ymmärtää et täällä kun lähtee puhumaan automaatiosta, niin siellä ollaan kohta pysäyttämässä Suomen vientiä. Sitä ihmiset tulee pelkäämään siellä. Mutta sen pitää vähän niin kuin ymmärtää keskusteluissa eikä pidä ideointia jarruttamaan, mutta mä näen kentällä et tämmöset ovat myös sitä realismia maailmassa. Hidastusasteita tulee olee ja nii ihmisten pelot myös siinä, et kuinka "tää automatisoi mut pois?"."

"The unions should not be neglected, which are probably the most famous in Finland. […] I kind of understand that when you start to talk about automation, all export is suddenly at halt. That is a thing the people are afraid of. But it should be considered during discussions and ideation should not be halted, but I see it on the field that this sort of thing is reality. Decelerations will emerge and the fear of people is one of those, in a way that how "am I being replaced by automation?"."

(Digital Infrastructure Provider A)

During the interviews and the workshop, two distinctive special interest areas in regards of challenges were raised: the *exchange area* and *port rush hours*.

As already explained, the purpose of the exchange area is to allow full and empty container transfers between depot companies and port operators and it has been established as the port actors have not been able agree on other means of transferring containers between each other. While the actors physically using the exchange area, that is the port operators and the depot company, saw the exchange area as sub-optimal in terms of functionality, interestingly Shipping Company A had an impression the area was well working.

"Kenen mielestä se oli ongelma kuuluu kysymys? Vaihtoaluehan on ihan hyvä"	*"The question is, who thinks it doesn't work? The exchange area is good!"*

(Shipping Company A)

Yet, a myriad of causes and issues were provided related to the area. First, *limited physical space* was perceived as one cause, which in turn results in a cap for maximum quantity of containers that can be placed in the area simultaneously, further resulting in having to fulfill job orders in a discreet manner. The stakeholders might also receive several overlapping exchange requests, causing orders to be stacked in a queue as long as the area is full. Furthermore, the limited space increases difficulty in container sorting.

"Tääl on annettu tietyt vaihotalueet, jotka ovat ihan liian pieniä. Ja kun vaihtoalueelle jos tilataan vaikka, et no nyt tarvitaan 100 konttii, vaihtoalueen koko on 40 konttii, nii eihän me voida koko tilausta niin kuin ajaa sinne ennen kun sielt on viety jotain sieltä pois. Tää koko rulianssi et se puuroutuu ja sitten kun se yks keikka on kesken, tulee toinen keikka, tulee	*"Certain exchange areas have been given here, which are way too small. If an order of 100 containers have been made and the capacity of the exchange area is 40 containers, we cannot bring the whole order there until something has been removed. The whole ordeal that it gets clogged and one gig is unfinished and then another one comes up and a third and a forth,*

kolmas keikka, tulee neljäs keikka ja no, minne niit viedään? Ja sit ne ajetaan sinne tänne."	*so where do you put them? And then they are driven here and there."*

(Depot Service A)

Resembling a root cause more closely for the exchange area challenges, the notion that *input does not match output* was raised.

"Ja nytten se ongelma on siinä, et ne kontit ei mee nii nopeesti pois sieltä kun me tuotais niitä."	*"And now the problem is that the containers do not move away as fast as they are brought there."*

(Depot Servicec A)

The slow output was explained through several reasons. For instance, *lack of information causes slow throughput*, in terms of increasing process steps. When receiving containers, the recipient has knowledge of the container's placement on a approximate basis, yet is still obliged to start the retrieval by finding the exact location.

"Et ne on kyl selvillä et mihin niit pitäis viedä mut siitä huolimatta niin ei ne saa mitään koordinaatteja. Et jos yks operaattori ilmoitti et vietiin 10 konttia, niin ne voi olla missä vaan niissä toisen operaattorin kaikista paikosta. Joka tapauksessa sen kuskin pitää käydä siellä etsimässä, et missä ne on. Ja jos se on esimerkiksi maakerroksessa ja siinä on kontti päällä, nii ei se vältämättä lukista näe et se on jonkun alla. Sit sinne varmaan fyysistei menee joku pakulla kattomassa ja ettimässä"	*"It is clear where they should be brought, but regardless they do not receive any coordinates. If one operator proclaims that 10 containers have been brought there, then they can be anywhere among another operator's places. Anyway, a driver needs to go and find them there. And if one container is on ground level and there's a container on top of it, it is not necessarily possible to see it from the truck. The someone probably goes there physically with a car and tries to find it."*

(Port Operator B)

Another reason was described as *task prioritization*, due to resource management issues and a natural desire to first and foremost serve own customers.

"Stevecolla on kaks laivaa tuossa, niin ne ei laita yhtään konetta hoitaa vaihtoalueen liikennettä, vaan ne jättää ne laivattomalle päivälle jolloin työntekijöillä ei ole muuta tekemistä, joka aiheuttaa sen että heille tulleet kontit saattaa olla 3 päivää siellä koska kukaan ei hae niitä pois"

"If [name of operator] has two ships there, they won't put any machine to handle the exchange area, but instead that is left to days when no ships are incoming and employees has nothing else to do, which causes a three day delay to retrieve them away ."

(Port Operator B)

"Tähän liittyy myös resurssointiongelma, [nimi] kerto siitä miten on haastavaa välillä, eli sit kun niillä on joku lyhyempi hetki, ei oo laivoja niin sit koko fleetti ajaa kontteja vaihtoalurelle, no just silloin sattuu että vastaanottajalla on kaksi laivaa työn alla, niin koko niitten fleetti taas operoi sitä laivaa, eikä ole yksinkertaisesti resursseja hakee pois. Nii sit voi olla aika pitkä aika et ei saada kontteja pois vaihtoalueelta, jotka sitten tukkii. Ja me ymmärretään et se on näin ja se on haastavaa, varustamo on kuteinkin operaattorin asiakas ja on kovia aikatauluja, eli laivaa pitää priorisoida usein"

"This entails a resourcing issue as well, [name]told how it sometimes is challenging, when there are no ships then the whole fleet drives containers to the exchange area and then when the recipient has a couple of ships under service, then their whole fleet works the ship, and there aren't simply resources to retrieve them. It can take quite some time to get the containers out of there and it blocks the area. We understand that it is like this and that it is challenging, the shipping company is the customer of an operator and they have strict schedules and the ship must be prioritized."

(Authorities C)

Sub-optimal governance was perceived to contribute to the slow output as well, as containers should not be allowed to be stored more than a specific time in the area, yet lack of supervision causes *misuse* of the area to a certain degree and consequently filling up space. In contrast, the governance system also causes pressure to postpone input activities due to fear of sanctions, resulting in last minute exchanges in large quantities.

"Kun se ei ole missää digitaalisessa muodossa, niin ei siellä kukaan käy ruutupaperin kanssa mikä on ollut eilen ja mikä tänään."

"When it isn't in any digital form, no one goes there with grid paper and checks what container was there the day before."

(Port Operator B)

"Se ei saa olla niin kauan siellä. Satama rupee sakottamaan niist konteista, nii me ei voida niin kuin lauantain kontteja ajaa tiistaina, vaikka me tiedettäis se keikka, vaan meidän pitää odottaa et tulee päivät lähemmäks ja sit me voidaan ajaa ne sinne."

"They can't stand there that long. The port starts to collect fees of the containers, so we can't drive containers for Saturday there on a Tuesday, even if we know about the gig, but we instead need to wait until the days move closer."

(Depot Service A)

Furthermore, *sub-optimal information exchange* was expressed to decrease output speeds.

"Kun tyhjiä tulee tuolt laivasta ja meil on ennakkotietoa annettu, nii me ei voida ottaa konttii sisälle ennen kun se on operaattori lyöny sen ulos, muuten sen asiakkaan tiedot menee niin kuin päällekkäin, se kontti on kahdes paikkaa yhtä

"When empty containers come from the ship there and we have received advance information, we can't retrieve a container before the operator has released it, otherwise the customers information is duplicated, that is a container can't

aikaa. Ja sitten kun sielt tulee monta sataa konttii, kun ne ei ilmoita ennen kuin se viimeinen kontti on tullut sinne laivasta, nii me joudutaan va kattelee et jaa tää kuuluu meille, mut me ei voida kirjata sitä mihinkään ja sit kun tulee viimeinen nii sitten ne lyödään sisään ja me ruvetaa äkkiä niitä naputtelee. Nii et vaikka silleen et me saatais kontti kerrallaan, mut silleen et se ei niin kuin työllistäis meitä liikaa koska jos se tulee kontti kerrallaan nii niit viesteihän tulee ihan älytön määrä, et sekin on vähän huonoo."

be at several places at once. And when hundreds of containers come, they don't inform anything until the last one has been moved there from the ship, but we can't put the info anywhere and when the last container finally arrives then we get information and we start in a hurry to smash the keyboard. Rather that we would get one container at a time, but then again that would be too much because then the amount of messages would be ridiculous and that is not good either."

(Depot Service A)

"Kun esim [operaattori] vie sinne kontteja niin siel on esimerkiksi semmonen juttu et niitten ohjelma ei tehnyt sitä ilmoitusta, tai s-postia vasta kun viimeinen kontti oli viety"

"When e.g. [operator name] brings containers there, the thing is that their system does not inform, or we won't get an email before the last one has been moved."

(Port Operator B)

At last, the exchange area was also perceived to cause a *safety hazard*, while *increasing overall volumes* increases exchange area issues.

"Tää on ihan mahoton ja vaarallistakin. Meit on kaikki toimijat yhel vaihtoalueella pyörimässä, siel on lukkeja, kurottajia, pinkkareita ja kaikkien

"This is impossible and even dangerous. We're all actors there on one exchange area and there are trucks and lifts and containers here and there."

kontit tosiaan ihan sikin sokin sekaisin”

(Depot Service A)

Moving on to *rush hours,* all participating stakeholders agreed that a prominent problem area in the port is long land traffic queues. More specifically, the queues form for incoming traffic, when trucks perform cargo and container drop offs and retrievals, which falls between certain hours.

“Et hirveen suuri ongelma on nämä ruuhkat täällä”

“A great challenge is the rush hours here.”

(Authorities C)

“Et välillä on aika pitkiä jonoja autoille, käsittääkseni. Mä en tarkemmin tiedä et mitkä nämä syyt välillä on, tai muuta, mutta se et kuinka nopeasti kun se auto tulee hakemaan jotain tiettyä yksikköä et kuinka nopeasti se saa sen kyytiin”

“Sometimes there’s long queues for the cars there, if I have understood correctly. I don’t know the reasons behind this, but the speed a truck gets a certain unit on board.”

(Shipping Company A)

“Eli ongelmat ei synny siinä kuljetuspuolella vaan kaikki ongelmat ovat ennen kun kontti on nostettu kyytiin”

“So the problems are not on the transportation side, but all problems arises before a container has been lifted on board.”

“Mutta tota, operaattorit tällä hetkellä palvelevat vuorokauden aikana aika pitkälti. Eiks se oo niinku kuutisentoist tuntia, vähän

“But the operators operate around the clock by large. Isn’t it around 16 hours, depending? The trucks still come mainly in an 8 hour time

riippuen? Mutta kyllä rekat pääsääntöisesti tulevat sellaisen kaheksan tunnin aikaikkunnassa, vaikka operaattori on paikalla 100% enemmän."

window, despite operators being open 100 % more.

(Authorities C)

The main reason for rush hours was perceived by most stakeholders as *end customer delivery requirements*, setting limited specific timetables for cargo retrieval and further causing the majority of trucks arriving to the port simultaneously.

"Kyl se on asiakasvaatimukset jotka ovat siinä, ei se oo… me ollaan kaikki pelinappuloita siinä; operaattorit, varustamot kuljetusliikkeet kaikki. Kyl se on asiakas joka määrittelee sen että milloin sen [voi hakee]"

"It is the customer requirements there, it isn't… we are only pawns, operators, shipping companies, ground transport, everyone. It is the end customer who controls when it can be retrieved."

(Port Operator A)

" Tässä tullaan taas siihen loppuasiakkaaseen toiveeseen milloin se voi ottaa vastaan"

"It comes down to the end customer wish, when they can receive."

(Shipping Company A)

Ground Transport Company explained that they operate based on a *one to many principle*, requiring truck drivers to visit several stakeholder while at the port. Alone, this means automatically extra time utilizing port infrastructure. By adding in *nonexistent information about port operator queues*, truck drivers are forced to make uninformed decisions about visiting orders, potentially resulting in increased time spent at the port, due to inabilities of optimizing in-port routes. Furthermore, queues at operators can also block passage to other areas in the port.

"Nyt kun me viedään… tai sanotaan silleen että meillä on 4 konttitapahtumaa kun auto menee sisään [satamaan]. Lähtökohtaisesti pyritään aina kuljettaa kahta konttia samaan aikaan. Pahimassa tapauksessa palautetaan näitä kaks tyhjää [konttia], yhden [operaattorille] ja yhden [depotille]. [Operaattori] on ihan tuolla ja [depotti] ihan täällä laidassa. Sit se ei ota yhtään konttia näiltä päälle, vaan se ottaa yhden [toinen operaattori] ja yhden [kolmas operaattori]. Vaikka ei olis jonoja, niin on äkkiä tunti mennyt ja yli"

"Now that we bring… or let's say, we have four container events, when the truck gets to the port. As a rule, we always strive to transport two containers at a time. As a worst case scenario, we return these two empty [containers], one to [operator name] and one to [depot name]. [The operator] is over there and the [depot] there at the other end. Then it does not take any containers on board from these, but instead it takes one from [another operator] and one from [yet another operator]. Even without queues, an hour passes by fast."

(Ground Transport A)

"Sit on silleen et kun sataman portin lisäksi on operaattoreilla omat portit. Jos operaattorin portin sisäpuolella tulee ruuhkaa, niin jono tulee portin ulkopuolelle jolloin jono voi blokkaa tien jollekin toisella operaattorille sen takii et jollakin toisella on ruuhkaa"

"Then it is as following, that in addition to the port gate, operators have their own gates. If there's a queue at one operator, the queue forms outside of the operator's port and it blocks the way to another operator, just because there is a rush at one actor."

(Authorities C)

Rush hours was also explained as occasionally being caused by random and uncontrollable events, such as *weather conditions, traffic accidents,* and *train blockages.*

“ Satamassahan on juna. Vaikka se ois aikataulun mukaan paikalla, mutta on väärässä paikassa se aiheuttaa jonon kun ei autot pääse junan läpi”

“There’s a train that comes to the port. Even if it were on schedule, but if it is at the wrong place, it can cause a queue as trucks can’t drive through it.”

(Authorities C)

Authorities

As mentioned earlier, efficient and thorough custom control relies on human intuition, as official authoritative information sources are not adequate for inspection decisions alone. Besides the weakness of risk analysis systems relying on preprogrammed and sometimes sub-optimal parameters, another acknowledged challenge is directly linked to AREX inconstancies, resulting in improper inputs for the risk analysis. Furthermore, Authorities B expressed a *difficulty in finding appropriate information in authoritative systems*. AREX is rather used as a secondary data source, whereas manifests are first investigated and if need be, further information is sourced from AREX.

“On monta hyvin yksinkertaista asiaa, joita tämän hetkinen järjestelmä ei pysty tarkistaa. Esimerkkinä kontti jonka numerosarja alkaa U:lla kertoo että kontti ei ole rekisteröitynyt. Yleensä rekisterissä oleva kontti kun siitä maksetaan vuokraa, on asiakkaalla lyhyen ajan. Kun omasta kontista ei makseta vuokraa voi sitä pitää jossain ja rakennella siihen kätköjä etc. Tällaista parametria ei tämänhetkiseen järjestelmään saa.”

“There are several simple things the current system cannot check. As an example, a container with an ID that starts with a U, tells us that the container is not registered. Usually you pay rent for a registered container and it is at the customer for a short amount of time. As you don’t pay rent for an own container, you can keep it somewhere and construct different stashes and so forth. This type of parameter is not supported by the current system.”

” Portnetistä kuulemma löytyy sama tieto, mutta se on helpompi katsoa suoraan s-postista koska muuten joutuu infoa etsimään että mitkä laivat on tulossa ja sen perusteella katsoa Portnet tietoja. Arexia käytetään niin, että kun manifestista löytyy mielenkiintoinen kontti, niin siitä tarkistetaan Arex. Arex hankala, kun yhden ilmoituksen alla saattaa olla suuri määrä tavaraeriä, mikä on työlästä. Jos kuitenkin on informaatiopuutetta, niin Arexista etsitään lisäinfoa”

“The same information should be found in Portnet, but it is easier to just check an email, otherwise information needs to be searched for in terms of what ships are arriving and accordingly check Portnet. Arex is used in a manner that when something interesting is found in the manifest, it is crosschecked with Arex. Arex is cumbersome, as one declaration can hold a large amount of lots, which is laborious. If there is some information shortage, Arex is used for finding additional information”

(Authorities B)

Even though the manifest contains reliable information, Authorities B proclaimed an occurrence of detail differences between shipping companies, resulting in occasional shortage in detail for decision-making. *Lack of information* was in general described as the toughest challenge for customs officers. Especially the use of feeders in the Baltic Region breaks up the logistical chain, generating less accurate manifests for the last mile route. Authorities B explained that manifests on oceanic routes are in general more precise and would be useful for customs daily operations. Authorities B further highlighted that it would benefit the whole ecosystem, by reducing unnecessary inspections and thus making port throughput more efficient. On the other hand, speculations were raised on potential unwillingness to provide detailed information to customs, from an end customer perspective.

“ R*iippuen laivayhtiöstä, tieto on hyvin valinnaista ja tiedon puute on isoin ongelma tullilla. Kuljetusketju ei ole yhtenäinen. […] yhtenä ongelmana on että suomeen ei tule valtamerilaivoja, jolloin suomeen ei*

“Depending on the shipping company, information is miscellaneous and information shortage is the biggest challenge for customs. The logistics chain is not unified. […] One problem is

myöskään saada valtamerimanifestejä. […] Toisaalta jos varustamo on todella viranomaisystävällinen ja lähettää kaikkia tietoja, niin jotkut asiakkaat eivät välttämättä haluu tällaista varustamoa käyttää. Voi olla että varustamot voi kokea että jos saavat maineen että kaikkea tietoa annetaan viranomaisille niin tämä voi aiheuttaa viivästyksiä."	*that oceanic manifests do not reach Finland. […] On the other hand if shipping companies are incredibly cooperative with customs and provides all information, some customers do not necessarily want to use that company. It's possible that these companies get a reputation that extensive information is provided to customs and this results in delays."*

(Authorities B)

Authorities B also claimed to experience *time pressure*, due to the nature of the port.

" Vuosaari läpivirtaussatama joka hyvä asiaa ja joka toimii, kun kaikki menee oikein. Toisaalta, aiheuttaa haasteita tullille koska kovassa aikarajassa tulee toimia"	*"Vuosaari Harbour is a throughput port, which is a good thing when everything goes as planned. On the other hand, it causes challenges for customs officers as they need to operate on a tight schedule.*

(Authorities B)

While human intuition plays a vital part in making decisions, experience is an important factor, yet Authorities C explained that *experience* also provides a *paradoxical drawback*, whereas reflection on previous cases causes customs officers to misinterpret information in favor of passing through suspicious cargo.

"Pitää olla terve epäilys ja sit ei saisi nähdä haamuja, koska tosi moneen asiaan löytyy järkevä selitys. Mutta sen pitää etsiä ja olen huomannut itsessäni ja monissa kollegoissani, että jossain vaiheessa sitä alkaa itse löytää sen	*"You need a healthy hunch and not see ghosts, as many situations have a rational explanation. But you have to find it and I have noticed in myself, that at some point you start finding the irregularity and then you come up with an explanation.*

epäkohdan ja itse keksii selityksen sille. Siihen ihminen syylistyy tosi helposti, et "joo, se on varmaan näin." Periaattessa pitäisi riittää että löydetään joku indikaattori, millä määritellään joku toimenpide ja sen jälkeen katsotaan et löytyykö siellä vastausta siihen, eikä niin että keksii kysymyksen ja vastauksen. Mitä kokeeneempi, niin sitä helpommin ajattelee että se on sama asia kun silloin"

Humans commit this error easily, that "okay, it probably this". In principle, it should be enough that we find an indicator and define a measure to be taken, while only after that instance if an answer can be found and not in a way where you come up with a question and an answer. The more experienced you are, the easier you think that it is just similar as it was on another occasion."

(Authorities B)

Shipping Companies

Starting with the container traffic side, two challenges were raised by the participants, first *container allocation*, due to the characteristic of owning containers causes a barrier to use full capacity of vessels as empty containers takes up space from value adding transportation, while also causing extra costs. Another challenge relates to future development, whereas containers could be equipped with sensors, monitoring the container condition for instance, or providing a means for developing digital twins for the containers. This could potentially help with *e.g.* identifying broken containers during passage, allowing measures to be taken to fix problems and thus protect compromised cargo. However, when containers are loaded on board, *real-time sensing* is challenging, due to nonexistent networks on open seas in addition to containers themselves creating connectivity dead-spots.

"Avomerihan ei ole täynnä tietoverkkoja. On hyvä myös pitää mielessä et kontteja kasataan isoissa laivoissa ja siinä on monta terrässeinää tiellä."

"The open ocean is not full of information networks. It is also good to keep in mind that containers are stacked onboard large ships and there are lots of steel walls in the way."

(Digital Infrastructure Provider C)

Within RORO traffic, Shipping Company B explained that they receive all necessary information needed for creating the manifest at a *late stage,* and thus being unable to check the *validity of the information*. This has an impact on safety, as weight affects how a ship is loaded. It also affects fuel consumption and further the port, as it receives payments according to cargo weights. The truck length is in addition informed by Ground Transport Companies, which neither can be monitored, resulting in potential under-utilization of ship capacity and direct monetary income losses.

Interviewee 1: "Kaikki se lastitiedoista tai painoista on se mitä meille ilmoitetaan, emme pysty mitenkään tarkistamaan sitä. Meillä ei ole oikeuksia käydä sinne sisään tarkistamaan sitä yksikköä että onko se tyhjä, kun ilmoitetaan et on tyhjä vaikka siinä voi olla mitä tahansa. Mielestäni satama ei millään tavalla puutu tähän, vaikka olemme puhuneet HelSan ja Turun sataman kanssa. Se on aika merkillistä etteivät halua tätä tarkistaa tarkemmin, koska hehän saavat näitä tuloja painon mukaan. Mul on sellainen arvaus että puolet niistä jotka ilmoittavat että ovat tyhjiä, eivät sitä ole. Tällä hetkellä kun kuljetusliike varaa sen yksikön, tiedetään onko se rekka vai irtoperä, sitten pituus ja onko yksi vai kaksi kuljettaja. Yleeensä emme saa lastin painoa."

Interviewer 2: "Onko teillä oma vaaka."

Interviewee 1: "All cargo information and weights are dependent on what is provided to us, we aren't able to check anything. We don't have rights to check units, if its empty when it is informed as being empty and it can contain anything. In my opinion the port does not take any stance on this, even if we've spoken about it with the Port of Helsinki and Turku. It is peculiar that they don't want to check this more precisely, as they receive payments based on this. I have a hunch that half of those claiming the truck is empty, aren't. At the moment, when transportation companies book a unit, we know if it is a truck or a trailer, we know the length and if there's one or two drivers. Usually we don't get the cargo weight."

Interveiwer 2: "Do you got a scale?"

Interviewee 1: ”Ei, ne on kuljettajan antamia tietoa.”

Interviewer 2: “Aiheuttaako se haasteita, jos miettii että seuraatte varmaan aika lailla tuota polttoaineen kulutusta ynnä muuta, et jos joku ilmoittaa että meillä on vakiona 10 tonnii mitä liikutetaan, mut sitten on jokaisessa lastissa tuplasti enemmän?”

Interviewee 1: ”Sehän on haaste, myös et mihin se laitetaan laivaan.”

Interviewee 1: ”No, this is information provided by the driver.”

Interviewer 2: “Does this cause challenges, if we think about that you probably monitor fuel consumption etc., so if someone informs that we have on basic 10 tons that we transport, yet each shipment is double that?”

Interviewee 1: “That’s the challenge, also where to board it on the ship.”

(Shipping Company B)

Shipping Company B further had an impression that *a large amount of their traffic is being inspected by customs officers*, which directly affects their business. The notion was presented that customs officers decisions are based largely on manifest information and more precise information would reduce the amount of inspections, for which Shipping Company B added that the manifest content is not in their control, as ground transport companies provide the information.

“ Just kuulin että etenkin Vuosaaressa tulli tarkastaa meidän liikennettä hyvinkin aktiivisesti. Se on erittäin huono asia meille… siis hyvä että ne tarkistavat, en minä sitä sano, mutta on tullut valituksia asiakkailta kun ne pysäyttää kaikki, niin siinä voi mennä parikin tuntia ennen kun rekka pääse pois satama-alueelta”

Interviewee 1: “I just heard that in Vuosaari Harbour our traffic is inspected very actively by the customs. That is very bad for us… I mean it’s good that they inspect, I’m not saying that, but we get complaints from customers that they stop everyone, so it can take up to a couple of hours for the truck to get away from the port.”

Interviewer 2: ” Näettekö mahdollisuutta, jos teillä on tietoa näistä muuta kun mitä lähetätte Portnettiin… jos se on kuitenkin teidän asiakkaan eduksi että heitä pysähtäis… että voisitte antaa jotain tietoa tullille mikä poistais turhia tarkastuksia?”	*Interviewer 2: “Do you see any chance, if you other information than the data you send to Portnet… it is still in the customers interest that they don’t get stopped… that you could provide additional information to the customs to reduce unnecessary inspections?”*
Interviewee 1: ” Meillä ei ole mitään tietoa. Kaikki on asiakkaan ilmoituksen varassa. Ei me voida todistaa että se on oikein.”	*Interviewee 1: ”We don’t have information. Everything is based on what the customer informs us. We can’t prove it is correct.”*

(Shipping Company B)

Ground Transport Companies

Challenges for ground transport companies are related to the port rush hours. First, *lack of information* of queue statuses at port operators during cargo retrievals causes a difficulty to stay on schedule.

“Se on meille suurin haaste että kuinka voidaan pitää aikatauluja, jos ei tiedetä että kauan tuolla [operaattorilla] menee”	*“It’s our biggest challenge, how we can maintain staying on schedule when we don’t know how long it takes at the operators.”*

(Ground Transportation A)

Ground Transport Company A also mentioned that their one to many operation logic, combined with port queues and several daily visits to the port, minimizes *value adding capacity utilization* during a working day.

“Auton tuottavuuden kannalta, sen pitäisi kulkea 24/7. Tämä ei ole realistista mutta monen kuljettajan ansioista voidaan kulkea enemmän	*“From a productivity point of view, a truck should be running 24/7. This is not realistic, however with more than one driver we can*

kun 9-10 tuntia. […] Kuskit käyvät kolme-neljä kertaa satamassa päivittäin. […] Nyt kun on ollut jonoja niin pelkästään että kaksi konttia menee [yhden operaattorin nimi] ja kaksi nostetaan päälle, niin helposti menee 2 tuntia. Jos kuski saa ainoastaan keskimäärin tehdä 9 tuntia töitä päivässä ja tästä odotetaan satamassa 4 tuntia tienaamatta mitään, niin se on aika iso prosentti"

operate more than 9-10 hours. […] The drivers visit the port 3-4 times a day. […] Now that there's been queues, only by taking two containers to [one operator] and load two on top, it can take up to 2 hours. If a driver is allowed to work only on average 9 hours a day and 4 hours is spent in the port, it is a fairly high percentage."

(Ground Transport A)

Port Operator

The most prominent challenge for port operators was expressed as *resource management.* First, ship arrival times causes uneven division of labour throughout the day, resulting in having to *balance and allocate resources according to service peaks and lows*.

"Laivat saapuu aamulla ja lähtee illalla. Työt eivät jakaannu tasaisesti. Nämä on tällaisia tyypillisiä piirteitä sataman liittyen kun tässä on niin nopee tää läpivirtaus. Eli, tää koko kuvio ja sit miettiä se että..no se laiva on saatu purettua, no mitä sitten tehdään? Ja kaikki odottelee puoleks päiväks ja heitetään korttia jossai tai tikkaa. Et se et se täytyy miettii et onko lastia saatavilla? Voi tulla jonkilaisia gäppejä ja täytyy miettii et mihin niitä

"Ships arrive in the morning and leaves in the evening. Work doesn't split evenly. These are typical features related to the port as it has such fast throughput. So the whole scheme, if you think about it like this… well, the ship has been unloaded, what do we do next? Everyone waits until midday and people are playing cards and throwing darts. So you have to think about if there is cargo incoming? Some gaps can occur and one has to decide where to

resursseja siirretään. Se on sitä päiväsunnitteluu mitä täytyy tehdä etukäteen ja miettii et tarvitaanko siihen 50 miestä, vai 100 vai 130. Et se on sitä päivittäistä painimista”

allocate resources. This is planning on a daily basis, which has to be done in advance, if we need 50, 100 or 130 men. It is a daily hustle.”

(Port Operator A)

Another resource management issue was described as *balancing between full time and part time employees*, for which misestimating needs can lead to undesirable repercussions.

“Joo, siis siihen täytyy sit taas tasapainottaa sen kanssa että osa väestä saa olla vakituisella työsopimuksella. Sitten saa käyttää tilapäisiä tietyn prosentin määrän, mutta sitten jos käytät liikaa tilapäisiä nii siit tulee raipparangaistus eli joudut alkaa vakinaistamaan väkeä. Sit kun vakinaistat ja sit kun työtkin loppuu nii sit oot kierteessä ja irtisanomassa niitä , taas tulee lakkoja ja kaikennäköistä inhottavuuksia”

“And then you have to balance in regards of permanent employment contracts. Then you are allowed to use temporarily workforce to a certain percentage, but if you use too many you are punished and have to give permanent contracts. When you then have permanent employees and work terminates, you’re in a vicious circle laying people off, which leads to strikes and other appalling situations.”

(Port Operator A)

“Ne on suhteessa kallista palkkaista väkeä. Niitä ei pysty hirveesti ylimääräisiä ottamaan. Ööh, työehtosopimuskenttä on hyvin tiukka. Joustot on vähissä, eli se että operaattori saisi jotain

“They are proportionally an expensive workforce. You can’t take too many of them. Mmm, the area of collective labour agreements is very strict. There isn’t much flexibility, so ensuring that the

rahaa siitä välistä vaatii just sen työsuunnittelun.”

operator gets paid requires exactly a work plan.”

(Port Operator B)

Further increasing the complexity of resource management, was described as *lack of information from ground transport companies.* In other words, lack of information between the two stakeholders in question goes both ways. Whereas ground transport companies do not have knowledge of port operator queues, Port Operator B claimed that lack of knowledge of when and how many trucks arrive, results in operational difficulties.

“Ja sit jos haluut laajemmin nii just tää sama vaiva meilläkin on että välillä meil on töitä ja välillä meillä on iltavuorossa, silleen et jengi potkii kiviä ja syljeskelee kattoon. Eli just se et laivathan me tiedetään. Me tiedetään et about kuinka kauan niitten menee, kun meillähän on historiadataa vaikka kuinka… paljon meil on keskimääräinen teho ynnä muuta. Mut tää sama vaiva loppujen lopuks meilläkin et ei me tiedetä kuinka paljon tääl tulee käymään ajoneuvoja. Et jos meil ois paremmat tiedot et mikä meidän huomisenpäivän työurakka on, niin pystyttäis käyttää meidän resursseja tehokkaammin. Sehän on ihan herran hallussa et tuleeks niit [rekkoja] 10 vai 50 vai tuleeks illalla yhtään vai tuleeks kolkyt ”

“If you take a broader perspective, we sometimes have work to do and sometimes during the evening shift people are kicking stones and spitting on the roof. That is, we know about ships. We know approximately the time working with ships takes, as we have much historical data… the average effectivity and so forth. But we have the same problem, that we don’t know how many ground vehicles will be visiting us. So if we would have better information, we could plan the next day workload better and use our resource more efficiently. It is in the hands of the lord if we’re visited by ten or 50, or any vehicle is coming in the evening or thirty.”

(Port Operator B)

On another note, *human errors* were described as causing erroneous flow of goods, while *erroneous import information not matching actual outcome* was portrayed as in causing delays in unloading operations. This could be described in other terms as bad quality data. Typically, two containers have been mixed up, while reasons for it are manifold. For instance, bad weather conditions can block the visibility for container identification, while ship crew can cut corners by neglecting double checking cargo placements, despite obligations. Furthermore, work force was described as aging, thus lowering visual acuity, while equipment size is increasing, resulting in container misreading during cargo handling. However, it should be emphasized that container blunders only count for a marginally small proportion of overall volumes, yet they can cause an expensive bill.

"Unelmatilanne on se että kaikki mitä on meille ilmoitettu tulevaks ja näillä paikoilla niin se on oikeata. Silloin ei ole mitään epäselvää. Otetaan vaikka sata konttia ja ne on just niillä paikoilla mihin ne on laitettu [ilmoitettu]. Silloin kaikki menee hyvin, mutta sit voi esimerkiksi olla niin että koordinaatit ovat pielessä. Me ollaan jossain tietyssä ruumassa ja siin pitäis olla ensimmäisen kontin joku, mut siin ei ole. […] Aina kun tiedossa on jotain virheitä niin tulee extraa. Ei välttämättä hidasta, mutta työllistää enemmän. […]Aika ajoin meille tulee vääriä kontteja ja aika ajoin me lastataan vääriä kontteja. Yleensä sitä huomataan vasta kun se puretaan siellä toisessa päässä."

"The dream situation is that everything that has been informed to be incoming in addition to placements are actually correct. That means nothing is unclear. Let's say, we receive a hundred containers and they are exactly where they have been placed [informed]. Then everything goes well, but coordinates can be incorrect. We are working in a specific cargo hold and a specific container should be there but it is not. […] Every time an error occurs, it results in something extra. It doesn't necessarily slow us down, but causes more work. […] From time to time we receive wrong containers and sometimes we load wrong containers. Usually it isn't noticed until it reaches the receiving end."

(Port Operator B)

At last Port Operator B noted that despite *automation* technology exists, the small trade volumes of Finland does not justify *investing* in such equipment, even though wage rates are considered high.

"Suomessa on niin pienet volyymit, et semmoset [automaatio] investoinnit on niin isoja et ei se täällä vaan toimi. Toisaalta täällä on yksi euroopan korkeimmista palkkakuluista, et siinä mielessä jos volyymit kasvais niin palkkakuluista tulis hirveet säästöt"

"The volumes in Finland are so low, that [automation] investments can't be justified. On the other hand, here's one of Europe's highest wage rates, so in that sense if volumes would grow, one could make huge savings from wage costs."

(Port Operator B)

Depot Companies

Depot Company A recognized *space limitation* as challenge, due to increasing empty container volumes in addition to *high quantity job orders requiring lots of inspection space.* Furthermore, *negotiating for more space* was perceived difficult. *Lack of supporting technology for inspections*, did not either offer a solution.

Interviewee: " S*iis nyt varsinkin kun tää satama on näin kauheen pieni, niin tuota kun näit tyhjiä kontteja nyt tarvitaan tänne kasvamassa määrin enenmmän, niin niit tulee tuolt laivoilta satoja kontteja kerrallaan, niin se alue on liian pieni siihen toimimiseen. Meilt loppuu yksinkertaisesti täält kenttätila. ... nii meidän pitää sitten vielä tietenkin meidän saada ne kontit leväällen siihen maatasoon"*

[...]

Interwiewee: "Especially now that the port is so small, while containers are needed here in growing numbers, so ships bring them in hundreds at a time, so the area is so small that we run out of space to work here. We need additionally to get the containers spread around on ground level"

[...]

Interviewer 1: "Could some sensors or technology help with the issue?"

Interviewer 1: ”Voisiko jotkut sensorit tai teknologia auttaa tässä?”

Interviewee: ” Ei pysty. Ei ole semmosia laiteitta… ei ole olemassa. Ne on fyysisesti katottava.”

Interviewee: “No. Such equipment doesn’t exist. You need to inspect them physically.”

(Depot Services A)

Despite introducing new technology to support ground transport services, Depot Company A similarly as the port operators found *lack of information on truck arrivals* as problematic.

“Siinä vois tietysti pientä parannusta, koska nythän me otetaan käyttöön tuo niitten itsenäinen ilmoittaminen, sellainen applikaatio, niin siinä mielessä vois olla tietysti et tietäis mistä kaukaa ne [kuljettajat] on ittensä ilmoittanut, koska meillähän on nyt ongelmana se että voi periaatteessa ilmoittautuu aamulla klo 7 ja se tulee se auto illalla klo 10 ja ollaan ihmetelty koko päivä et missä se kontti on”

“Well there’s a chance for minor improvements, as we are now taking into use independent notifications, an application, so in that sense it would be good if one would know how far out they [truck drivers] have notified their arrival, because currently someone can make a notification at 7 in the morning and the truck arrives at 10 o’clock in the evening while we have been wondering all day where the container is.”

(Depot Services A)

Regarding information, *late information from shipping companies* was further perceived as causing pressure to execute tasks.

*“*T*ääl pitäis salaman nopeasti reagoida siihen ja meiltä ku odotetaa vielä sitä, tietyist linjoista*

“Here we need to react lightning fast and we are expected to do that, by certain customers, as they

riippuen, nii ku ilmoitetaa vaikka perjantaina että tuota 30-40 konttii on saatava laivaan… koska konttoristi lähtee klo 16 kotiin. Et vai että no niin, siinä sitä taas [naurua] Et ei ymmärretä sitä et ei tääl tapahdu tiekkö, kun meil on kaiken maailman juttuja tehtävänä et ei me voida kaikkee miehistöö laittaa tekemään vaa yhtä asiaa"

inform on Friday that they need 30-40 containers to a ship… because they leave the office at 4 PM. Then you'll be like okay, it's like that [laughter]. There's no understanding that stuff just doesn't happen, do you know, we have several things going on and we can't allocate all our employees to do just one thing."

(Depot Services A)

On the other hand, the exchange area presents a unique challenge for depot companies, due to *lack of equipment required to lift full containers.*

"Nii, tai siis niin kuin vaihtoalueet… sanotaan vaik sillei kun siel on tyhjii ja täysii kontteja tuol vaihtarilla, nii jos ne pystyttäis pitää erillään. Koska nythän siellä voi olla silleen esimerkiksi vaihtarilla et meil on alarivi täynnä tyhjiä kontteja ja sinne päälle on ajettu lastikontteja. No meidän koneillahan niitä lastikontteja ei voi siirtää pois kun ne ei jaksa nostaa niitä"

"Well, the exchange areas… let's put it this way, there are full and empty containers at the exchange area and it would be good if they could be kept separately. Because currently, we can have the bottom of a stack full of empty containers and someone has brought full containers on top. Well, our equipment cannot lift the full containers."

(Depot Services A)

Finally, the whole business was considered tough in terms of profitability.

*"*S*iinä on sitten omat haasteensa, että kun asiakkaat ei tietysti haluu maksaa kauheen paljon vuokraa ja sataman vuokrat taas on ihan*

"That presents its own challenges, because our customers don't want to pay high rent and the rent for the port is very large, which we pay

hirveet, eli me maksetaan joka tapauksessa ja sit se saatu raha siitä mitä siellä säilytetään, nii ne ei kyllä tällä hetkellä oikein kohtaa. Tää on haasteellista tällainen tyhjien konttien korjaamon pyörittäminen, et ei se oo nii yksinkertaista"

regardless and the rent we receive, well these two does not really match currently. It is challenging to run a workshop for empty containers, it isn't that simple."

(Depot Services A)

Digital Infrastructure Providers

Digital Infrastructure Provider C mentioned a challenge they had encountered, directly related to the port ecosystem. Despite currently having a 5G network solution to offer, a non-technical problem of international frequency allocation and regulation surfaces, whereas deployed technology cannot automatically be used for shipping companies abroad.

"Meillähän on tällä hetkellä tarjota sellainen 5G pohjainen verkko, sekä satamille että laivoihin. Teknologisesti sitä ei estä mikään, mutta se haaste mikä tulee on se että eri maissa on erilainen regulaatio käytettävistä taajuuksista. Eli jos Suomeen on rakennettu satamalle jollekin tietylle taajudelle, esim jonkun operaattorin taajuutta käyttäen, niin tätä taajuutta ei voi käyttää todennäköisesti Rotterdamin satamassa koska siellä on erilainen regulaatio. Meille tulee haaste siihen että kuinka näitä taajuuksia

"We have at the moment a 5G based network to offer, both for ports and ships. From a technology perspective there is no hinders, but our challenge emerges as countries have separate regulations regarding frequencies. So if something has been built in Finland, using for instance some tele operators frequencies, likely this cannot be used in Rotterdam port as they have their own regulation. Our challenge is thus that how can our equipment manage these frequencies sufficiently?"

meidän laitteiden osalta pystytään
hallinnoimaan sujuvasti?"

(Digital Infrastructure Provider D)

Summary

This part presents challenges in the port ecosystem, which are summarized in Table 6.

Table 6. Summary of challenges

Level	Characteristics
Global	*Interest Misalignment, quantity of international stakeholder & political power structures*
	Scaling issues
	Manual information production
	Separation of goods and containers
	Differing technological needs, dependent on container location
Europe	*Collaboration Disinterest in System Development*
	Slow Development
Finland	*Data quality & inconsistencies in authoritative systems*
	Power Balances
	Barriers for IoT utilization
Port	*System integration*
	Fierce Competition
	Platform ownership
	Sensitive Data in manifest
	Strong Unions
	Exchange Area: limited space, mismatch of input and output, lack of information, task prioritization, sub-optimal governance, misuse, sub-optimal information exchange, saafety
	Rush hours: End customer delivery hours, one to many principle, lack of information, random events
Authorities	*Authoritative IS insufficient*
	Lack of inforamtion
	Time pressure

	Human intuition and experience
Shipping	*Container Allocation*
	Real-time sensing
	Late booking information (RORO)
	Validity of information (RORO)
	Intense Customs Inspections (RORO)
Ground Transport	*Lack of Information from operators*
	Value Adding Capacity Utilization
Port Opertor	*Resource management: peaks and lows, full-time employees*
	lack of information from ground trasnport
	Human Errors
	Import information does not match outcome
	Automation Investments
Depot	*Space limitation*
	High quantity job orders
	Lack of technology for inpections
	lack of information from ground transport
	Late information from shipping companies
	Lack of equipment to lift full containers
	Profitability
Digital Infrastructure	*Frequency allocation and regulations on an international level*

8.4. INTER-DEPENDENCIES AND OPPORTUNITIES IN THE PORT ECOSYSTEM

This part of the thesis presents inter-dependencies between characteristics and challenges in the port ecosystem, while introducing opportunities presented for port development. Inter-dependency diagrams have been created in regards of the most pressing issues, as well as the opportunities with the most prominent links to different characteristics and challenges. More specifically, four diagrams are provided, while the remainder of this chapter presents additional opportunities raised in the workshop and the interviews.

In the diagrams, the characteristics and challenges associated with the different hierarchical levels are color coded in the corresponding figures with red for challenges and blue for characteristics.

Opportunities presented in this section have a direct impact on port proceedings, while smoother operations and fluid throughput results in a more attractive port further complementing the collective value offering of the port ecosystem presented in the value network segment:

"Jos me pystytään parantamaan sataman läpivirtausvauhtia, niin satama toimii tehokkaammin ja siitä saa varustamot kuulla josta syntyy mielikuva että Vuosaaressa kaikki toimii ja silloin on isompi intressi tulla yksinkertaisesti Vuosaareen. […] Satama palvelee laajaa joukkoa ja on tärkeää että satama toimii"	*"If we're able to improve the throughput flow of the port, so that the port functions more efficiently and shipping companies hears about this, a notion of the port operating well emerges and the interest to use the Vuosaari simply grows. The port serves a broad scale of stakeholders and it is important that it works."*

(Authorities C)

Global Characteristic of Container Ownership

Taking a top to bottom approach, interdependencies are examined starting from the global characteristic of *shipping company container ownership*. Figure 17 presents the interdependencies and opportunities that arises.

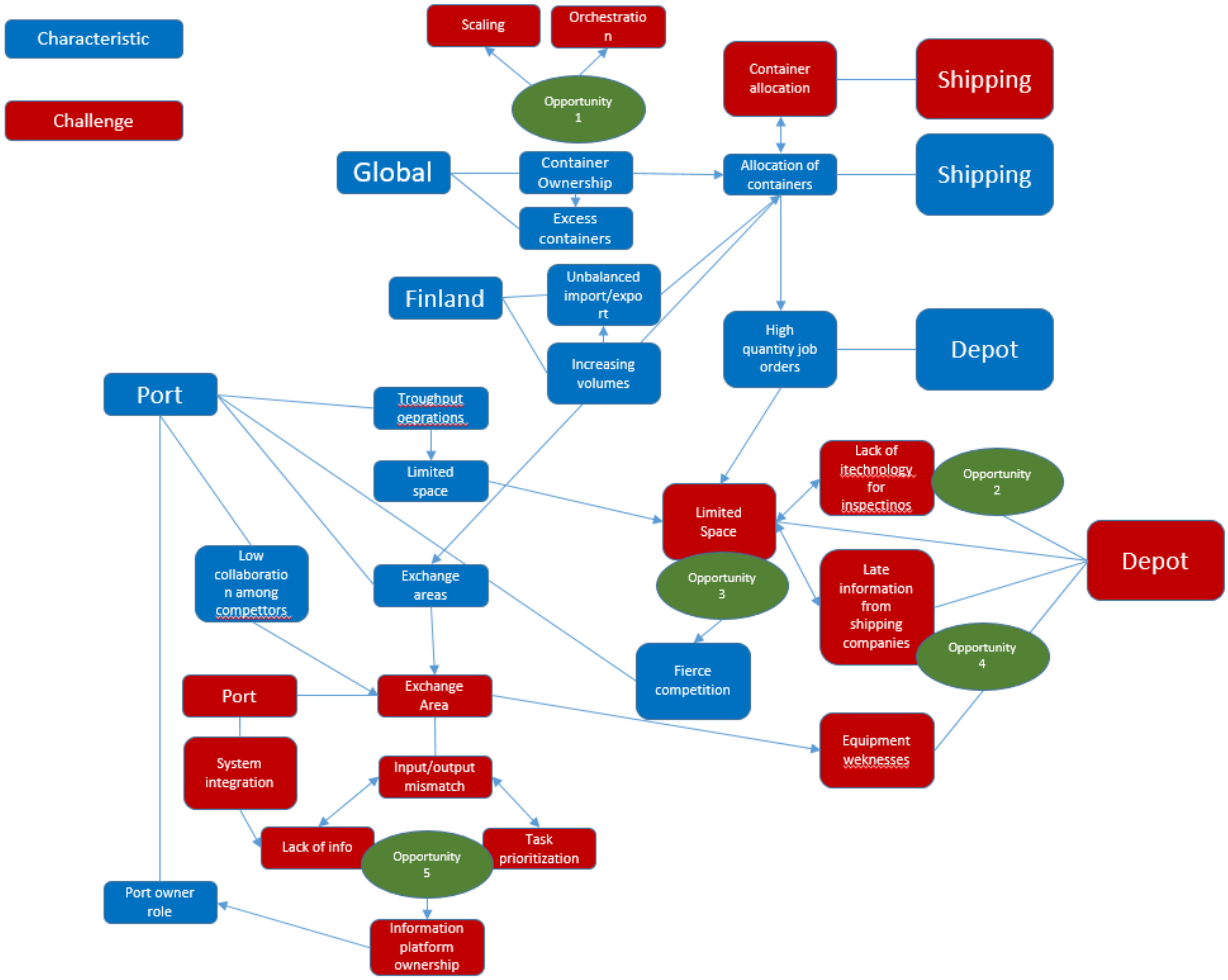

Figure 17. Inter-dependencies related to the characteristic of container ownership

The global characteristic of shipping companies owning their containers, means an excess number of overall containers on a global scale. Furthermore, it means a need for shipping companies to allocate empty containers to Finland as a direct cause of unbalanced import and export, as explained earlier. Increasing volumes will further increase the future need of empty containers. Empty container allocation also means that shipping companies are not able to utilize full capacity of their ships for value adding transportations.

Allocating containers in high quantities, results in high quantity job orders for depot companies. Consequently, the challenge of limited space, related to the characteristic of the port being designed for throughput operations, puts pressure on depot companies due to restricting the operative area of the depot. Furthermore, by not having access to technology supporting inspections, while containers need to be placed

on ground level for inspections, increases the limited space challenge. Additionally, late information causes depot companies to work under strict time constraints. At last, empty container allocation results in the need of the exchange area, consequently causing challenges related to this, of which one from the depot company's perspective is the lack of equipment to move full containers, in cases whereas empty ones needed to be retrieved are stacked underneath full containers. Not merely restricted to empty containers, the exchange area presents also general problems, whereas non-communicating information systems and low collaboration among competitors slows down throughput. At last it should be noted that, unbalanced import and export in addition to increasing volumes, while not being static characteristics, are dependent on factors which cannot be manipulated by the port ecosystem. On the other hand, attributes related to the exchange area, does not exceed the hierarchical level of the port, indicating a more fruitful prospect for successful development efforts.

Five separate opportunities were raised related to the attributes presented above.

Opportunity 1: *containers as a shared resource among shipping companies (Level: Global).* While discarding current container ownership practices would reduce the total need of of containers in rotation, the reason for ownership explained earlier sets a high barrier for shipping companies to terminate the practice. The opportunity was described as having a large impact on the maritime industry, further increasing an adaption barrier.

"Business menisi hyvin erilaiseksi, jos lähettäis miettimään yhteisiä kontteja"	*"The business would change drastically, if we started to think about shared containers."*

(Shipping Company C)

The global challenges of orchestration and scaling, would also play a crucial role in successful change. In conclusion, opportunity 1 presents itself as an unrealistic endeavor.

Opportunity 2: *Technological support for container inspections (Level: Depot and Shipping Company)*. Despite the claim of human touch required for inspections, to detect for instance smell, certain technological solutions were presented for supporting inspections.

"Tos on nyt ollut kehitteillä semmosia laitteita, jotka värähtelytekniikalla, niin kuin ilmoittais jos siel on reikiä tai muuta, mutta edelleen ollaan siin ongelmassa et se ei ilmoita, et haiseeks se, onks se likainen"

"There's been equipment under development, which using vibration technology could inform if a container has a hole or something else, yet the problem still remains that it does not inform if it smells, or if its dirty.."

(Depot Services A)

"Kuulin start-upista joka hyödynsi painesensoreita, joilla pystyi seurata että onko kontissa pullistumia"

"I heard about a start-up, that uses pressure sensors with an intent to keep track if a container has bulges."

(Port Operator B)

Shipping Company A also mentioned the possibility of image analysis, which would allow monitoring the condition of a container. It would further allow shipping companies to ensure cargo would not be compromised, by enabling timely information to be used for taking measures in case of container damage. Thus, the benefits would exceed serving merely a single actor in the ecosystem.

"Semmonen kuva kun sais, et just kun se kontti on irrotettu siitä (nosturista) ja jätetty laivaan tai jötetty laivaan, no periaatteessa kun se on nostettu/nostetaan laivaan ja otetaan irti, nii siitä kuva katosta ja sitten taas kun se tulee seuraavaan satamaan, nii siinä just se nappaa sen kuvan. Saatais myös aikaisemmin tietää että vaikka Rotterdamista heti tieto että nyt siinä meni viallinen kontti, niin sen vois vaikka paikata siinä paikan

"If you could get an image, right after the container has been released from the (crane) and placed onboard the ship, well actually when it is released/being lifted from the ship, an image of the roof and then the next picture is taken when it arrives to the next port. We would get notified earlier, for instance immediately in Rotterdam that something has happened and a container is faulty, so it could be repaired there and no

päällä eikä tulis sitä lastivahinkoa. Jos jollain tapaa sais sen indikaation siitä et nyt se reikä on sinne syntynyt, niin se ois arvokasta tietoa”

damage would be caused to the cargo. If you would somehow get some sort of indication of a hole, that would be valuable information.”

(Shipping Company A)

At last the concept of developing a digital twin for containers, able to anticipate maintenance needs was regarded as an interesting opportunity.

Interviewer 1: “Olemme miettnineet asiaa, jossa kontilla olisi historia eli tietyllä tapaa kontin digital twin, jolloin esim tekoälyn avulla voisi ennakoida milloin on korjaustarpeita jne”

Interviewee 1 & 2: ”Se olisi todella kiinnostavaa!”

Interviewer 1: “We’ve been thinking about, if the container would have some sort of history, a digital twin of sorts, which would be capable of i.e. using AI to predict maintenance needs and so forth.”

Interviewee 1 & 2: “That would be very interesting!”

(Shipping Company C)

If the need for human labor cannot be mitigated fully, at least an opportunity presents itself whereas processes can be made more efficient, by achieving information about possible repairs in advance. It should be noted however, that as containers are shipping company’s property, the initiative for equipping containers with sensors needs to be made by said companies. On the other hand, image technology is dependent on port operators lifting equipment, indicating that an optimal solution is dependent on multiple parties.

Opportunity 3: *Increased space allocation (Level: Depot):* In order to ease depot companies’ pressure on inspection processes, depot company A proclaimed that a simple solution as more space, would support their practices. An increased need for more space was furthermore recognized by Authority C.

"Toistaiseksi on vielä tilaa tyhjille konteille, mutta alkaa pikku hiljaa tulla aika laajentaa tyhjien konttien tila allokaatio"

"For the moment, there is enough space for empty containers, but the time for expanding the space for empty containers is relvenat shortly."

(Authorities C)

Opportunity 4: *More timely information received from shipping companies (Depot).* At last, timely information would support pre-planning of processes, allowing empty containers to flow more smoothly within the port.

"Nii, et sekin et jos ne haluu jotkut kontit aikaisemmin nii sit pitäis ilmoittaa meille etukäteen, et tämmönen juttu, et me voitais tehä se keikka niin kuin valmiiks"

"Well, also if they want certain containers earlier, we should be notified in advance, that this sort of job, so that we could prepare it properly."

(Depot Services A)

Opportunity 5: *Shared IT system and real-time information flow (Level: Port)*. The participants saw a solution for the exchange area as a shared IT system, which would allow for faster output through simultaneous container delivery and retrieval from the area. Furthermore, enabling the system to recognize container placement in the exchange area would mitigate extra unnecessary steps of first finding the containers, consequently increasing efficiency. On the other hand, platform ownership was perceived as a port challenge, meaning an open question of who is responsible for operating the system. Yet, as the exchange area is neutral ground, the port owner would be a natural candidate, however earlier mentioned Authorities C expressed an uncertainty regarding the role it should take within the ecosystem.

"Mieti jos sulla on 50 sellukontin erä, se ei lähetä real time:na. Siit hetkest kun se vie ekan kontin, niin vastaanottaja voisi alkaa ottaa niitä, mut se oli semmonen et sen

"Think about this, if you have a batch of 50 pulp containers, it doesn't send information in real time. From the moment the first container is brought, the recipient

piti eka viedä kaikki 50 ja sit vasta sanoo et sul on 50 konttii siellä. Mä *oon ehdottanut jo kauan aikaa sitten et pitäisi tehdä joku järjestelmä, jota Helsingin Satama, joku ns moottori tai softa et siltä joka vie sinne kontin, niin siltä lähtis automaattisesti EDI viesti tähän järjestelmään ja siinä näkyis koko ajan että montako konttii siellä on ja kelle ne on. ”*

could start fetching it, but first you have the bring 50 containers and only then inform that they are there. I've suggested already a long time ago, that a system should be developed, that the Port of Helsinki, or some party or software, that when a someone brings a container there, a automatic EDI message would be sent to the system and you could see all the time that how many containers are there and to whom."

(Port Operator B)

"Sehän ois aivan loistavaa jos se vaihtoalueelle sä viet ne kontit, nii se tieto lähtis johonkin ohjelmaan tai ihan mihin vaa et ne on tässä. Ne on oikeesti tässä, nyt ei tarvii enää mennä ettii, et vastaanottaja tietää et "jaaha, siinä ne on"

"It would be magnificent if a information would be sent to some software or whatever when you bring containers to the exchange area informing their status. They are here for real, you don't have to go looking for them, but the recipient knows that "okay, here they are"."

(Depot Services A)

Global Characteristic of Trade Arrangements and Documents

The global characteristic of trade arrangements and documents presents a less complex inter-dependency figure compared to container ownership, yet it has its own ramification and a concrete opportunity regarding the matter was raised by the participants of the study.

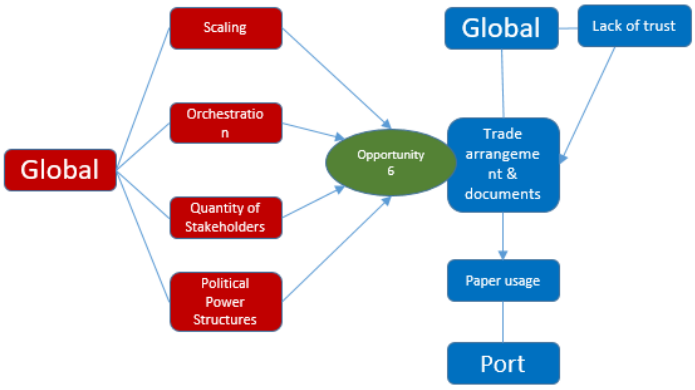

Figure 18. Inter-dependencies related to the characteristic trade arrangements and documents

First, the trade arrangements of reimburse trade in addition to bills of ladings are a result of lack of trust between trade partners. This in turn results in high paper usage in Vuosaari Harbor, despite an effort to decrease the use of paper.

Opportunity 6: *Digitization of trade documents (level: Global)*. Shipping Company C expressed a desire of digitizing trade documents, while anticipating a shift within a couple of years.

"Jos sais valtakirjan digitaaliseksi ja automatisoiduksi. Parin vuoden sisällä voi odottaa."

"If you could get the bill of lading in digital form and automated. It will happen within a couple of years."

(Shipping Company C)

A concrete solution for the effort was presented in the form of blockchain developments.

"Se on paperinen dokumentti vielä, mutta nyt kun me istutaan tämmösessä digitalisaatiotyöpajassa niin tähänkin ollaan tällä hetkellä kehittämässä lohkoketjuun

"It is still a paper document, but as we are sitting in a digitalization workshop, currently a blockchain based bill of lading is under development, which is very

perustuvaa sähköistä konossementtiä, joka on erittäin mielenkiintoinen. Mä seuraan tämmöistä projektia kuin Cargo X tällä hetkellä, koska… jos mä saan polttaa nyt pari minuuttia? Jos tämä menee läpi tää lohkoketjuun perustuva sähköinen konossementti, niin se poistaa tän koko rumban siitä välistä ja paperia ei tarvitse pyörittää pankista toiseen ja kuskata fyysistä lappua, lennättää tuolla maailman taivaalla, vaan sitä voidaan sähköisesti siirtää, jos puhuin siitä öljyn myymisestä siinä matkan varrella, et sitähän voidaan diilata päivän mittaan viis kertaa sitä samaa lappua, eli se lähettiparka jouksee nyt pankista toiseen hakemassa sitä lappuu minkä se just vei sinne, niin me voidaan tehdä se hyvin nopeesti sähköisenä. Todentaa että tämä on aito ja sille joka tän mulle myi on oikeus myydä sen"

interesting. I'm following a project called Cargo X at the moment, because… if I am allowed to use a couple of minutes? If this blockchain based electronic bill of lading goes through, it mitigates the whole shenanigan of shuffling papers between banks, deal with a physical paper, fly it across the world, but it can rather be transferred electronically, when I talked about selling oil along the logistical journey, the paper can be dealt five times during a day and the courier runs from one bank to another, however we could transfer this very fast electronically. We could authenticate that it is real and the one who sold it has the right to sell it.."

(Port Operator A)

Yet again, orchestration, acquiring a critical mass for adaption, scaling, and political power structures might slow down or hinder development. However, it was noted that large global companies can be able to sway opinions and function as frontrunners, which was portrayed through an example of an earlier development effort.

"Se on ehkä enemmän tää skaala se haaste, et teknisesti ei oikeastaan ole mitään vaikeaa, mutta kaikkien

"It is the scale that is problematic, technically there is nothing that difficult about it, but everyone

pitäisi yhtä aikaa päättää et tehdään nyt näin. [Name of a global shipping company] punnitsi kontteja kauan aikaa ennen kuin tuli jotain VGM:ii, et ne ilmoitti Aasiassa että ne nostaa kyytiin ainoastaan punnittuja kontteja. [Shipping company] voi tehdää niin ja yleisesti ne on edelläkävijöitä"

should decide simultaneously that this is how we are doing things from here on. [Name of a global shipping company] weighed containers long before the introduction of any VGM:s, they just informed that they won't take anything onboard in Asia unless they have been weighed. [Shipping company] can do this and in general they are frontrunners."

(Port Operator A)

Global characteristic of Scattered Data Production

Figure 19 presents inter-dependencies for the global characteristic of scattered data production.

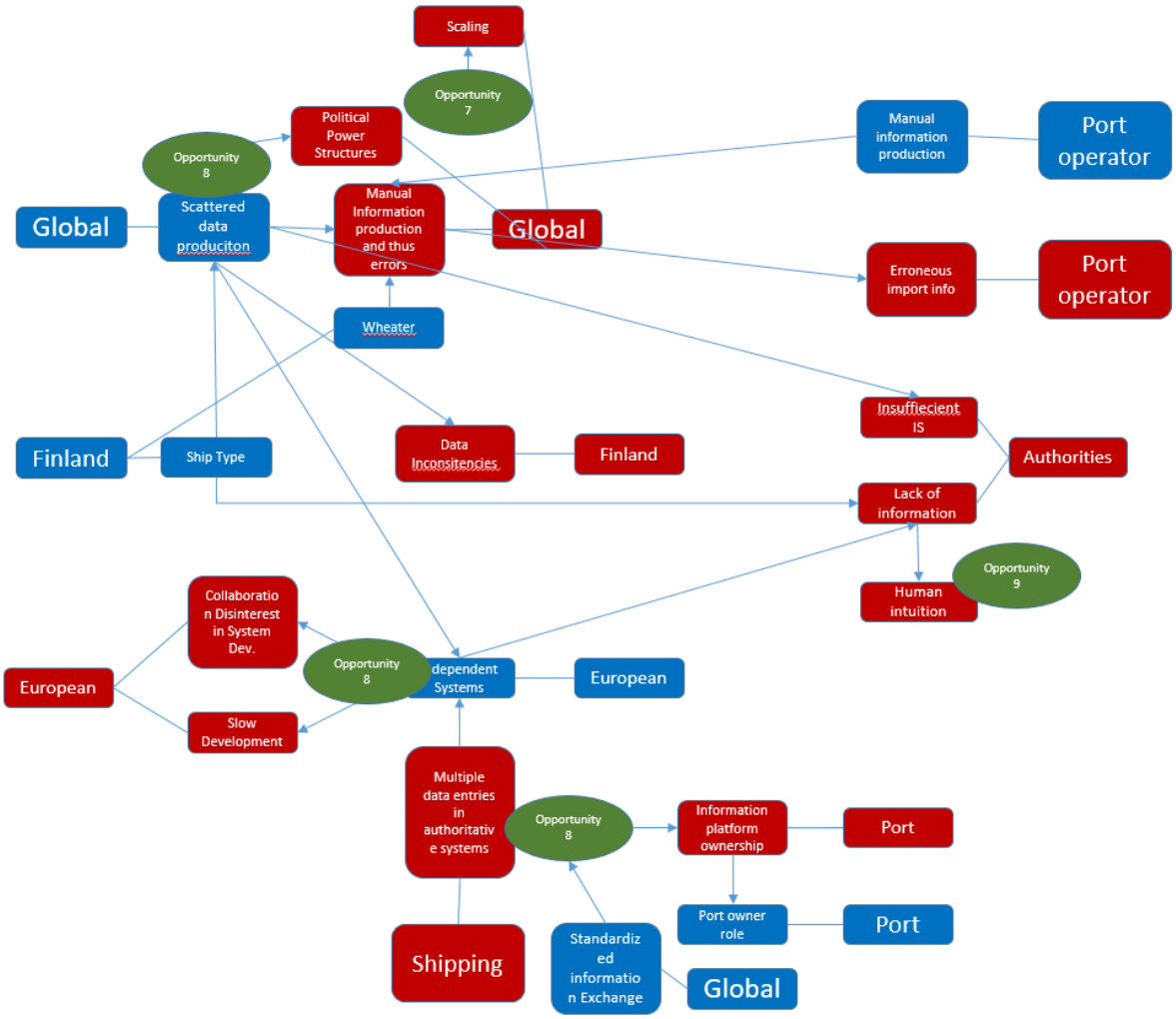

Figure 19. Inter-dependencies related to the characteristic scattered data production

As data production is scattered along the cargo journey in addition to data being manually produced, it causes unreliable flow of goods, which can be seen as import information not matching outcome at port operators. Yet, port operators are part of data production and by doing so manually, they contribute to the problem. From a Finnish perspective, weather conditions during winter, causes container misplacements on the port operators' field, and due to manual data production wrong containers are exported, which in turn is detected at the receiving ports' operator.

Scattered data production can also be seen as in feeder ships handling cargo flow to Finland, and while the EU has several independent authoritative systems, the information reaching Finnish custom officers is insufficient. As the EU systems further does not communicate, data inconsistencies occur in Finnish authoritative systems, making custom officers' operations increasingly difficult. The lack of

information, results in customs relying on human intuition and experience in turn. Furthermore, the independent systems, requires shipping companies to make several overlapping information entries.

Opportunity 7: *Automated data production by port operators (Level: Operator, Shipping and Global)*. In order to mitigate human made errors in data production, automating data entries in information system was presented as an opportunity. Possibilities were presented as new technology bringing new functionality to port operator equipment. Furthermore, Port Operator B explained that equipment supporting this practice had been ordered and will be used in the near future.

"Jos konttinosturin olisi joku lukupää ja kontissa joku lähetyspää, niin silloinhan kaikki ihmisten tekemät toteamat, että onko tää nyt tää numero ja toi nyt toi numero jäisi pois. Eli jos nosturissa olisi joku tämmönen älyjuttu, et sil ois tietoa mitä kontteja se ottaa ja sillä on joku tämmönen millä saa tiedot et mitä kontteja se ottaa nii sehän osais tavallaan ite valkata ne kontit. […] Meille on tilattu uus konttinosturi joka tulee meille ensi vuoden maaliskuussa ja siihen tulee tää Dynamic Position System, eli siihen ohjelmoidaan sitä meidän konttikenttää, niin kuin valmiiks positioita ja sitten jos täältä liikenneohjauksesta käsketää laittaa se johonkin paikkaan niin se vie sen itte niin kuin sinne. Tässähän on hirvee mahis inhimilliselle virheelle, kun se on mekaaninen se

"If the container crane would be able to read information and a container could send information, then all human made errors would cease, so there would be no more guessing if this is that number and so forth. So if the container would have some sort of smart functionality that would enable it to know what container it picks and it would have something that lets it know what containers to pick, it could do in a way choose them independently. […] We have ordered a new container crane that will arrive in March and it will have this Dynamic Position System, where we program our field into it and can order it to put a container at a certain position and it drives it there by itself. There's a big chance for human errors, as the positioning system is manual and you can have snow and ice and a container can be put to row 30

paikannusjörjestelmä siellä ja esimerkiksi kun on lunta ja jäätä nii se laittaa sen riville kolmekymmentä [34 sijaan]. Senhän takia näitä kontteja menee väärin"

Interviewer: "Kuvantunnisteet mahdollisuutena?"

Interviewee: "Sellainen meille on kait tulossa."

[Instead of row 34]. That's why faults happen."

Interviewer: "Image recognition as a possibility?"

Interviewee: "I think we are getting that."

(Port Operator B)

Specifically, image recognition was mentioned by Shipping Company A, as an opportunity that could further possibly mitigate the single largest reason for customer complaints: damaged containers and thus damaged goods. The opportunity would require automated image recognition equipment at port operators, whereas discreet supervision of the container condition during each container handling procedure could reveal possible defects and trigger precautions.

Scaling is an issue related to the opportunity regardless of the approach of the solution, as human errors will not be mitigated entirely before all port operators have modern technology in use.

Opportunity 8: *Single Window Information Systems (Level: Global, Europe and Port).* Single window information system, with a purpose to reduce scattered data production, were presented as an opportunity on three levels. On a global scale however, despite efforts by the IMO as explained, political power structures and lack of will hinders development and implementation. In Europe on the other hand, the opportunity was perceived as more realistic for authoritative systems, yet development was considered slow, while disinterest in abandoning current systems reinforces slow development. Such system would however, make shipping companies mandatory information provision easier, while also supporting custom officers by a possibility to attain more detailed information.

The participants of the study saw also an opportunity in implementing a more general single window solution on the port level, not restricted to merely authoritative information, but rather functioning as a platform with API's enabling different systems to have access to appropriate information in the platform. Authorities B suggested that authoritative information standards present a further opportunity to develop such a platform. The opportunity would further lower the barrier to break current pipe-like and integrated business relationships, in both good and bad, while opening opportunities for optimization.

"Paras ois yks purkki täällä suomessakin, johon laitetaan just mitä mä huumoilinkin, et laitetaan kaikki data sinne siitä laivasta, sen lastista ja sen konteista."

"The best would be one "can" here in Finland, where you put, as I imagined, all data from the ship about its cargo and containers.."

(Shipping Company A)

"Minä haaveilen että joku tällainen open platform periaattessa, jossa menis kaikki tieto konteista, tavarasta ja sisällöstä. Sit siinä on sellaisia rajapintoja joita avataan… tai mulle avautuu se tieto mikä mulle kuuluu. Se olis aika unelma, jos pystyisin reaaliajassa näkee joka ikinen lastiyksikkö joka on satamassa ja miten ne liikkuu siellä, koska sit kun sä näet logistiikkavirrat satama-alueella, niin silloin sä pystyt optimoimaan kunnolla. Ja jos se on avoin, niin kuka tahansa voi käydä katsomaan niitä tietoja ja joku fiksu keksii sen hyvän optimointitavan ja myy sen ratkaisun vaikka meille"

"I dream about an open platform, where all data from the container and its cargo would be gathered. Then it would have open boundaries… or I can access data that belongs to me. It would be pretty nice, if I could monitor in real-time every single cargo unit at the port, because then you can see the logistic flows in the port-area and optimize properly. And if it's open, anyone can look at the information and someone smart will come up with a good optimization solution and sells it to us.."

(Authorities C)

Yet, platform ownership is an open question regarding such a system, as explained earlier. Several alternative solutions were presented, ranging from centralized to decentralized systems and ownerships, in addition to both closed and open platforms, as was suggested by Auhorities C above. Shipping Company C in turn, presented an upcoming centralized and privately-owned solution.

Port Operator A: "Onko viranomaisella sitten intressiä ylläpitää tällaista? Että itsellä tulee mieleen ehkä vähän uudemmat teknologiat ja ajatukset siitä, että kun siel on kuitenkin paljon tietoa mistä pitää kuitenkin rajoittaa kenellä on pääsy niihin. Että äkkiseltä tulis taas vähän mieleen lohkoketju. Että sieltä pystyttäis todentamaan ensinnäkin et se tieto on validia. Ja sit voitais alkaa tutkia et kenellä on siihen pääsy, mut kuitenkin kaikilla ois se tieto, elikkä se ei ois kellää yksittäisellä viranomaisella, vaan se pyöris kaikilla yhtäläisesti hajautettuna. Niin mä näkisin et semmonen ois järkevin"

University Staff: "Sittenhän tarvittais jonkun näköinen alusta, jossa se tieto sitten ois yhteismitallisena ja tavallaan yleispääsykeinot siihen, mut sit on vaa rajattu ne oikeudet ja sit jollai lohkoketjulla sitten seurataan sen tiedon hakemitsa ja kulkemista

Port Operator A: "Is it in the authorities' interest to manage such platform in the first place? I at least am thinking about newer technologies and whilst there is a lot of data that has to be limited in terms of access. Blockchains comes quickly to my mind. First, one could authenticate that the information is valid. Then one can start investigating who can access the data, yet everyone would have it, so it wouldn't be only at one authoritative figure, but it would rather be decentralized. I would consider it the most reasonable alternative.."

University Staff: "Then it would require some sort of platform, where the data would be and some basic access functionality, however with rights limitations for who can access it, may it be using blockchains and then you should be able to follow the data journey, but it would require a platform which centralizes the information. It can

siellä, mut silti tarvittais joku alusta, joka ikään kuin keskittää sen tiedon. Se voi olla hajautetusti tuotettua, mutta miten siihen pääsee… tai hajautetusti säilytettyäkin, mutta miten siihen pääsee eri systeemien kanssa? Et voisko siinä olla joku konsortio, vai onko se sit helsingin satama, vai onko se liikennevirasto. Et kenen tavallaan pitäis semmonen pistää pystyyn, vai voisko se olla yritysryhmittymä, joka sen polkasee?"

Shipping Company C: "Mä voisin mainita siitä että [name of shipping company] ideana on tällainen hanke joka tulee olemaan avoin myös muille toimijoille, toki tietoa siitä saa vaan ne jotka siihen kuuluu, mutta keskusteluja on käyty myös aika paljon hallitusten ja tullien ja tällaisten kanssa"

be produced decentralized, but how can it be accessed… or even storage could be decentralized, but how can you access it with different systems? Could it be a consortium, or is the Port of Helsinki, or is it the Finnish Transport Agency? Who should initiate it, or could it be a grouping of companies who starts it?"

Shipping Company C: "I could mention that [name of shipping company] has this idea about a project, which will be open to others, of course information is only available to those being part of it, but discussions with customs and governments have taken place."

Authorities C provided a view, whereas despite having mixed contemplation around the role of the port owner, a neutral facilitator providing holistically beneficial services might be necessary in the future.

In the case of a consortium, Port Operator A made an observation that a large amount of data is shared without a charge and the possibility of monetizing data, could provide a means to run and develop an information platform, regardless of governance model. Yet, a consortium requires good collaboration ties and taking into consideration the fierce competition of port actors, establishing a consortium presents its own challenges.

"Että voisko kehittää sitten tällaisen yhteisen alustan, sen sijaan että tulli jakais tätä dataa ja oisko se sitten Helsingin sataman tehtävä pyörittää tämmöst tai kenties jonkun konsortion jossa olisi useampi yritys. Ja tähän ehdotettiin kans just tätä tiedon monetisointii, eli jos olis just periaattessa parempii kannustimia tiedonjakamiseen, niin tavallaan sitä vois sen puitteessa kehittää?"

"Could a shared platform be developed, instead of the customs running it, would it then be the Port of Helsinki or some consortium with several companies. And as was suggested about data monetization, if there would be better incentives to share data, could that provide a means to develop it?"

(Port Operator B)

It should further be noted, that a shared system could additionally support information needs for the previously raised issue regarding the exchange area.

Opportunity 9: *Machine learning as support for customs officers (Level: Authorities and Port).* In order to reduce drawbacks of current risk analysis systems for customs officers, while simultaneously even out issues brought forth by human intuition and experience factors, machine learning was perceived as a good opportunity. Furthermore, better formed inspection decisions would benefit the port as a whole by reducing unnecessary inspections and thus improve flow of goods.

"Ilman muuta kokisin että ois hyvä asia, koska nyt on selkeä ero että on sähköinen systeemi ja sit on meidän tällainen ihan perustuen suurin piirtein näppituntumaan. Tähän väliin olisi hyvä se, että näitten väli tasantuisi."

"I certainly think it would be a good thing, as currently there is a clear distinction between an electronic system and our gut feeling. It would be great to even this gap out."

(Authorities B)

Finnish Characteristics of Cyclical Fluctuation, End Customer Dictated Delivery Times, and Just-In-Time Production

Figure 20 presents inter-dependencies stemming from the Finnish characteristics of Cyclical fluctuation, end customer dictated delivery times, and Just-In-Time production.

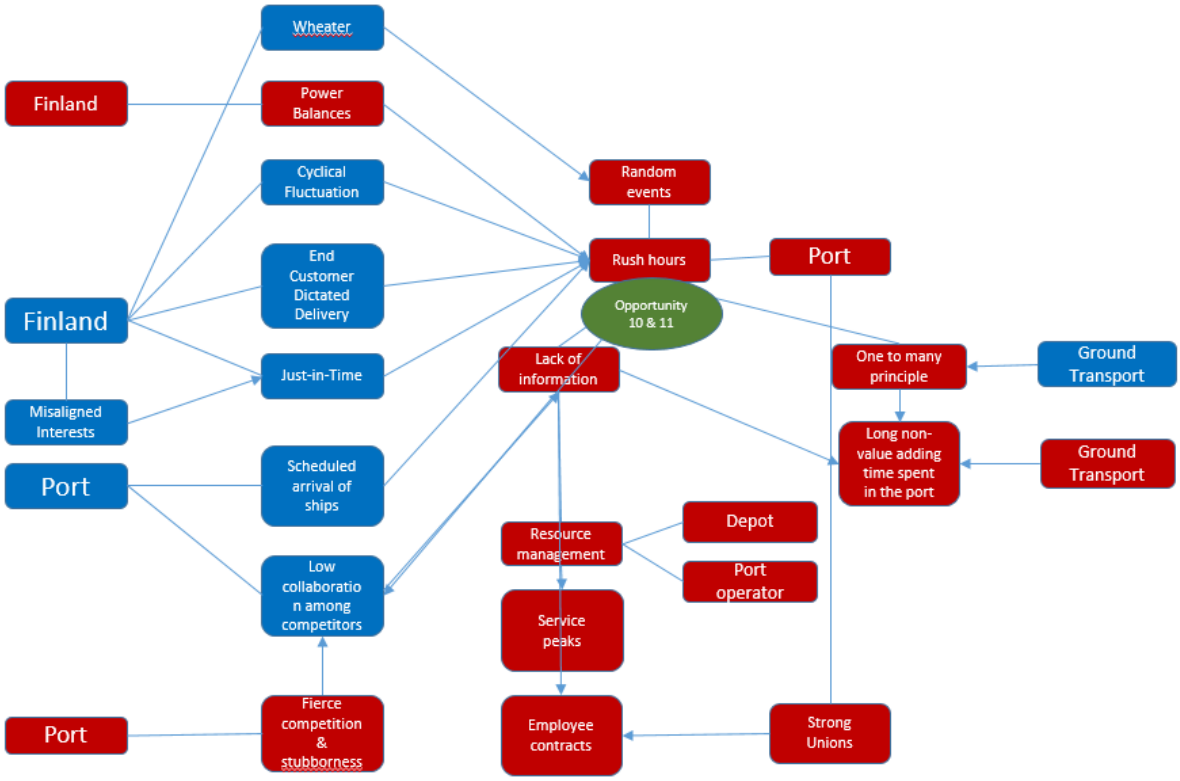

Figure 20. Inter-dependencies related to the characteristic cyclical fluctuation, end customer dictated delivery times, and Just-In-Time production

Cyclical Fluctuation along with end customer dictated delivery times and scheduled arrival of ships all contributes to the port infrastructure being clogged during certain rush hours. Just-In-Time production increases the need of timely deliveries, which in turn increases the need for ground transport companies to arrive at the port at given times. Yet, misaligned interests among port stakeholders can have a negative impact on Just-In-Time deliveries, as certain parties might want to quickly get rid off cargo, while receiving parties might not need cargo immediately. Furthermore, power balances within the ecosystem, results in the core port stakeholders being unable to negotiate delivery terms and thus neither being able to even out flow of trucks to the port. Off course, Finnish weather conditions can cause random events resulting in rush hours, which cannot be affected. Further influencing rush hours is the one-to-many business principle of ground transport companies, having to visit several port operators during one port visit, prolonging the stay. This in turn has a direct impact on ground transport companies, by increasing non-value adding time spent in the port, which is

further boosted by lack of information about port operator and depot companies' queues.

While weather conditions cannot be affected, lack of information is a factor that can be improved, whereas in addition to ground transport companies receiving a lack of information from port operators, port operators mutually receive lack of information from ground transport companies. The two-way communication deficiency can be regarded as low collaboration effort within the port ecosystem, despite obvious benefits that would be gained by better data utilization. Furthermore, lack of information causes resource management challenges for port operators and depot companies. Strong unions in turn, increases the resource management issue by setting requisites for balancing between full-time employees and contractors.

Opportunity 10 & 11 *Time-slot allocation for ground transport companies* and *improved information exchange & real-time service level information (Level: Port).* Two separate, yet inter-related opportunities were presented as a possible solution for reducing port rush-hours. First, an approach utilized in central Europe by providing cargo and container retrieval/drop-off time-slots to ground transport companies, was perceived as an opportunity, which could to a certain degree even out the flow of trucks into and out of the port. In practice, an envisioned approach was presented as selling time-slots, from which ground transport companies could be able to buy slots most convenient for their job order, hence providing optimization possibilities and service guarantees. Consequently, unnecessary early arrival and thus port infrastructure clogging could possibly be avoided. Furthermore, the opportunity would provide a means for port operators, as well as depot services to more efficiently manage human resources and task allocations within the work force, consequently reducing uncertainty of the amount trucks arriving. The time-slot approach would additionally provide early information about job orders, resulting in an opportunity for operators and depot companies to prepare the arrival of a truck. Thus, efficiency increases could be achieved in two ways: containers could be sorted and stored in regards of job orders, mitigating redundant container handlings and containers could be pre-maneuvered to ensure fast service for ground transport companies. Although the benefits was recognized by Port Operator B, one obstacle was also described. As port operators work with several ships simultaneously, difficulties in reasonable sorting emerges, due to time- and space constraints.

“siit on ollut paljon keskustelua operaattoreiden välillä että kehiteltäis just tämmöstä että asiakas tilaa ikään kuin sen palvelun. Jos se tietää et se on tulossa hakee konttia maanantaina klo 14, niin se tilaa itselleen slotin jolla aikana se tulee ja operaattori voi varautuu ja kontti voidaan kaivaa vaikka esille siihen mukavasti jo ja sit me voidaan katsoa että aha, on tulossa iso piikki autoja palveluun, niin me voidaan laittaa lisää koneita liikkeellle.”

“There’s been a lot of talk among operators, that we would develop something, so that customers would order their service. If they know they’re going to retrieve a container at 2 PM on Monday, they can order a slot and the operator can be prepared, by for instance .”

“ yks tapa ois et operaattorit möis slotteja näille maakuljetusyrityksille, et silloin me tiedetää… ja sä voisit palvella x määrä rekkoja tunnissa nii sit sä myyt nii monta slottia nii se leikkais ainakin ne pahimmat piikit pois. […]Eli tasaisempi virtaus jollain tavalla, oli se sitten tämä slotti ajattelu tai et kuljettaja pystyy itse optimoimaan.”

“One way would be that port operators would sell slots for ground transport companies, then we would know… and you could serve x amount of trucks in an hour and you only sell as much as you can serve, then it would remove the worst pikes. […] In other words, a more even flow in a way, whether it would be through this slot thinking or by allowing drivers to optimize themselves.”

(Port Operator B)

While the solution provides several benefits for port operators, depot companies, and the port as whole in terms of faster throughput, the solution was perceived as challenging by ground transport company A. First, time-slots does not automatically

ensure that truck drivers would not arrive early to the port and wait for a time slot at the premises. Secondly, ground transport companies cannot affect the desired delivery time of end customers. Hence, time-slots would not be evenly distributed throughout the day, despite operators wishes. Third, external factors such as general port external rush hours can cause drivers to fail hitting the time-slot, requiring a re-order of a new time slot, thus increasing non-value adding waiting time. Fourth, uncertainty of service time at operators, taking into consideration drivers often visiting several operators at the port, results in further risk missing time-slots.

Quotes…

The second opportunity can be regarded as a variation of time slots, while providing by large the same benefits in addition to reducing the pressure and inconvenience of ground transport companies. As previously illustrated, the two way information exchange deficiency, could be improved. The newly introduced truck arrival applications, indicates a leap towards the right direction, yet it was noticed that the low adoption level in addition to shortcomings in the application and common practices alone does not provide an optimal solution yet. The shortcomings were explained as the application not enabling truck drivers to estimate their arrival time, instead merely informing their arrival in general. Thus, further development is needed, enabling Ground Transportation representatives to estimate their arrival.

Similarly, as mentioned, Ground Transportation companies expressed a concern over having zero knowledge on port operator and depot company service levels. Receiving real-time estimations of service-levels from port actors, could allow ground transportation companies to do micro-adjustments for their port visit, hence improving the overall flow within the port. In order to have a true impact however, a shared system combining all data of incoming trucks, their intended visiting order and the port actors service levels, would yield the biggest impact. Furthermore, due to the principles of Just-In-Time production, providing real-time information to end-customers or integrating their delivery-time desires as input for a control mechanism for cargo pick-up, would yield an even greater impact on a national level. Naturally, the development effort would increase as the hierarchy level to be included in the solution increases. Despite possible difficulties in development, an indication of a port level shared information platform emerges as the most viable path for the solution. Yet, the impact of lower hierarchy, actor dependent improvements in information

exchange should not be disregarded, as short-term and general optimization can be reached requiring less effort in terms of orchestration.

Additional opportunities

Opportunity 12. Low-adoption barriers for automation (level port) was recognized as an opportunity, despite the earlier presented issue of justifying investments due to low volumes. Compared to traffic automation, the port was described as an isolated and restricted area, thus being alienated from certain general laws and regulations. While, a single factory was described as even a simpler environment for automation, the port still offers the same advantage through independent self-governance, providing means to write and agree on own rules on an ecosystem level. Different levels of automation were further described from automated lifting of containers, to trucks driving autonomously, to the port being able to function without humans even in complete darkness.

Yet, legacy systems within an ecosystem comprised of several actors, increase the difficulty compared to a single factory. Furthermore, the strong unions of the port were also recognized as a barrier, as explained in the section of challenges. In conclusion, automation was considered realistic in terms of providing an unrestrained environment for development.

Opportunity 13. Tele-operator offerings: New network capabilities (level port and level Finland). Tele Operators provided insights in how new network capabilities will lay out the foundation for new technological capabilities in the future, such as processing large data sets, AI, and video analytics. As explained in the value network segment, tele operators are or will be able to offer 5G networks, private networks, and IoT-specific narrowband networks, all with their own area of superiority. By large, different solutions require different capabilities, which can be divided into three categories: massive data sets, speed, and latency. Furthermore, network related new offerings of tele operators include building base stations in the Finnish archipelago, supporting i.e. the development of autonomous ships.

Opportunity 14. Tele operator offerings: sensor equipment and data processing (level port). Despite port-operator's efforts to reduce data-collection to the bare minimal serving their current operations, new equipment integrated with sensor technology offers new data points to gain insight and provide opportunities for optimization. Thus, a paradigm shift can be sensed, in terms of a need to collect additional data as the

potential benefits can offer great possibilities for business development. All tele-operators included in the study expressed capabilities in providing data processing services, either in-house or through their partners, on top of their core services of connectivity provision, network infrastructure and data storage. Yet again, as explained in the value network segment, Tele Operator A emphasized that the port actors need have or create high-level comprehension of how data can and should be utilized.

Opportunity 15. Tele-operator offerings: Video analytics (level port) were presented as a huge opportunity by tele operators, for the analysis of equipment and human movement on the field. Video analytics can either lay the foundation for automation purposes, general safety monitoring, or monitoring field utilization efficiency.

5G tuo videosiirron ja tää on se kohta missä ensimmäiset mahdollisuudet tulevat olemaan tosi kovat.

From the perspective of the Authorities C, video analytics could be one possible solution among others in order to realize the before mentioned desire of acquiring knowledge of the movement of cargo and containers on a port level.

Opportunity 16. Shared capacity utilization (level port) was presented as an opportunity to mitigate problems arising from growing volumes, as ground Transport Company A, explained that not all port operators are simultaneously busy. Thus, during a certain actor's service peak, human and machine resources could be hired from a competitor, in order to more efficiently handle these peaks. Furthermore, port operators and depot companies would achieve higher utilization degrees for their assets. Yet, the competitive environment and low collaboration desires among the actors, poses a challenge in realizing the opportunity. Additionally, fear of revealing company secrets and thus losing a competitive advantage might be a further barrier for the opportunity.

Summary

This segment has presented inter-dependencies of characteristics and challenges within the port ecosystem, as well as corresponding opportunities to further develop the port and the industry at large. Table 7 summarizes the presented opportunities of this segment.

Table 7. Summary of opportunities

Opportunity 1: *containers as a shared resource among shipping companies (Level: Global)*
Opportunity 2: *Technological support for container inspections (Level: Depot and Shipping Company)*
Opportunity 3: *Increased space allocation (Level: Depot)*
Opportunity 4: *More timely information received from shipping companies (Depot)*
Opportunity 5: *Shared IT system and real-time information flow (Level: Port*
Opportunity 6: *Digitization of trade documents (level: Global)*
Opportunity 7: *Automated data production by port operators (Level: Operator, Shipping and Global)*
Opportunity 8: *Single Window Information Systems (Level: Global, Europe and Port)*
Opportunity 9: *Machine learning as support for customs officers (Level: Authorities and Port)*
Opportunity 10 & 11 *Time-slot allocation for ground transport companies* and *improved information exchange & real-time service level information (Level: Port)*
Opportunity 12. *Low-adoption barriers for automation (level port)*
Opportunity 13. Tele-operator offerings: New network capabilities (level port and level Finland

Opportunity 14. Tele operator offerings: sensor equipment and data processing (level port).
Opportunity 15. Tele-operator offerings: Video analytics (level port)
Opportunity 16. Shared capacity utilization (level port)

8.5. INTER-ORGANIZATIONAL DATA-SHARING

In this segment, findings related to inter-organizational data-sharing is presented. Table 8 represented survey results on the topic, gathered at the end of the workshop.

While inter-organizational-data sharing functioned as one main theme during the interviews and the workshop, additional aspects related to data-sharing did not emerge, that is not represented in Table 8. Furthermore, data sensitivity was also the most frequently mentioned barrier for not adopting or seen as a challenge to adopt such practices. Sensitivity in turn, varied slightly according to the role of the actor. For instance, Equipment manufacturer A, found data sharing simultaneously as a great opportunity, yet more importantly as a big risk, since strict contracts are written between them and the customer, resulting in a potential loss of confidence if data were to be shared to outside parties. Thus, data ownership was explained as being in the hands of the equipment user. Shipping companies on the other hand regarded sensitivity as possessing end-customer related data, which cannot be openly shared. Additional data collected by shipping companies, was described as KPI related information used internally, such as engine utilization which was regarded as non-useful to the other actors.

All actors in this study concurred on the sensitivity of end-customer related data, i.e. port operators mentioned sensitivity in terms of possessing core process data, which could compromise their competitive advantage by revealing the means of running their operations. Port Operator B saw an opportunity however to share data with operators in another country, with an intent to support development of processes. In opposition Port Operator B also expressed concerns regarding data ownership, as a large portion

of the data was described as having an origin from shipping companies. Similarly, Depot companies regarded their data as collected on a purpose driven basis, while ownership was assigned to shipping companies Thus, difficulties were expressed in terms of finding usefulness of the data to anyone else.

While, the greatest barrier of sharing data was related to sensitivity and directly- or indirectly to data ownership, the participants of the study were not able to express in further detail potential data of other actors, that could be useful for their operations. An exception was data related to opportunity x in the prior segment, whereas operators would desire detailed information on truck arrival times and ground transport companies port operator service levels.

When discussing data sharing, the participants of the study, contemplated by large over operational data that was inter-connected with port processes and having a notion that the recipient would be an actor within the ecosystem. Authorities C provided an complementary view, while presenting opportunity 11 of monitoring the movement of cargo on a port level. The notion entailed opening data to outside parties, in order to provide an opportunity to build solutions for the port ecosystem.

“ Se olis aika unelma, jos pystyisin reaaliajassa näkee joka ikinen lastiyksikkö joka on satamassa ja miten ne liikkuu siellä, koska sit kun sä näet logistiikkavirrat satama-alueella, niin silloin sä pystyt optimoimaan kunnolla. Ja jos se on avoin, niin kuka tahansa voi käydä katsomaan niitä tietoja ja joku fiksu keksii sen hyvän optimointitavan ja myy sen ratkaisun vaikka meille..”

“It would be a dream, to be able to monitor in real time each and every cargo unit in the port and see how they move there, because then you can watch the flow of goods in the port area and optimize properly. If it is open [data], anybody can see the information and someone smart will come up with a way of optimizing and sells the solution to us.”

(Port Authorities C)

At last, highlighting data sensitivity and the rather narrow vision of data sharing opportunities in terms of restricting it to the existing ecosystem, Tele Operator A provided an opinion on the current status quo as well as the potential that could be achieved by developing data sharing practices.

“ Nyt kun me ollaan tämmöses sataman tyyppisessä syysteemissä, missä tää toimija tekee oman vertikaalinsa ja tää toimija tekee oman vertikaalinsa ja seuraava tekee oman vertikaalinsa ja nää ei juttele poikittain yhtään. Tää on tavallaan se et ymmärretään niin kuin datan käyttäminen tämmösissä ekosysteemeissä, jotka on laajempia teollisia paikkoja, niin siellä on myös niin kuin se oikeesti tutkimuksellinen, niin kuin murroksellinen asia. Välttämättä me ketjussa olevat toimijat ei olla niitä, meil on kaikil aina se halu omistaa sitä dataa ja pitää se itellä koska data on tavallaan arvokasta”

“Now that we are in a port environment, where every actor does his own vertical which do not discuss horizontally at all. It is all about understanding how to use data in these type of ecosystems, which are wider industrial settings, and it is there you can find research worthy and disruptive things. We who are part of the chain are not necessarily the ones, we all have a desire to own data and keep it to ourselves as it is valuable.”

(Tele Operator A)

Table 8. Summary of survey results related to data sharing

What do you think are the greatest opportunities related to data- sharing?

• (N=13) Increased efficiency, speed, and productivity for individual actors as well as the overall port proceedings through:
  o (N=1) automation of information exchange,
  o (N=4) data transparency leading to better/real-time situational awareness due to
  ▪ (N=2) improved data access policies,
  ▪ (N=2) as well as more timely information exchange,
  o (N=4) and increased data quality.
  o (N=1) Furthermore, decreased costs of the overall logistical chain, leading to increased global trade.
• (N=3) New technologies leading to overall benefits for the maritime industry, such as
  o (N=1) blockchains or other information platforms
  o (N=1) and image robotics.
• (N=1) Data monetization
• (N=1) New business models
• (N=1) Refining data

- (N=1) Unification of an ecosystem
- (N=1) Increased customer satisfaction
- (N=1) Better health & safety

What are the greatest challenges related to data-sharing?

- (N=8) Data sensitivity and sensitivity related factors, such as
  - (N=1) Data access mechanism
  - (N=2) and sharing-rights
- (N=5) Large number of actors and actor related factors, such as
  - (N=3) difficulties in interest alignment
  - (N=2) and difficulties in finding a unifying party as no-one is alone responsible for development efforts,
  - (N=1) responsibility of infrastructure development, such as building required information networks
  - (N=1) Global nature of the maritime industry
  - (N=1) Lack of technology and thus the need to share data to several actors independently
- (N=3) Cyber security
- (N=2) Lack of standards
- (N=2) Data quality
- (N=1) Data ownership
- (N=1) Disinterest to share data
- (N=1) Data monetization
- (N=1) Regulation
- (N=1) Historical barriers such as outdated laws
- (N=1) The high involvement degree of authorities

IV DISCUSSION

9. DISCUSSION AND CONCLUSIONS

In this chapter, empirical findings are contrasted with the theoretical framework and the main findings are discussed. Conclusions are made through answering the empirical research question as well as the sub-questions. Finally, a tentative process model for digital transformation is provided.

9.1. ANSWERS TO THE RESEARCH QUESTIONS

9.1.1. RESEARCH STREAM 1 & 2

This thesis has studied two parallel research streams, with an intent to initiate and form the baseline for an innovation intervention. Research stream 1 focuses on the focal value proposition of the ecosystem under scrutiny. Research stream 2, in turn, focuses on exploring characteristics, inter-organizational processes, challenges and opportunities within the ecosystem. Additionally, these two streams are merged by a final sub-question that draws a conclusion from the main findings of each stream.

Research Stream 1

This part exposes the generic value proposition of the port ecosystem, as well as how the port system can evolve with new entrants.

S1Q 1: What is the collective value proposition of the value network?

In accordance with Den Ouden (2011), value network analysis can be a useful tool for uncovering the value creation dynamics within an ecosystem. This thesis utilized the method and generated the value proposition of the ecosystem.

The port ecosystem consists of many actors, creating value for each other in accordance to several business models. Shipping companies hold a large share of value in the form of information, from the perspective of port operators and by sharing this information they receive value through fast ship turnarounds. Authorities have a relatively strong role in the industry.

While there are differences in business models and strategies among the many actors within the port ecosystem, such as either providing encompassing “door-to-door”

logistics services or in contrast narrow focus on one core activity, a common denominator can be distilled regarding a focal value creation, despite how from a single organization's point of view the materialization of the value is delivered. This value proposition encapsulates the fundamental existence of all actors in the ecosystem. In order to study *how* value is created, literature suggests treating ecosystems-as-structures (Adner, 2017). Thus, distilling the focal value proposition provides a means to understand the ecosystem at hand from not separate organization's point of view, but rather as a whole entity. Furthermore, value is a prominent feature of digital transformation (Skog, 2019; Vial, 2019), which in turn depicts a need for uncovering the focal value proposition, in order to study *how* digital transformation can unfold. The collective value proposition of the port ecosystem can be described as:

Smooth and timely flow, in addition to reliable and cost-effective deliverance of goods to end customers.

S1Q 2: What is the role of new entrants providing technological infrastructure?

New stakeholders are entering the field changing the value network *status quo*, providing technology and capabilities to improve and/or potentially disrupt current practices. It is evident that the port ecosystem is evolving. Providers of IT infrastructure and services have showcased a great interest in port development, due to new emerging technologies, that yields business opportunities within nodal hubs, similar as to a port.

Despite the growing interest among providers of digital infrastructure, the value offered lies in support for the core ecosystem, where responsibilities for innovations are among the core actors themselves. This holds especially in terms of finding new innovations directed towards the end-user, as well as building internal know-how for cyber security related factors. In line with theory (Vial, 2019), digital transformation opens up possibilities for innovation, through "*combinations of information, computing, communication, and connectivity technologies"*. Several participants in the study recognized the potential of new possibilities, especially for operational analytics, that digital infrastructure through their offerings could generate. Meanwhile, digital infrastructure providers laid out fundamental capabilities that they could offer through new technology. Yet, at least at the point of conducting the study, detailed plans for what could be possible were not expressed, indicating a co-creation balance

leaning more strongly towards the core actors themselves. Indeed, depending on potential future contractual agreements, these balances could possibly change. However, the changing nature of new business networks urges members to proactively understand the changes, in order to leverage new emerging possibilities.

Research stream 2

This stream explores the AS-IS situation of a port ecosystem, while contemplating possible opportunities and innovations for developing the port ecosystem.

S2Q 1: How are inter-organizational business processes organized?

The research yielded a detailed inter-organizational business process map. The map was utilized as boundary material in the innovation workshop, organized in this thesis. Furthermore, it provided input for analyzing the root-causes and interdependencies of the port ecosystem related traits identified in this thesis.

Uncovering the port processes yielded further detailed information on general industry characteristics. These characteristics has set the foundation for placing the case ecosystem in a larger context. In other words, ecosystems do not operate in isolation, but rather are intertwined in a mesh of ecosystems of ecosystems, which in turn is acknowledged in the analysis of this thesis, by categorizing challenges and characteristics, as well as opportunities in accordance to geographically hierarchical levels.

The inter-organizational process map reveals that shipping companies function as the primary source of information required to plan and execute tasks related to the movement of containers and goods. While the physical movement of goods is relatively simple, several information systems are involved in the processes, and these processes requires considerable information exchanges.

In further detail, information functions as a first initiator of all tasks performed in the process. As a case specific example, truck drivers upon pick-up of containers announce their arrival to port operators when approaching the gate of said operators. This sets in motion a task to be performed by the port operator, namely finding, retrieving, and handing over the cargo to the truck driver. As another example, port operators and shipping companies in this study shared relatively strong relations, resembling bilateral dedicated pipe-like interdependence. Part reason for this is that the port operators in this study had at some point been part of a certain shipping

company and due to these historical ties, shipping companies visiting the port utilize in the majority of cases one chosen port operator and in general shipping companies rarely switch the port operator. These pipe-like relations have further yielded integrated information systems between certain port operators and shipping companies, creating lock-in effects. Despite this integration, same logic to operations applies as in the case of truck companies and port operators. As a difference, shipping companies send the information that sets new tasks in motion at the port operator with a longer lead time.

According to classical contingency theory (Thompson, 1967) these type of arrangement resembles reciprocal interdependence between the actors, whereas output (information in these examples) from one actor functions as input to another actor. Reciprocal interdependence is characterized by high uncertainty and a need for coordinating procedures through continuous mutual adjustments. In the case context, this is visible through high uncertainty of the quantity of trucks a port operator will serve during a day, at what times, and how much resources are needed throughout a day.

S2Q 2: What are the corresponding challenges of the ecosystem?

A multitude of challenges were uncovered in this study. As with the characteristics, these challenges ranged from organization specific to a global scale, whereas the hierarchical context of “ecosystems of ecosystems” provided a useful approach for analyzing root causes of these challenges, in the interdependence analysis part of this thesis.

As a key finding in regards of the research question, the most prominent challenges corresponding to the inter-organizational processes lie in the intersection between two or more actors. Both port congestion is a cause of one such intersecting process step, as well as the challenges related to container exchange area. Indeed, root causes of these challenges are ramifications of conditions and characteristics based on This can be interpreted through contingency theory, where the high reliance on information in unison with untimely exchange of information and lack of coordination causes sub-optimal process phases. Thus, utilizing coordination mechanism proposed in contingency theory can offer useful support for minimizing these challenges. Most prominently an effort to reduce uncertainty through timely information sharing is called upon.

S2Q3: What opportunities can be identified?

As with characteristics and challenges, opportunities alike could be assigned to a multitude of hierarchical levels. In other words, certain opportunities entailed global innovation, *e.g.* blockchain deployment in the logistics industry, while others were port specific, such as port specific data platforms intended to aggregate and distribute port related information. However, whether the opportunities identified correspond to global development or an individual organization, the outcomes of these opportunities were uniformly directed towards internal operational improvements, with little justification for how value is created for the end customer. Indeed, it can be argued that port efficiency serves likewise the end customers at least indirectly. Moreover, blockchain deployment could open doors, as identified in the workshop of this thesis, for end customers to trade goods while they are being transported. This served as an exception however, whereas the end user was in the forefront of consideration.

S2Q 4: Are the solutions/opportunities corresponding to the challenges based on data sharing practices?

From an inter-organizational data-sharing perspective, it was clearly visible that unwillingness or fear of sharing data stems from leaking company secrets. Yet, again the actual problems that are related to inter-organizational processes are not bound to information that is sensitive *per se* but rather real-time operational data. More specifically, deploying typical IoT data seems to be an important addition to add to the port ecosystem.

Merged Sub research question from stream 1 & 2: How well does the collective value offering complement the identified innovation opportunities?

The identified opportunities in this thesis, provided only part alignment with the collected value proposition of the ecosystem. There are indeed misaligned agendas among the port ecosystem members, that does not correlate with the collective value offering of the port. As a clear example is the desire of freight forwarders to deliver the cargo, even if it is early and thus not in accordance to *timely* deliveries, in order to receive payments as fast as possible.

Summary of research stream 1 & 2

Figure 21 provides an overview of the core questions and key findings for research streams 1 & 2. Simultaneously, the research reveals the logical flow of the research streams that has been conducted in this thesis.

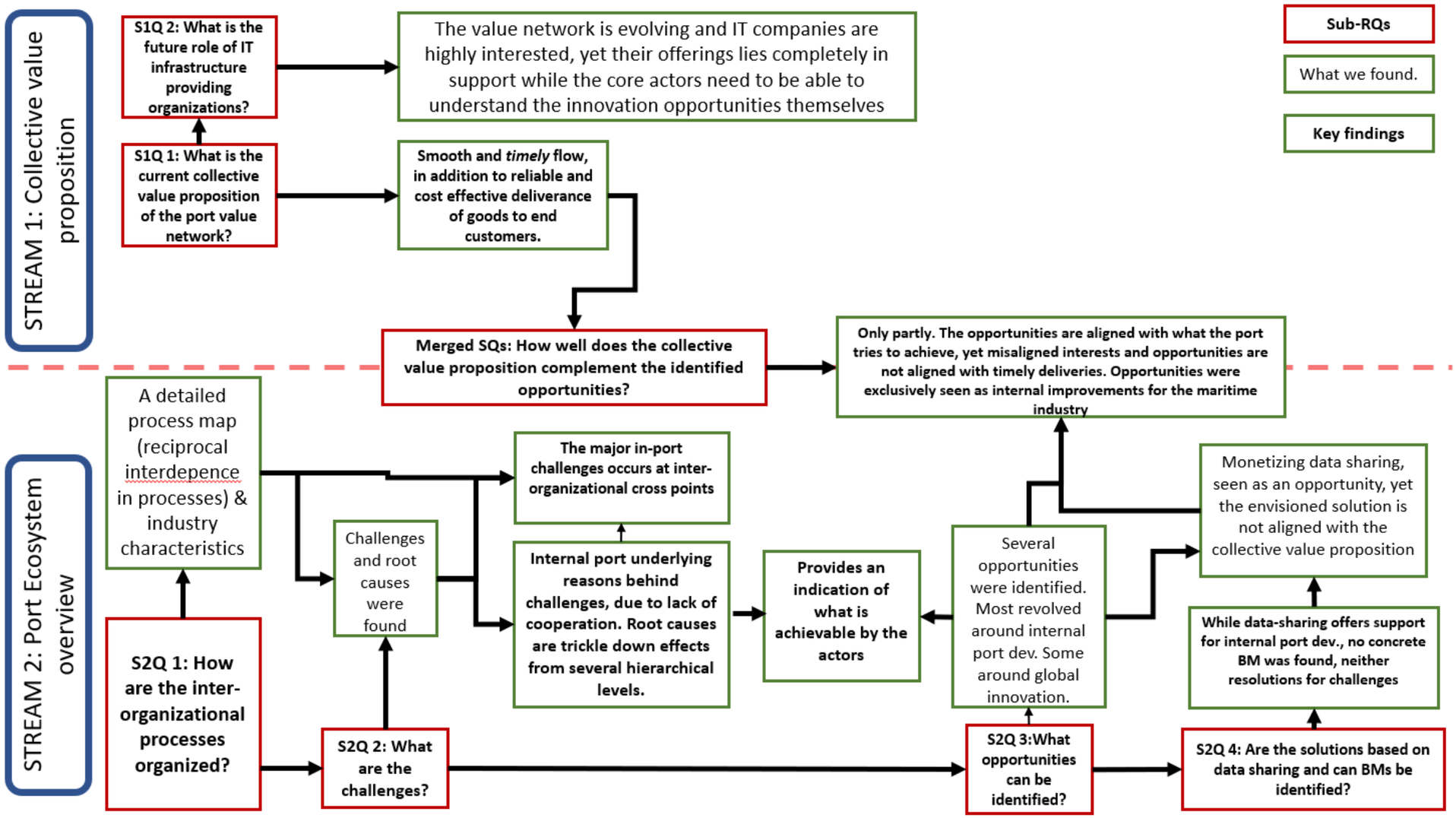

Figure 21. Overview of findings in regards to research streams 1 and 2

9.1.2. ADDRESSING THE EMPRIRICAL RESEARCH QUESTION

As this thesis aims to design a digital transformation process model for removing the disconnection between the process and content / context of DT (Skog, 2019), and thereby addressing a prevailing gap in literature, the primary research question of this thesis is as follows:

How can an ecosystem wide digital transformation process be organized?

The empirical research question is answered through an exploratory reflection against an innovation intervention, organized within the case context of this thesis. The proposed model is illustrated in Figure 22 and entails two main perspectives, an internal stakeholder consideration, that aims to provide a governance structure and shared vision in accordance to findings provided by Lavikka *et al.* (2017), as well as an external stakeholder consideration, that aims to align development and innovation efforts with end customer needs and expectations, in accordance to digital transformation theory (Skog, 2019; Vial, 2019). It is to be noted that despite this thesis refers to end users/customers as a separate group, these are indeed a prominent part of the ecosystem and can potentially take part as co-producers of value integrated in processes, as is identified in service-dominant logic literature (Lusch and Vargo, 2006). Thus, the end users can be part of both the left side and right-side process, illustrated in Figure 22. The primary reason for separating the end users from the internal stakeholder process is instead to clearly emphasize the need to reflect development efforts against this important stakeholder group. Thus, the model suggests continuous iteration and alignment to be conducted between the two perspectives throughout the process.

In addition to the two perspectives, the model provides a top-down and bottom-up approach, differing from the existing literature of both IT enabled business transformation and digital transformation (Vial, 2019). The top-down approach stems from the initial vision creation step, as well as the end user alignment efforts, while a bottom-up approach is conducted throughout the differing stages by unearthing the inter-organizational processes and corresponding challenges of the ecosystem members (preferably including the end user), as well as re-engineering these processes. As such, the model takes horizontal alignment into consideration by reassuring end user needs are met, as well as vertical alignment reassuring operational

developments lines up in accordance to the strategic vision created for the transformation.

In order to crystallize Figure 22, each step is as said a result of the analysis of the case study and corresponds to lessons learned, which justifies an organized structure for executing a digital transformation. However, as the scope of this thesis has not from a schedule perspective allowed to see through a complete life cycle of a transformation, the model should be regarded as an initial and tentative proposition, ripe for iterations and adjustments. The green colored steps in the process model correspond to actions and considerations that have been directly conducted and addressed in the empirical case study, the shifting colored boxes in turn have partly been addressed, while the red ones should be regarded hypothetical, as they are lacking empirical justification. Each process step is presented in further detail, encompassing an explanation as well as an empirical comparison as justification.

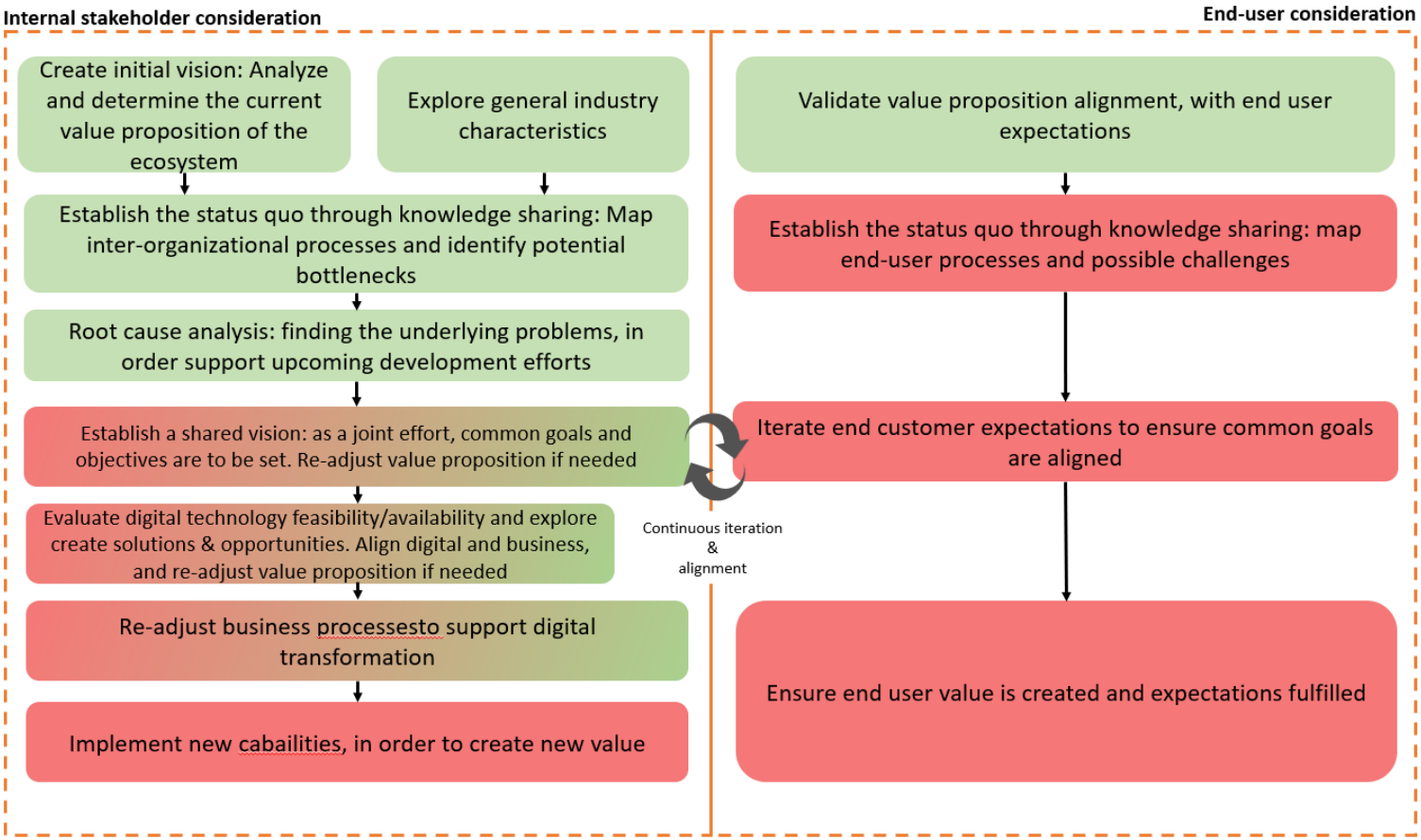

Figure 22. Proposed process model for digital transformation

Initial vision

Creating the initial vision is in line with the general notion of digital transformation as a top-down endeavor. The purpose is to set the transformation effort on an initial successful path, by contemplating the focal value proposition of the ecosystem. This value proposition can be generated by conducting a value network analysis. As the ecosystem is characterized by coopetitive participants, often with mixed agendas (Skog, 2019), it is imperative to create a shared understanding of what is sought to be achieved, as well as sharing differing opinions and perspectives. Simultaneously, exploring the overall characteristics of the industry/market/operational environment supports upcoming analysis stages while providing the overview of possible enablers and barriers for the task up ahead. Furthermore, the value proposition should be reflected against the expectations and needs of the end user. This last part needs to be emphasized, as the empirical study provided a useful lesson to be learned in this regard.

The participants in the case study described the port as being designed for and following a throughput strategy. This, in turn, has created an environment that is limited in space as containers and cargo are expected to remain in the port only for a short period of time, preferably flowing through without being stored in the port at all. Now, the focal value proposition generated through the value network analysis revealed a shared agenda of reliable and *timely* deliveries, with emphasis on the word timely. The participants had conflicting views on the end users urgency of receiving cargo, however according the ground transportation company on several occasions, cargo can arrive early. Furthermore, hinterland deliveries follow a cyclical rotation, picking up cargo in the morning, in order to be at the end users at noon, thus allowing a second pick up run in the afternoon. Freight forwarders, in turn, receive payment upon a completed delivery, creating incentives to deliver cargo as fast as possible. On the other hand, at points cargo can be late or in a hurry and at these occasions, a throughput port is certainly serving the end customer needs. As a last remark, Just-In-Time production is increasing among end users, heightening the timely delivery expectation. Hence, neither an early nor a routine-based cyclical delivery scheme of receiving cargo either at noon or in the evening and certainly not late deliveries are meeting the changing end user needs, unless this stakeholder group plans all operations in accordance to cyclical and possibly early deliveries. Thus, a throughput port and *timely* deliveries can be regarded as conflicting aims.

In the study, this revelation and end user reflection should have been made early in the process, in order to constructively set the tone for development discussion. The value proposition was brought up at a later stage than in the proposed model, while the author of this thesis finds that an earlier involvement could have yielded a more constructive discussion in terms of development if it would have been the starting point. Hence, the justification of the first stage in the proposed model.

Establishing the *status quo*

Inter-organizational process mapping is a useful tool for uncovering the wider operations of an ecosystem, including possible bottlenecks. As these processes include a wide variety of participants, visualizing the internal operations and interdependencies crystallizes the greater picture, as the holistic operations of the ecosystem can be unclear to a certain degree for the participants. Organizing an intervention and discussing these processes allows the participants to both put their own operations in a larger context, while ensuring differing perspectives regarding the processes to be shared among the ecosystem members.

In the case context, participants had a great sense of the overall processes and operations of other members of the ecosystem during one on one discussions, however bottlenecks and challenges within these inter-organizational processes were not evident for all. Instead, these bottlenecks were intensely discussed during the workshop organized for the thesis, creating thus new knowledge and a shared vision among the participants.

During this stage, end user processes and possible bottlenecks from their perspective would preferably be useful to uncover in order to evaluate if there are correlations between the inner operations of the ecosystem and the end user problems. In this thesis, the equipment manufacturer would have simultaneously represented an end user, but was unfortunately not present during the workshop. Thus, this perspective and process step could not be validated in this thesis.

Root cause analysis

The root cause analysis aims to unearth the underlying reasons for different bottlenecks discovered in the previous phase. The purpose is to reassure that the correct challenges are being solved, as well as provide input for how to solve these

challenges and which can de facto be solved in the first place in the later stages of the process.

In the case context of this thesis, a hierarchical approach proved useful for reviewing the case ecosystem in the larger interconnected context. Solving challenges in higher hierarchical tiers would result in larger impact as well, yet orchestrating a solution would simultaneously be more complex. On another note, the participants of the study were quick to condemn challenges as being unsolvable due to higher hierarchical tiers forcing the participants to operate in a certain way. However, the root cause analysis revealed that the most prominent challenges within the port did not extend beyond one level above the port, while the majority of underlying reasons could be assigned to the port level, where lack of communication in regards of late information exchange and low collaboration and coordination efforts could be identified as a primary element of the challenges identified.

As a port level example, the exchange area was regarded as problematic. The interdependency analysis revealed that empty container exchange could be assigned to characteristics all the way up to a global level, yet the main problems were inclusively on the port level. Low collaboration between actors results in the area getting clogged. As the challenge in turn does not exceed the port level, the challenge can be considered solvable.

As an example of a challenge exceeding the port level, port congestion can be mentioned. This is a problem area increasing in magnitude globally (Heilig, Schwarze and Voß, 2017). There are certainly reasons for port congestion beyond the control of the port itself, yet again lack of coordination and untimely communication, in addition to reciprocal interdependencies, makes the challenge worse. Thus, port efficiency improvement areas are to be found, in order to reduce the impact of this challenge.

Establishing a shared vision and leverage digital technologies

As the initial value proposition and operational mapping has been laid out, a shared vision for the digital transformation can be established. The prior steps should have yielded in an initial shared logic among the ecosystem members in addition to a crystallized overview of operations and challenges. Utilizing the findings in the prior when establishing the shared vision supports ensuring that vertical alignment between operations and strategy can be established, as well as horizontal alignment in order to reflect the strategy against end user expectation and needs. Only then should digital

technologies be considered, in order to reduce possibilities of developing sub-optimal and inadequate digital solutions.

In this study, participants were eager to start discussions on the possibilities of new digital technologies. Upon further review, these technologies would not provide an optimal nor a sensible way to solving the main challenges in the port. As in Davenport's (1990) model for business process re-engineering, Venkatraman's (1994) model for IT enabled business transformation and existing knowledge on digital transformation, technology should be leveraged to support value creation, not the other way around. The participants eagerness of evaluating technologies first can be regarded as solutionizing, which the proposed model of this thesis strives to mitigate by first uncovering and establishing the challenges and aims of a transformation, before looking at specific solutions. Consequently, the model takes into consideration an aim of ensuring development of digital solutions that generates true value and growth.

Moreover, regarding creating a shared vision, the workshop organized for this thesis generated constructive discussions on governance aspects in regards of new information systems. The participants recognized that the existing structures related to authoritative systems might not be adequate for future needs. Thus, the participants juggled with prospecting alternative information platform management arrangements, from centralized to decentralized consortium-based versions. Taking into consideration the generally fierce competitive environment and the sudden open discussion on possible collaborative system developments, this debate provides favorable evidence of how an intervention-based effort to create a shared vision is useful in ecosystem wide DT.

Business process re-adjustment

In order to foster an agile development environment, business processes should be re-adjusted as much as possible to resemble the upcoming processes new digital technologies will support. When processes are re-adjusted, the digital technology development gains vice versa support in receiving valuable feedback of requirements. In other words, a digitalization strategy could be implemented through aligning current processes to support the digital transformation efforts, while maintaining flexibility to change when required due to external factors.

In the case context, there were uncertainties of future authoritative system requirements coming from the EU. Simultaneously, platform-based information sharing systems were regarded as promising solutions for solving *e.g.* the exchange area problems. As the underlying problems in this area consisted of mostly low coordination efforts, mechanisms for solving it were already available using simple methods by creating better collaboration ties and finding ways to share workflows and coordinate processes. Thus, implementing these low effort process re-adjustments could support digital development, while safeguarding against uncertainties through providing flexibility to further adjust the physical processes in accordance to changing requirements. A process with low information system integration is easier to change, if regulatory changes emerges.

Implementation and leveraging digital technologies

As a snowball effect of the previous stages having been conducted successfully, the foundations for implementation conditions should be favorable. Yet, implementations can cause a wide variety of challenges on its own. The researcher of this study was not in a position to examine an implementation and thus this phase requires rigor through best practice exploration.

Reflections on reasons for carrying out a digital transformation on an ecosystem level

As was evident in this study, ecosystems do not exist in siloes. Thus, there is not only internal competition among ecosystem members; rather, ecosystems compete externally with other ecosystems. A shared digital transformation effort can provide support for making the ecosystem more competitive. An ecosystem wide transformation effort could reduce internal development that produces counterproductive results from the focal value creation perspective of ecosystems.

Indeed, individual companies should compete and develop in order to increase competitiveness, in accordance to the ecosystem characteristic of competition, due to the myriad reasons related to competition-based benefits. Yet, the collaborative characteristic should likewise be fostered in order to increase the competitiveness of the ecosystem as an entity. As members of certain ecosystems share processes that extend the bilateral relations of a supply chain, an ecosystem wide DT might ensure simultaneous company specific development, as well as ecosystem development.

To which degree an ecosystem wide DT should extend, remains an open question. Should an ecosystem strive to achieve new ecosystem wide business models, or even disruptive offerings? Or should an ecosystem strive to create favorable conditions for its members to create these new business models, while the ecosystem wide development would aim to predominantly improve internal efficiencies and operations, while fostering inter-relations?

At last, the proposed model does not consider who should lead the process. In the case context of this thesis, it became evident that a neutral facilitator (the author and the university) were paramount to initiate the intervention, as the participant expressed reservation towards potential hidden agendas, if initiation would have been set in motion by a possible competitor. However, the intervention sparked internal discussion on how to proceed and recognized different means for who should be in charge. Furthermore, it is to be emphasized that in accordance to Smeds (2005) methodology, the role of the facilitator who in this instance initiated the intervention, is not to function as a leader or primary source of knowledge creation. Thus, a facilitator role can be in theory taken by any member within an ecosystem, yet there seems to be positive in terms of utilizing a neutral source as an orchestrator and facilitator.

10. EVALUATION

This thesis is based on an abductive single-case study of a port ecosystem that is comprised of a mix of 16 public and private organizations, including 18 informal face to face meetings, 14 recorded in-depth interviews, and a half-day workshop with altogether 29 participants, including said organizations and university researchers. A case study approach has been chosen, as it is fitting for studying phenomenon that are not thoroughly understood, while the main research question addresses a "how" in order to build comprehension and depict the phenomenon. As qualitative research is susceptible of being interpretive, contextual, and subjective (Chilisa and Kawulich, 2012; Denzin and Lincoln, 2011), the degree of trustworthiness of this thesis is to be assessed. This chapter evaluates the study, in accordance to Lincoln and Guba's (Guba and Lincoln, 1989) four criteria of evaluation: credibility, transferability, dependability, and confirmability. Utilizing these criteria for evaluation is aligned with the research paradigm of this thesis. Furthermore, the limitations of the study is discussed.

10.1. CREDIBILITY, TRANSFERABILITY, DEPENDABILITY, CONFIRMABILITY, AND THE LIMITATIONS OF THE STUDY

Credibility refers to how believable or truthful the results of a study are. The truthfulness can be improved by following sound research practices, *e.g.* through triangulation and by providing the findings to the research subjects in order to assure an accurate comprehension of the context (Guba and Lincoln, 1989). The credibility of this thesis is established through the construction of the data collection method in relation to proper representation of the research questions. Triangulation is the primary credibility enhancing factor, which is utilized by including a multitude of data collection methods and including multiple interviewee sources from different organizations to construct the findings. Data was collected through note taking during informal meeting, through recorded interviews, as well as video recording of the workshop conducted. These recording were additionally transcribed. The thematic interview guide in turn was tested and honed before and during the interview period. At the interview situations, questions from different perspectives were asked, providing support to capture the nuances of the case context. Furthermore, the interviewees were provided with boundary materials and illustrations, in order to ensure the researcher and research subjects had a shared understanding of the context.

Thus, the researcher(s) provided a means for the interviewee to comment, correct if needed, and reflect on the context that was being investigated. At last, the workshop conducted for this thesis, provided an adequate opportunity for all participating research subjects to collectively comment, review and build upon the findings of the first part of the data collection phase.

Transferability refers to the how well the findings can be generalized to other contexts and how well the findings represents the context at another time (Guba and Lincoln, 1989). This thesis strives to provide thick descriptions of the context, the research process as well as the findings and results, with an intent to provide the means of judging the transferability. Furthermore, direct quotes from the research subjects are provided extensively throughout the thesis, to support transferability of the study. In order to mitigate misinterpretations caused by translating interviews, both original and translated quotes are provided.

The consistency of the research process with regard to transparency and the ability to replicate the research, in addition to disconnecting the researchers identity from the process is referred to as dependability (Guba and Lincoln, 1989). The research process was designed as a joint effort with the thesis supervisors, while observations were regularly discussed among the researcher, the supervisors, and colleagues, in order to seek transparency and alleviate personal interpretations impacting the process. As Finnish is the second language of the researcher of this thesis, these discussions supported in ensuring any language induced misinterpretations was reduced. To further hinder misinterpretation caused by language barriers, analysis was conducted before translating interviews from Finnish to English. Additionally, the researchers neutral affiliation with the participating organizations of the thesis was emphasized in the beginning of all interviews, with an intent disconnect said researcher from the context and ensure interviewees would be comfortable to provide accurate descriptions, without being reserved due to misunderstandings or false preconceptions of the researcher(s) intentions.

The last criterion, confirmability, addresses potential biases, prejudices, and values of the researcher that can contaminate the results of the research (Guba and Lincoln, 1989). As the researcher is subject to influence results to a certain degree, confirmability is ensured by linking the empirical findings with raw data, thus allowing the reader to draw own conclusions.

As a qualitative study, the main limitation is generalizability of the findings. This thesis aims to answer how an ecosystem wide digital transformation can be conducted and the specific case context and time of the study, affects the applicability of the presented model in broader contexts. Thus, a limitation is the lack of data, in terms of broadness. Furthermore, the time factor and scope of the thesis did not allow the researcher to follow through a digital transformation, setting further limitations on validating the model also in the specific case context. While a thorough representation of the case ecosystem was achieved, the researcher recognized a need for including more end-user specific stakeholders to enable more elaborated results. Thus, the quantity of data from a time- and ecosystem represnation perspective is a further limitation. In conclusion, further research in other contexts and longevity in the specific case context would be needed to validate the model presented in this thesis.

11. IMPLICATIONS

11.1. PRACTICAL IMPLICATIONS

This thesis has important implications for trade in Finland. In today's rapidly changing business world, with increasing need for just in time processes, smooth logistical chains play a key part in ensuring competitiveness. This thesis provides valuable insights for the case research participants in developing their internal operations, the inter-organizational processes, while creating a shared knowledge for enabling future value creation serving the needs of the Finnish industry and commerce. The study provided means for the ecosystem members to open a dialogue on collective improving and co-development. The research suggests a top-down and bottom-up approach, with continuous alignment with the collective value offering of the ecosystem provides a prominent foundation and structure for undertaking a digital ecosystem transformation, including clear guidelines on how to transform. Not only does the model presented in this thesis, provide the means for the port ecosystem to improve internally, but furthermore it provides guidelines to increase the competitiveness of the ecosystem as a whole.

On a more general level, the lack of knowledge regarding digital transformation models, especially on an ecosystem level, results in unfavorable conditions for organizations to comprehend this contemporary yet widely recognized topic. By addressing this gap, the study opens new avenues and increases general knowledge on the phenomenon at large. However, the model presented is an early proposition that is

in dire need of further validation in other contexts. Yet, it can be utilized as a solid foundation and starting point by organizations from a wide range of industries that are willing explore ecosystem wide digital transformation, thus improving the capabilities for new value creation, as well as opening doors for improving inter-organizational relations while fostering co-development efforts.

11.2. THEORETICAL IMPLICATIONS AND FURTHER RESEARCH

The objective of this thesis was expand knowledge on digital ecosystem transformation, especially from a how perspective. Both digital transformation and ecosystems are widely explored topics in non-scholarly and academic literature. Yet, there is low comprehension on processes for undertaking a digital transformation, while very few studies addresses the topic from an ecosystem's point of view beyond the impact of an organizational DT on an ecosystem. Hence, this thesis combines two literary domains, while contributing with a tentative framework for conducting a digital transformation, providing unique comprehension on the topic.

The limitation of the study in terms of broadness and longevity, suggests that the results of this thesis requires further empirical validation, both from a case specific perspective as well as in additional contexts. The thesis provides a thorough description on the research design, allowing the study to be replicated.

In order to further build on the study, end-user perspective and the value proposition alignment with end-user needs, is an avenue overlooked in this thesis. As ecosystems can have a broad range of end-user stakeholders with differing needs, strategies for addressing these differing needs can be explored. At last, how to foster healthy internal competition, while empowering the ecosystem's competitiveness through digital ecosystem transformation should be understood. That is, how should the transformation effort balance between increasing the ecosystem competitiveness, while simultaneously foster healthy internal competition? To what degree should an ecosystem wide DT extend? Should an ecosystem strive to achieve new ecosystem wide business models, or even disruptive offerings, or should an ecosystem strive to create favorable conditions for its members to create these new business models themselves, while the ecosystem wide development would aim to predominantly improve internal efficiencies and operations, while fostering inter-relations?

IV DISCUSSION

In conclusion, this thesis presents novel insights in how to conduct a digital ecosystem transformation through a conceptual process model. The conceptual model provided, follows a top-down and bottom-up approach, while maintaining an end-user centricity. Furthermore, the model utilizes a focal value proposition, aiming to disregard possibilities of development revolving around any specific ecosystem member. The model sets a foundation for further research in the field as a theoretical contribution.

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APPENDICES

Appendix 1. Interview protocol for the port core ecosystem

Johdanto haastatteluun Tässä tutkimuksessa tarkastellaan Vuosaaren sataman ekosysteemiä ja millä tavalla voitaisiin paremmin hyödyntää dataa ja edistää datan jakamista eri toimijoiden välillä. Haastattelun tarkoituksena on kartoittaa sataman ekosysteemin nykyistä arvoverkkoa ja sen tietovirtoja. Tämän lisäksi tiedustellaan mitä muuta dataa toimijoilla on halussa tai kykyä kerätä.

Taustatietoja
• Kerro meille lyhyesti organisaatiostasi yleisesti. • Mikä on sinun rooli organisaatiossa? • Kuinka kauan olet työskennellyt nykyisessä asemassasi? • Oletko ollut muissa tehtävissä aikaisemmin, joko tämän organisaation sisällä, tällä alalla tai tässä satamassa jonkun muun toimijan alaisena?
Prosessi- ja ekosysteemikartoitus
• Olemme tuoneet mukaan karkean prosessikuvauksen **satamaa läpi menevästä lastista (mereltä saapuva lasti)**. Voitko käydä läpi koko prosessia kokonaisuutena, niin kun sinä näet sen? • Mikä on organisaatiosi rooli tässä prosessissa?   o Mitä tarkalleen teette ja missä? • Ketkä ovat prosessin muut toimijat, joiden kanssa olette yhteistyössä? • Mitkä ovat näiden toimijoiden roolit? • Mitkä ovat organisaatiosi suhteet näihin toimijoihin? Asiakas, toimittaja tai jotain muuta? • Onko prosessissa erityisiä haasteita tai pullonkauloja, joita teidän organisaationne joutuu käsittelemään? • Mitä arvoa teidän organisaationne saa sataman ekosysteemiin osallistumisesta? • Mitä arvoa teidän yhteistyötoimijanne saavat ekosysteemiin osallistumisesta??
Data ja tietovirrat
Sataman ydinprosessiin liittyvät data ja informaatiovirrat

- Mitä dataa ja tietovirtoja teidän organisaatio tarvitsee, jotta tämä satamaansaapuvan lastin käsittelyn ydinprosessi toimii?
    - Keneltä saatte tämän tiedon/datan?
    - Missä muodossa ja miten saatte tämän datan?
    - Mihin tallennatte tämän datan?
    - Miten sinä näet tämän datan arvon? Teille? Muille?
    - Onko olemassa erityisiä haasteita, esteitä tai pullonkauloja, jotka aiheuttavat ongelmia liittyen dataan jota saatte?
- Mitä dataa itse tuotatte tässä prosessissa?
    - Kenelle toimitatte sen?
    - Missä muodossa ja miten toimitatte tämän datan?
    - Mihin tallennatte tämän datan?
    - Entä minkä arvoisena näette tämän datan teille? Muille?
    - Onko olemassa erityisiä haasteita, esteitä tai pullonkauloja, jotka aiheuttavat ongelmia liittyen dataan jota toimitatte?
- Onko muuta dataa tai tietolähteitä liittyen suoraan tähän prosessiin, josta olisi teidän organisaatiolle hyötyä tämän prosessin kannalta, mutta jota ei tällä hetkellä ei ole käytössänne?

Muu data

- Mitä muuta dataa teidän organisaationne kerää, mikä ei liity suoraan tähän ydinprosessiin, mutta mitä hyödynnätte jollakin tapaa?
    - Miten te keräätte/luotte tätä dataa?
    - Mihin tallennatte tämän datan?
    - Mikä on tämän datan arvo teille?
    - Näettekö että tästä datasta olisi arvoa muille ekosysteemin toimijoille?
    - Onko olemassa haasteitä, pullonkauloja tai esteitä jakaa tätä dataa?
- Kertyykö teidän organisaatioonne muuta dataa mitä te ette hyödynnä ollenkaan?
    - Miten tämä data kertyy?
    - Mihin tallennatte tämän datan?
    - Onko tällä datalla arvoa teille?
    - Näettekö että muilla ekosysteemin toimijoilla voisi olla hyötyä tästä datasta?
    - Mikä voisi olla tämän datan arvo heille?
    - Onko olemassa haasteita, esteitä tai pullonkauloja joka estää tämän datan jakamisen?
- Onko olemassa dataa jota teidän organisaationne pystyisi keräämään, mutta ette sitä tee tällä hetkellä?
    - Millä tavalla sen voisitte kerätä?
    - Olisiko tällä datalla hyötyä teille?
    - Mikä voisi olla tämän datan arvo teille?
    - Näettekö että muilla ekosysteemin toimijoilla voisi olla hyötyä tästä datasta?
    - Mikä voisi olla tämän datan arvo heille?
    - Onko olemassa esteitä tai haasteita jakaa tätä data muille?

Muiden toimijoiden halussa olevaa data

- Onko teillä näkemystä mitä dataa kenties muilla toimioilla on halussa, josta olisi teille hyötyä?
    - Millä tavalla voisitte käyttää dataa?
    - Mikä olisi tämän datan arvo teille?
    - Onko olemassa esteitä tai haasteita, jotka voivavat estää tämän datan saamisen?

Appendix 2. Interview protocol for the providers of digital infrastructure

Johdanto haastatteluun

Tässä tutkimuksessa tarkastellaan Vuosaaren sataman ekosysteemiä ja millä tavalla voitaisiin paremmin hyödyntää dataa ja edistää datan jakamista eri toimijoiden välillä.

Haastattelun tarkoituksena on kartoittaa teleoperaattoreiden roolia digitaalisen ekosysteemin kehityksessä.

Taustatietoja

- Kertokaa meille organisaatiostanne yleisesti.
- Mikä on teidän roolinne organisaatiossa?
- Kuinka kauan olette työskennellyt nykyisessä asemassanne?
- Oletteko ollut tällä alalla muissa tehtävissä aikaisemmin, joko tämän organisaation sisällä, tai jonkun muun toimijan alaisena?

Organisaation rooli satamakontekstissa

- Tässä on karkea prosessikuvaus mereltä Helsingin satamaan saapuvista konteista ja niistä toimijoista, jotka käsittelevät kontteja ja niihin liittyvää tietoa. Miten näette teidän organisaationne roolin tässä ydinprosessissa?
    - Tällä hetkellä?
    - Tulevaisuudessa?

Operaattorit tukena digitaalisen ekosysteemin kehityksessä

Nykytilanteen kartoitus. (Päämääränä on tunnistaa datan hyödyntämisen tapoja, joilla voidaan kehittää ja tehostaa sataman toimintaa**)**

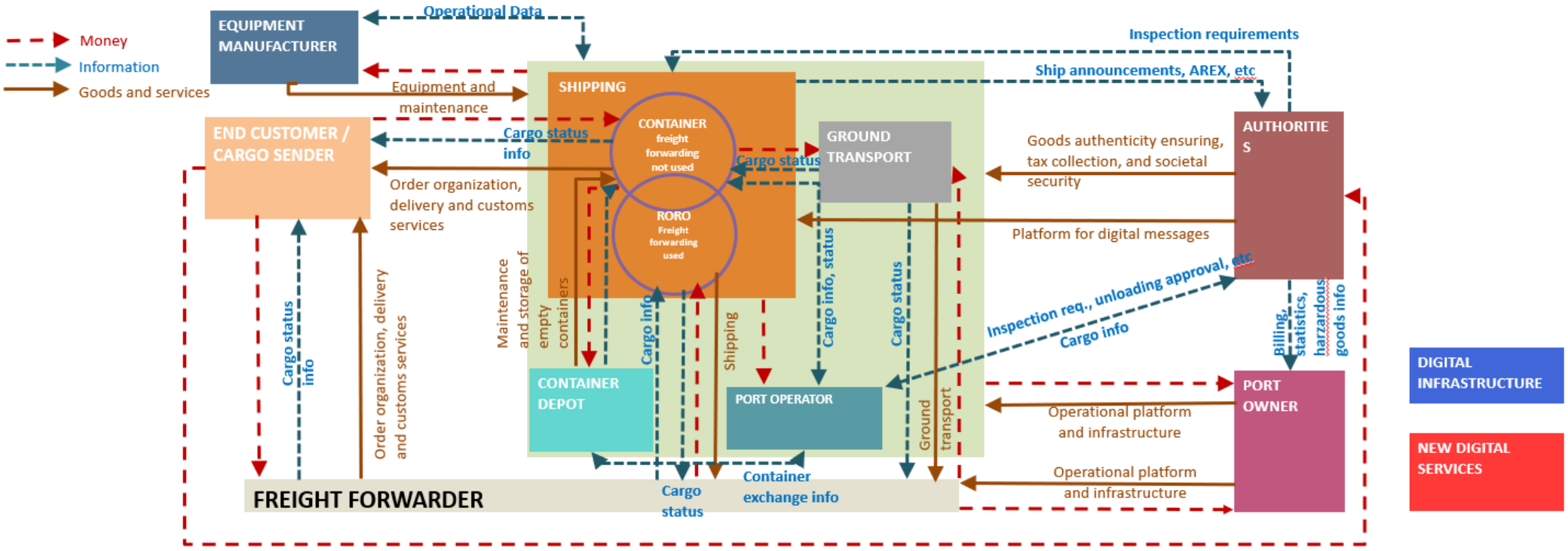
- Käyttääkö joku sataman toimijoista teidän palvelujanne sataman ydinprosessin ohjauksessa?
- Mitä muuta palvelua voisitte jo nyt toimittaa, joka edesauttaisi sataman prosessien ohjausta?

Virhe. Määritä Aloitus-välilehdessä Heading 1, jota haluat käyttää tähän kirjoitettavaan tekstiin.

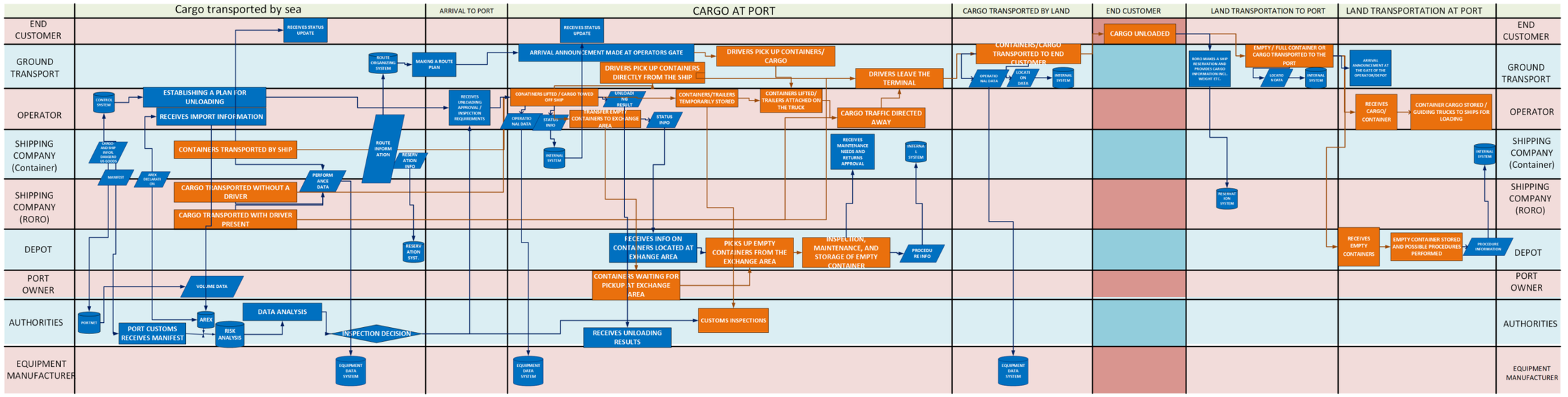
Tulevaisuuden näkymät

- Miltä operaattoreiden tulevaisuus näyttää sataman kehittyvässä ekosysteemissä?
- Millä lailla pystytte tulevaisuudessa edesauttamaan sataman lastivirtojen ohjausta?
- Millaisia ratkaisuja voitaisiin ajatella sataman konttien digitaaliseen ohjaukseen? Mikä olisi teleoperaattoreiden rooli?

Appendix 3. The value network of the port ecosystem



Appendix 4. The inter-organizational process map



Appendix 5. Survey results

Mitkä ovat mielestäsi datan jakamisen suurimmat mahdollisuudet satamaekosysteemissä?
• Blockchain tai muu vastaava alusta • Toimijoiden tehokkuuden nosto • Sujuvuuden parantaminen • Oikeilla tahoilla olisi aina pääsy heille relevanttiin dataan, jolloin ”manuaalisen” avisoinnin tarve vähenee & näin ollen prosessit nopeutuvat ja datan laatu säilyy eheänä prosessin sisällä • Tehokkuus • Tiedon laadun parantaminen • Reaaliaikaisuus • Toiminnan tehostaminen • Parantuntu asiakastyytyväisyys • Sataman turvallisuus • Tehokkuus • Tuottavuus • Uusia liiketoimintamahdollisuuksia • Uudet teknologiat -> enemmän hyötyä koko meriteollisuuteen • Nopeus • Sujuvampi toimintamalli • Leffarobotiikka; [unreadable] • Yhteinen ekosysteemi • Datan jalostaminen • Tilannekuva • Tehokkuuden kautta kilpailukyvyn parantaminen, sekä kokonaiskuljetuskustannuksien pienenemisen myötä enemmän kauppaa globaalisti • Kokonaisprosessin parantaminen • Ansaitamahdollisuus datan myynnissä • Mahdollisuus toiminnan tehostamiseen • Paikkansa pitävä ja oikea-aikainen tieto auttaisi kaikkia osapuolia • Tehokkuuden parantaminen • Tiedon oikeellisuus ja oikea-aikaisuus
Mitkä ovat mielestäsi datan jakamisen suurimmat haasteet?
• Dataa pitää jakaa useammalle toimijalle kullekin erikseen • Oikeuksien hallinta/tietoturva • Datan oikeellisuus • Kenelle datan saa jakaa? • Intressien yhteen sovittaminen • Datan monetisointi • Paljon toimijoita & sensitiivistä tietoa • Tiedon standardointi • Tiedot sensitiivistä • Yhteinen toimija vaikea löytää

Virhe. Määritä Aloitus-välilehdessä Heading 1, jota haluat käyttää tähän kirjoitettavaan tekstiin.

- Omistajuuden puute
- Kuka investoi, verkkoihin -> mikro-operaattori
- ”Viranomaisvetoinen” toiminta
- Regulaatio
- Datan sensitiivisyys
- Historian kahleet -> mm aiempi lainsäädäntö
- Sensitiivinen informaatio
- Globalisuus
- Monta toimijaa
- Kukaan ei ole yksin vastuussa
- Stakeholderin valtava määrä ja sitä kautta standardien ja yhteisymmärryksen löytäminen
- Tietoturva
- Halukkuus jakamiseen
- Käyttöoikeudet
- Datan oikeellisuus
- Datan omistajuus, kuka saa nähdä ja mitä?
- Toimijayritysten oma politiikka
- Tietoturva ja [unreadable]