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DISRUPTIVE INNOVATION AND MARITIME SECTOR

Discovering smart-shipping's potential to disrupt shipping

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1 INTRODUCTION

1.1 Background for the research

Finland's Ministry of Employment and the Economy has a national working life development strategy 2020, which aims to lift Finland to the Europe's best country in terms of working life. It is based on challenges regarding to competitiveness. Development in areas such as productivity and innovativeness are being emphasized. Strategy 2020 calls for companies and employees to challenge their normal beliefs and to think more outside the box. (Työelämä2020.) Disruptive innovation stems from competence theories, dynamic capabilities and resource-based view challenging learned values and replacing them with new ones. With the recent interest on disruption in shipping, this research tries to support the working life development strategy by studying the digital related change in shipping and further develop the understanding of potential disruption in shipping. Ideally this research shakes one's beliefs of conservative industry leading to further discussions of the shipping's future, Finland being one of the first countries to drive change in shipping with innovative IT- and digital mindset.

The fourth industrial revolution is speeding automation and data exchange in manufacturing technologies. The idea of industry 4.0. thinking is that the smart sensors and monitoring systems develop more towards self-operating technologies that are connected to other machines leading to predictive health monitoring. Consequently, these systems generate a lot of data, big data that are gathered and utilized (Lee, Bagheri & Kao 2015, 18–19) and further offer significant potential also for ships that are full of different sensors and monitoring systems.

Marine industry is facing its fourth wave according to world's famous shipping analyst Martin Stopford (2015). He further calls this fourth wave as smart-shipping. Smart-shipping differs from earlier waves by making cargo transport management possible through Information Technology and Communications (ICT) systems offering significant efficiency for process owners. Stopford's ideas follow largely the industry 4.0. thinking that will lead to more automation in shipping. One domain is the concept of autonomous ships. Rolls-Royce Oy Ab established a Ship Intelligence unit in 2015, which is introducing a concept of autonomous ships. Recently Rolls-Royce among with total of 80 Finnish marine companies established One Sea Ecosystem for autonomous marine transport led by DIMECC (Digital, Internet, Materials & Engineering Co-Creation). Finland aims to create the world's first autonomous marine transport system into the Baltic Sea (Autonomous ships ecosystem 2016). With less manning, autonomous vessel's need less accommodation thus reducing weight and space costs and providing better cargo capacity. The outcome is obviously more efficiently operating

vessel and through automated and connected systems more reliable entirety (AAWA 2016). This kind of operational efficiency is hypothesized to disrupt marine shipping markets.

There has been steady increase on the interest of disruptions and disruptive innovation theory after Clayton Christensen introduced the theory first in 1995 and explained the concept more in detail later in his book *Innovator's Dilemma* (1997). Autonomous shipping is one example of disruptive innovation creating new service marketplaces through increased digitalisation. New marketplace, such as online cargo service could be tempting for new players to disrupt incumbents the same way as Spotify and Uber disrupted their own industries. (AAWA 2016.)

“Autonomous shipping is the future of the maritime industry. As disruptive as the smartphone, the smart ship will revolutionise the landscape of ship design and operations” - Mikael Mäkinen, President, Rolls-Royce Marine

Instead of focusing fully in autonomous shipping, this thesis takes the smart-shipping more approachable concept, which will be studied as disruptive innovation and reflected with the empirical findings. Smart-shipping helps to understand the disruptive factor that is the connectivity of ships with advances in ICT-technologies. Autonomous shipping is a potential long-term consequence of smart-shipping.

1.2 Earlier studies and research question

Christensen (1995; 1997) brought up the concept of disruptive technologies, which he later complemented with disruptive innovation theory (Christensen, Raynor 2003). First, the concept relied on technologies but was later applied to business models as well. Markides (2006) argued that disruptive innovations should be studied as separate innovations in terms of competitive outcomes. Disruptive innovation (DI) is basically a market result (disruptive relative to markets) that evolves from a root innovation. Therefore, a disruptive innovation should not be treated as equal to other innovation types but rather it should be paired with root type innovations that is an innovation which eventually becomes disruptive. So, there is a clear distinction between a type of innovation and market related disruption. To demonstrate the multidimensional DI, both technology- and business model innovation could end up being disruptive but in different ways and even at the same time.

The original theory of Christensen (1997) has got a wide public coverage with critics along. The theory has been challenged and complemented by many authors (e.g. Charitou & Markides 2003; Danneels 2004; Markides 2006; Govindarajan & Kopalle

2006; Schmidt & Druehl 2008; Govindarajan, Kopalle & Danneels 2011). This research studies disruptive innovation in the context of shipping that is rather untouched area in DI studies and further brings more practical approach into DI research by studying the smart-shipping also from the responders' view. Although containerization could be seen as a major disruption in shipping that is still encroaching upwards in the shipping markets, this study aims to provide better understanding of the more recent and ICT-systems related disruption called smart-shipping. Studies of disruptive innovations in other industries emphasizes the elements of DI theory, which are adjusted with this study's empirical findings of shipping markets.

Digitalization is changing industries rapidly. Shipping industry is assumed to have major changes ahead and these changes may require shipping companies to rethink their market position. In the mid 1990s when internet revolutionized the world many companies in different industries faced a problematic question: "Should we respond to these disruptive innovations and, if so, how?" Those companies included airline giant British Airways competing against low-cost airlines such as easyJet and Ryanair and Barnes & Noble competing against Amazon's online bookstore. (Charitou & Markides 2003, 55.) The same dilemma sets the ground for the research question of this thesis:

RQ: How do established firms see the disruptive threat of smart-shipping and how could they respond?

Internet has already had impact in shipping but smart-shipping is on its way, changing shipping through developed ICT-technologies. First, it should be studied carefully that what are the features in disruptive innovation and is the concept of smart-shipping a disruptive innovation.

1.3 Marine shipping overview

Overview is based on Martin Stopford's book *Maritime Economics* (2009). Short overview of the marine shipping is mandatory to reach a sufficient understanding of what is hypothesized being under the threat of disruption since DI is a relative phenomenon (Christensen 2006). As Baiyere (2016) noted: "in order to be able to say an innovation is disruptive, it should be possible to identify what it is disruptive to".

Merchant shipping accounts for almost one third of the total marine industry trade. In 2004, the merchant shipping turnover was approximately 426 billion USD and total marine industry trade accounted for 1,3 trillion USD. These rough estimates help to understand the scale of merchant shipping and the size of marine industry. Merchant shipping (31 %) is included under the vessel operations sector in which naval shipping

(13 %), cruise industry (1 %) and port operations (2 %) forms the rest of the group (percentages presents each operation's share of the total industry turnover in 2004). Merchant shipping is one part of the international transport system that can be divided into three categories: 1) inter-regional deep-sea shipping and air freight between continents, 2) short-sea shipping at coastal seas and 3) land transport on rivers, roads and rails. This thesis takes the perspective of marine deep-sea and short-sea shipping, both operating with ships or ferries. Empirical data for this thesis is collected from short-sea shipping companies but deep-sea shipping is included in the analysis. *Deep-sea shipping* is the only economic transport for high-volume cargo between continents. Global transport network is large extended and covers each major industrial region such as Asia, Europe and North America. In 2005 air freight accounted only 0,4 % of the inter-regional cargo volume compared to deep-sea shipping although air freight is a bit faster growing market in trade comparisons due to premium and expensive cargo commodities such as electronic devices. Deep-sea shipping trend is that cargo ships are built even larger. Cargo space versus transport cost, in other words cost effectiveness is one of the main value drivers in shipping. *Short-sea shipping* focuses on port-to-port routes and operates within regions. It competes with land transport providers like rail companies. Short-sea ships are much smaller than deep-sea ships and they are more flexible to deliver more often.

However, in a global transport everything is interconnected and requires a lot of cooperation between different actors to operate cargo flows effectively. This research has its limitations because only a sea transport is under the scope so it is not surprising if the research results will indicate also challenges related to whole international transport chain. Key thing to note here is that a disruptive innovation is a relative phenomenon and in this thesis marine shipping is hypothesized facing disruption and therefore it is justified to limit the data gathering and analysis only in sea transport, henceforth defined as *shipping*.

Demand for shipping can vary as much as 10–20% in a year and can be predicted with the help of longer-term trends but changes even shocks can be rapid and unpredictable. Sea trade is tightly linked with world economy and random shocks. For example, oil crises (1973 & 1979) and financial crisis (1989–1992) affected to sea trade crucially and the recent financial crisis that started in 2008 is still affecting in shipping. Sea trade is not equal to world economy but it can be generalized follow the same business cycles. This is obvious since world industrial production creates most of the demand for sea transport.

If considered that disruption is to happen in the shipping market, a short review of the four-dimensional shipping market is needed, which is illustrated in the figure 1.

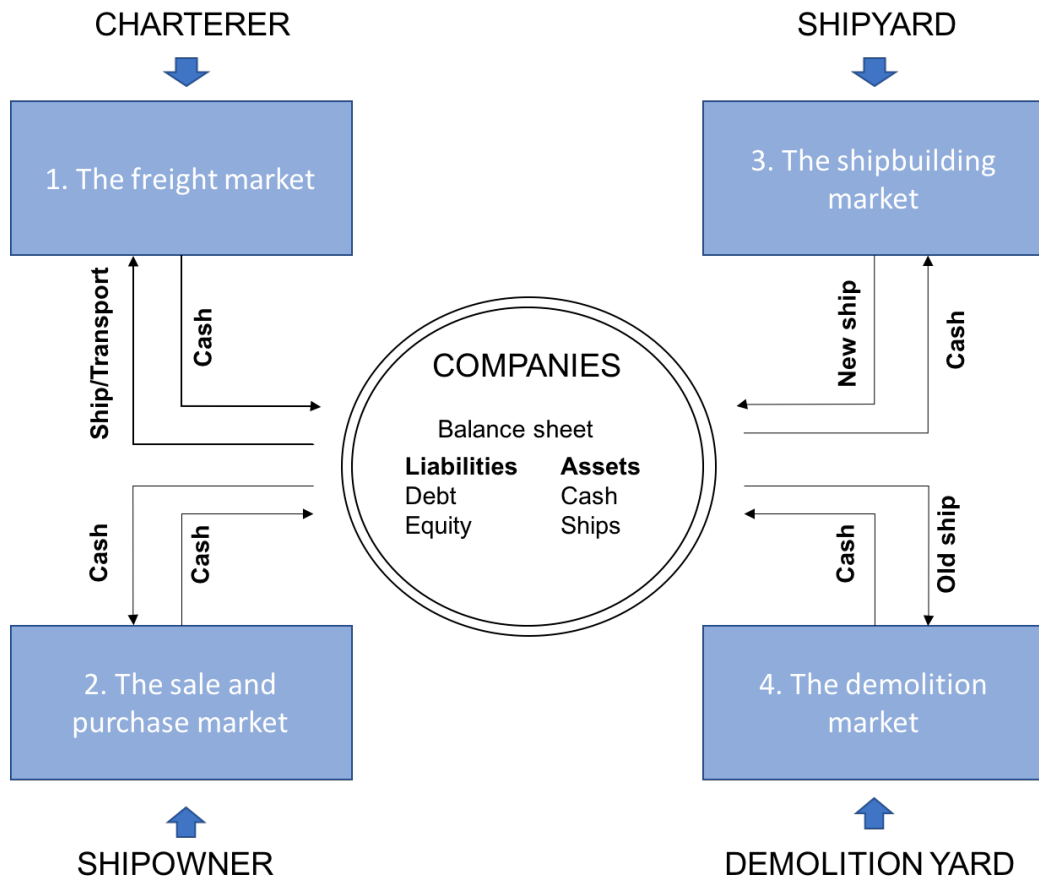


Figure 1 Four shipping markets (adapted from Stopford 2009, 179)

Figure 1 demonstrates that shipping companies are operating in four different markets in the shipping industry. *Freight market* is the main source of cash flow for shipping companies where freight rates earned are the most driving value for shipping investors. *The sale and purchase market* operates around second-hand ships that ship owners sell to another ship owners. The total sum of this market is a zero since the capital and ships only switch places although good investments may have longer-term benefits for one party. *The shipbuilding market* turns the cash flow other way around since shipping companies pay shipyards who in turn pay for labour, material and profit. *The demolition market* is another income for shipping companies by selling old ships to demolition yards. This market can be exploited for instance during recessions if ships are not in active use but require maintenance to upkeep their operational functionality. Understanding the overall picture of the four-dimensional shipping market is important in the chapters of results and analysis and discussion.

2 PRIOR RESEARCH ON DISRUPTIVE INNOVATION

Rogers (1983, 11) describes innovation as: “...*idea, practice, or object that is perceived as new by an individual or other unit of adoption...The perceived newness of the idea for the individual determines his or her reaction. If the idea seems new to the individual, it is an innovation*”. Schumpeter (1939) attached the concept of innovation tightly to entrepreneurs who constantly introduce new ideas over old ones. He developed the business cycle theory, which emphasizes a discontinuous process of innovating like a tidal wave moving forward and then receding as innovation requires time before it can really have its impacts on economy by lowered costs and new products. This ultimately leads to a dynamic development of economy, which keeps the competitive capitalism alive by allocating capital and labour in optimal ways. Schumpeter is best known for his creative destruction theory, which is related to this process of revolutionizing economic structure by incessantly destroying the old one and replacing it with new one (Schumpeter 1962, 83). Danneels (2002, 1095) recognizes Schumpeter’s work as a starting point for organizational innovation research, in which organizations try to withstand creative innovations, but also create them.

Innovation research and especially technological innovation research along with Schumpeter’s creative destruction theory led to Christensen’s disruptive innovation theory (Yu & Hang 2010, 436), which was first labeled as disruptive technologies highlighting the fact that at first disruptive innovation mainly concerned products by their design and not the business model (Christensen 1997). Resource-based view (RBV) with competence and dynamic capabilities theories have stressed the importance of organization’s resources when responding to new threats (Wernerfelt 1984), which have directly impacted the disruptive innovation theory.

2.1 Root types of disruptive innovation

To understand the fundamentals of disruptive innovations it is important to define root type innovations that cause an innovation eventually to become DI (Markides 2006). Three types of innovations are introduced including technology innovation (TI), radical innovation (RI) and business model innovation (BMI). A short literature review of each type helps to form an adequate overview of the root type innovations that lead to disruptive innovation. Selection of the three innovation types (TI, RI and BMI) is based on Baiyere’s (2013) review of disruptive innovations & IT, in which he emphasizes the three actual root innovations that eventually become disruptive.

Root type innovations are presented separately and they are different by their characteristics. Despite of their differences they can be combined to present a disruptive sce-

nario. Amazon is a good example of mixing two types of innovation in terms of bringing a new-to-the-world platform of online bookstore (RI) and combining that with fundamentally new business model compared to other bookstores (BMI) (Baiyere 2013, 8.).

2.1.1 Technology innovation

Technological evolution has been widely studied (e.g. Schumpeter 1964; Morison 1966; Mench 1979; Sahal 1985; Tushman & Anderson 1986). Christensen's (1997) theory of disruptive innovation was first built on technology design that changes the product's performance trajectories offering new set of values. DI theory has got its impact largely from these earlier studies of technological innovations. Schumpeter's (1964) theory of creative destruction demonstrates the constantly renewing technology by addressing new products replacing older ones incessantly. Earlier innovation studies have made a distinction between two technological change, incremental and radical changes (Christensen & Rosenbloom 1995, 233), which both end up destroying the existing competence of organizations (Tushman & Andersen 1986, 439).

Tushman & Anderson (1986, 440) defines technology as tool, device and knowledge, which can be used to promote process and product technologies and further suggest that technology evolves in response to the interplay of history, individuals and market demand. Danneels (2002, 1102–1103) argues that product innovation is a result of technology and customer competence, in which technology competence gives the know-how of designing and producing new products and customer competence gives the know-how of serving certain customers by knowing their needs and processes. Christensen (1997) argues that listening to customers leads more likely to sustaining innovations than disruptive innovations but also emphasizes that DIs should be targeted to either overlooked low-end- or new markets with certain customers, which makes a call for both technology and customer competence as Danneels' (2002) demonstrated. Digital camera's improvement in technological performance compared to older products such as film cameras is a good example of technology innovation that ends up being disruptive (Baiyere, 2013, 128)

2.1.2 Radical innovation

Radical innovations are critical foundations for future product and service generations (e.g. Sandberg & Aarikka-Stenroos, 2014; Baker, Sinkula, Grinstein & Rosenzweig, 2014). Adoption of radical innovation requires pre-innovation conditions such as an

aggressive technology strategy and unique structural arrangements like concentrating on specialists. Radical process adoption is stronger when strategy supports centralization and informal structures. On the contrary incremental innovation process supports traditional structures and market orientated strategies such as complexity, decentralization and formalization. The use of radical strategy is not a matter of a company size but instead, a matter of structural choice that matches the desired innovation type (Ettlie, Bridges & O'Keefe 1984, 692–694).

Getting too close to customer needs leads more likely to incremental changes in products than true innovativeness and radical products. Usually a radical innovation is built on a new technology and attracts the mainstream customers. Mainstream customers are usually expected to value product attributes and therefore they are more likely to follow new technological improvements. Cordless phones are good examples of a radical innovation. They were targeted to the existing customers but the substantial new technology made wired phones to extinct.

Technology investments are expensive and can be risky, but when they are targeted to mainstream customers, they are easier to be justified than when entering into emerging markets. Emerging markets can be described as evolving and uncertain customer segment that is initially smaller than mainstream segment and requires more risky decisions. (Govindarajan, Kopalle & Danneels 2011, 122–125.) Facades are enablers of change and can be used to overcome innovation barriers like doubting investors. Usually the change requires a pre-stage that is used to sell the idea for customers and other stakeholders. Facades help the progress of radical innovation by convincing stakeholders in that conventional roots must be replaced by new ones. Root practices suggest that common archetypes are taken for granted and forms a frame that new roots try to break by departing their ideas. Hard part in deviating from archetype is to identify the root, which is first defining a complex archetype. Radical innovation with the help of facades works as a tool to re-define archetypes like ideas, beliefs and values. (Baumard 2014, 1324–1325.)

A common view on radical innovations is to think them as new-to-the-world products such as mobile phones, cars and televisions (Markides 2006, 22). Christensen (2006, 48) argued that Markides is quite right in the concept but the examples are wrong. For example, before mobile phones, there were cordless- and wired phones thus a mobile phone is relative to its predecessor. Christensen continued by arguing that there really was a first wheel, a first photograph and a first boat and relativeness should help us determine how new-to-the-world product is. If there is not a pre-existing product compared to an innovation it could be declared to a new-to-the-world product that is a radical innovation. However, Govindarajan & Kopalle (2006) suggested that instead of asking questions of whether a product is radical or not there could be a more fitting word that is radicalness. Each product has its own relativeness compared to a similar

pre-existing product and radicalness could be determined with a scale of low or high radicalness. Baiyere (2013, 7) puts it well by asking how “new-to-the-world-ish” a product is when considered its radicalness.

2.1.3 Business model innovation

Business model can be divided into four parts; value proposition (customers), resources (people, cash and technology), processes (products and services) and profit formula (margins and assets). These parts do not have to happen simultaneously, instead building a sustaining business model through value proposition, resources and processes could end up being profitable at one point. And then again there is always the risk of emerging companies introducing their new business models with new value propositions. (Christensen, Bartman & van Bever 2016, 32–34.)

At first Christensen (1997) labeled disruptive innovation as disruptive technologies. The name was quite incorrect, which he later acknowledged in his work and redefined it to match the current definition of disruptive innovation (Christensen & Raynor 2003). Disruptive innovation can indeed be a result of business model innovation instead of technology being the only force that drives incumbents to lose their market leading positions (Christensen 2006, 43). Charitou & Markides (2003, 56) described BMI as playing the game with different rules. Markides (2006, 20) continued by suggesting that disruptive BMI is relative to its pre-existing business model and changes the model fundamentally. Again, Amazon’s online bookstore serves as a good example of BMI with totally new business model to sell books online. Amazon didn’t invent bookstore but it redefined the process of book distribution. When encountering a new business model incumbents are forced to rethink their own business model. Govindarajan et. al (2011) suggested that companies may have to “cannibalize” their own business to facilitate disruptive innovation for their own use and it can be a hard decision for managers. Cannibalization would mean downsizing current productive business to survive in the future hence the dilemma.

2.2 Disruptive innovation

2.2.1 Hard disk drive Industry – Where it all began

Christensen (1997) used hard disk drive industry as an example of disruptive innovation (DI) to give managers a two-way option when should a manager stick with the good

management principles and when should alternative principles to be taken into consideration. Between 1952 and 1956 IBM developed the first disk drive. Christensen's studies used the database of disk drive models between 1975 and 1994. Disk drive providers were divided into two categories. The leading firms were defined as *established firms* who mainly utilized the prior technology and the new firms using new technology defined as *entrant firms*. Established firms were related to sustainable technologies with incremental or radical changes. In the disk drive industry, the improvements were related to total capacity and recording density. Entrant firms on the other hand used disruptive technologies to take large businesses down.

An example of a disruptive innovation was the series of changes that made the size of disk drives from 14-inch to only 1.8 inches. According to Christensen disruptive innovation usually underperforms compared to the sustaining innovation. Christensen (1997, 15) demonstrated DI with his classic disk drive chart (see Figure 2).

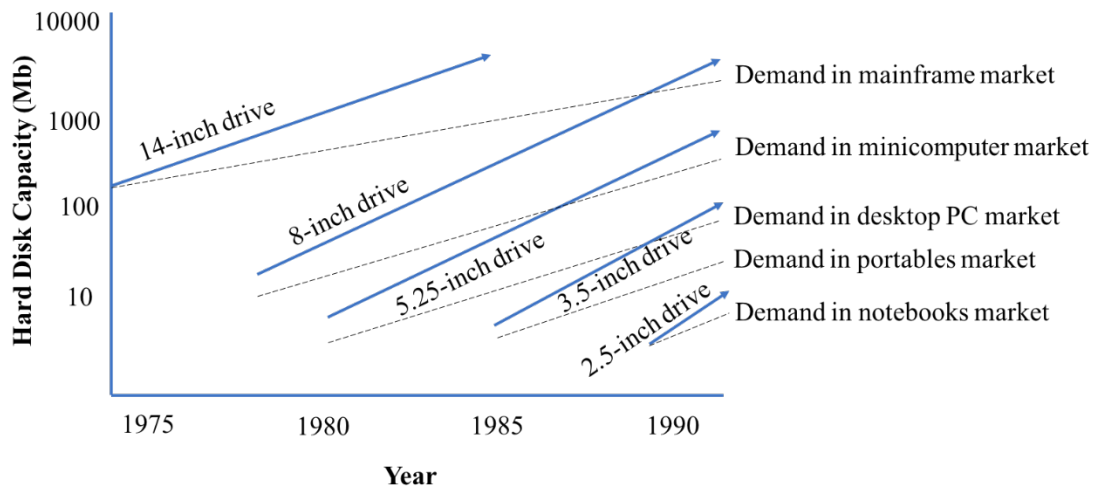


Figure 2 Classic example of disruptive innovation (Christensen 1997, 16)

New smaller 5.25-inch drive version was more convenient than 8- and 14-inch drives to use and a unit costed only 2000\$ while i.e. 8-inch model was priced up to 3000\$. 5.25-inch-drive lacked capacity and the access time was much bigger than in the prior models. Sustained products thereby trusted that mainstream customers wanted better quality over price and convenience and did not see the threat of new smaller disk drives to disrupt their business. This cycle between the disruptors and the sustained market leaders lead to a competition where disk drive size changed from big to small and the performance level from high to low – the point where a low-end disruption started moving upwards in the market.

2.2.2 *Characteristics of disruptive innovation*

This chapter presents a literature review on disruptive innovation characteristics that have been identified and complemented by many scholars since Christensen & Rosenbloom (1995) explained the attacker's advantage, work that was redefined into disruptive technologies and ultimately to definition of disruptive innovation (Christensen 1997; 2006; Christensen & Bower 1996; Christensen & Raynor 2003). Christensen's (1997) original DI theory highlights few important features that are in the core of DI. First, a disruptive innovation is inferior by its quality (it underperforms) compared to mainstream products and second, it is usually performed by an entrant firm. A disruption happens when mainstream market and DI trajectories intersect (Yu & Hang 2010, 436). Disruptive performance dimensions may first satisfy only a niche market due to innovation's convenience or low cost but primary performance dimensions that mainstream customers value are still unavailable. When disruptive innovation starts to perform better also regarding to primary dimensions it starts disrupting incumbents (Druehl & Smith 2008, 347). Since DI usually introduces a product that underperforms mainstream customer needs, it does not appeal to mainstream markets (Govindarajan et. al. 2011). These are all examples of low-end market disruptions, which Christensen (1997) characterizes by low-cost and underperforming features. Christensen did not consider disruption to start from high-end markets until Danneels (2004); Govindarajan & Kopalle (2006) suggested that DI theory should be complemented with a high-end approach.

Yu & Hang (2010, 438) agreed with Danneels (2004) and Govindarajan's & Kopalle's (2006) suggestions about high-end disruption's relevance in the DI theory. For example, Christensen did not consider premium products (convenient but expensive) such as cellular phones that were first in the hands of corporation executives to end up being disruptive. In the later phase when cellular phones were offered with a lower price and they reached a sufficient reliability in terms of coverage a disruption was real. Schmidt & Druehl (2008) quotes this kind of a high-end example as a detached market low-end encroachment and explains how low-end disruption could still start as a higher priced product. This will be explained more in detail in the next chapter where DI's trajectories are explained using an optional encroachment curve approach.

Christensen (2015) recently identified some of the DI characteristics that are commonly forgotten. First, DI usually targets those overlooked segments that mainstream market providers are not interested anymore because they focus on high margin segments and more paying customers. Charitou & Markides (2003, 56) explained this also by established competitors lacking long-term commitment on low-margin businesses. Second, DI is a process instead of an event. Disruptive innovation and mainstream market trajectories intersect when mainstream customers start adopting the entrant's disrupt-

tive offering in volume which means a disruption has occurred. Third, a business model innovation is the most common root type innovation that makes a true disrupter. From Christensen's view Apple's smartphones were sustaining innovations but their disruption was due to new business model that challenged the internet access market by letting app developers discover ways to make internet access via smartphones more convenient. This seems to be consistent with Markides (2006, 21) critique that business model innovation and technology innovation are so distinct from each other that it is a mistake to put them under the same disruptive category. And fourth, DI is the same whether the process takes different time. We have seen in the recent years that digital technologies make DI more unpredictable and faster which makes it more dangerous for incumbents.

Recent critics (e.g. Lepore 2014 & Moazed 2016) have turned DI discussion more towards digital products that do not follow the same trajectories that Christensen (1997) used in his examples. Digital disruption needs more research to have evidence of how it differs from other types of disruption. Baiyere (2016, 86) suggests that the speed of the process, cost, scale, value source or value effects of firm's operations might be changing due to digital innovations. Nambisan, Lyytinen, Majchrzak & Song (2017, 223) further argue that digital innovations have radically changed the nature and structure of new products and services, which seems to be consistent with Baiyere's (2016, 86) call for new analysis on digital materials and their potential disruptive impact.

Business authors often write: "disrupt or be disrupted", but DI is not a guarantee for success. The message should include that disrupter should not forget its still-profitable business. Incumbents should keep investing in sustaining innovations and create a different division for disruptive innovations that could bring more opportunities in the future. Most incumbents focus on sustaining innovations by listening to their customers and they find it very hard to invest in other smaller markets. The challenge here for many organizational reasons is to be an incumbent and an entrant at the same time. (Christensen 2015.)

Danneels (2004, 249) highlights the fact that DI changes the bases of competition by deviating from other sustaining technologies and these new DIs becomes adopted or rejected by customers. It means that customers have a big role in diffusion process since DI will not succeed without adopting customers. Christensen (1997, 206) acknowledges the problem of knowing whether an innovation becomes disruptive or not, but it should be looked from the trajectory point of view. If DI is on its trajectory to improve its main attributes faster than the mainstream product, then it could eventually become disruptive. Best way to draw trajectories is to seek data from the history and base the trajectory on those numbers (Danneels 2004, 251) and, also instead of listening to customers, watching what they do offers even more valuable data (Christensen 1997, 206).

Christensen's examples of trajectories have been criticized because of their linear approaches explaining innovation's diffusion. Danneels (2004, 254) criticized DI's pre-

dictability by addressing the fact that it is unclear what methods exist for ex ante predictions such as knowing what performance is expected from technology and what performance can be supplied at some point of the future. Danneels also noted that Christensen's DIs are only examples of succeeded innovations and examples of potential disruptive innovations that failed, e.g. Finkelstein & Sanford (2000) should be explained. Tellis (2006, 35) agreed with Danneels by saying: "*...if one must wait till the disruption has occurred, then what predictive value is there in the concept?*". Christensen (2006, 45–46) answered to Danneels (2004) and Tellis (2006) by arguing that DI is useful when one can interpret the meaning and future potential of a phenomenon when it is observed and DI provides these tools to predict what will happen for established and entrant firms. He even gave examples of successful predictions including his flash memory trajectory (Christensen 1997, 48–53), but agreed that predictions should be relative to business models rather than technologies. Govindarajan & Kopalle (2006, 16) defended DI's predictive value by suggesting that it could be utilized in making ex ante predictions by distinguishing firm A from firm B by their willingness to cannibalize themselves. The one that is more willing to adopt new innovations and cannibalize own business is more likely to end up being disruptive.

Geels & Schot (2007) and Geels, Kern, Fuchs, Hinderer, Kungl, Mylan, Neukirch & Wassermann (2016) suggest an alternative concept for entrants to overcome incumbent's market leading position. Their sociotechnical approach suggests that multilevel perspective (MLP) is more rational model for new innovations development instead of drawing only a technology trajectory e.g. Christensen (1997). MLP theory includes three different levels: niche-innovations, sociotechnical regimes and sociotechnical landscape. This means that a new niche-innovation does not only face the technology challenge but instead a sociotechnical regime, which takes policy makers, scientists and other special-interest groups into consideration. Above these, sociotechnical landscape affects by its macro-elements such as macro-economics, deep cultural aspects and macro-political decisions. These macro-elements develop usually slowly and changes in sociotechnical landscape can take even decades. A new niche-innovation could start from the pressure of a landscape change and disrupt incumbents if the landscape's pressure opens a "window" in the sociotechnical regime (Geels 2002, 1263). This thesis takes the view on concentrating in disruptive innovation theory even sociotechnical approach is taken into consideration because of shipping's complex nature requiring many different actors such as policy makers to develop innovations. Disruptive innovation theory demonstrates a simpler model of innovation challenging incumbents.

2.2.3 Market diffusion

Market diffusion offers a way of explaining DI instead of focusing only in trajectory charts by complementing the theory with encroachment curves (Schmidt & Druehl 2008, 362). Diffusion is a process where innovation is communicated through certain channels over time among the members of social system. Communication is not kept as a one-way process, instead a two-way process where two individuals or organizations change information. The content of the message is about new idea. This newness of an idea characterizes diffusion communication. Diffusion process can be described as social change, which occurs when new idea turns into invention, diffuses and eventually becomes adopted or rejected. Usually diffusion process takes time and innovators are trying to solve a problem of how to speed up the process, but not all good ideas become adopted although they could offer advantages. For example, keyboards we all use called “QWERTY” have not been replaced by Dvorak-keyboard yet although the latter has proved to be more efficient and less overloading keyboard. One reason for rejected diffusion is simply the newness of the idea because it is also considered as a mark of uncertainty. Rogers (1983, 1–11.) Baiyere (2014) explains this by relativeness and emphasizes the fact that potential disruptive innovation (PDI) could be disruptive by its design (small, convenient etc.), but not necessarily become DI because of responders such as existing competitors take actions to prevent the disruption happening.

Schmidt & Druehl (2008, 348) divides innovation types either sustaining or disruptive. Sustaining innovation starts as high-end encroachment diffusing downward in the existing markets. Encroachment means that the new product takes sales away from the old product. Pentium IV relative to Pentium III and iPhone 7 relative to iPhone 6 are sustaining innovations that start taking sales away from the old version (see Figure 3).

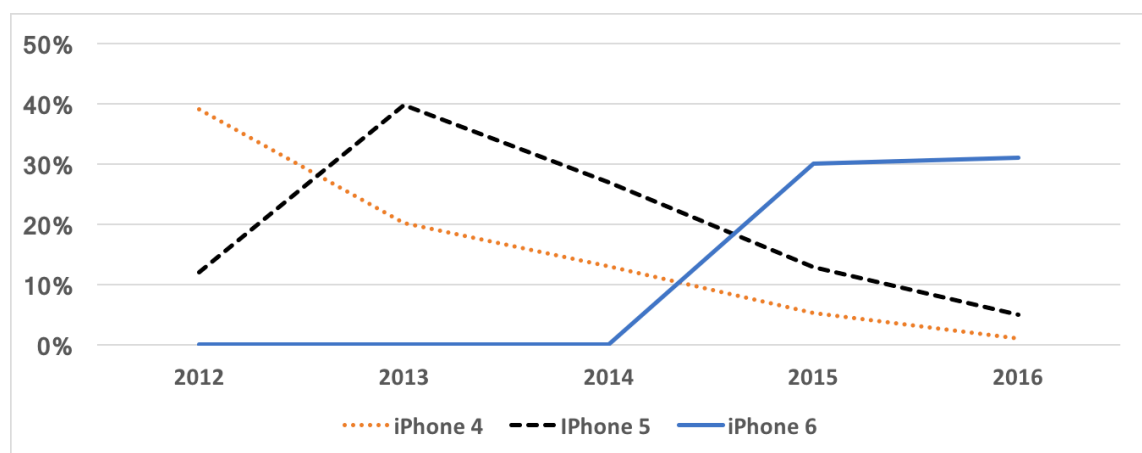


Figure 3 iPhone model market share as an example of sustaining innovation (data from Localytics, 2017)

iPhone market share chart serves an updated version of Pentium example that Schmidt & Druehl (2008) used explaining sustaining innovation. The iPhone model market share comparison between 2012 and 2016 includes only three iPhone models but it offers a simple overview of new product's high-end encroachment taking sales away from the old product.

Sustaining innovation diffuses downward in the existing market when disruptive innovation starts as a low-end encroachment diffusing upward in the existing market. In turn, DI can be divided into two categories; new-market disruption and low-end disruption (see Table 1). New-market disruption starts from fringe-markets where customer needs are incrementally changed or in detached-markets where customer needs are dramatically different. 5.25-inch disk drive relative to 8-inch drive was a fringe-market low-end encroachment by creating a desktop market, which was incrementally different from high-end mainframe markets. Cell phone relative to land line was a detached-market low-end encroachment by opening a totally new market for business executives. (Schmidt & Druehl 2008, 348–351.)

Table 1 Types of market diffusions (adapted from Schmidt & Druehl 2008, 349)

Type of innovation	Type of diffusion to which it maps	Description	Example
Sustaining Innovation	High-end encroachment	Diffuses downward in the existing market	iPhone 7 relative to iPhone 6
Disruptive innovation	Low-end encroachment	Diffuses upward in the existing market	
New-Market disruption	Fringe-market low-end encroachment	Opens up a fringe-market where customer needs are incrementally different	5.25 inch disk drive relative to 8 inch drive
	Detached-market low-end encroachment	Opens up a detached market where customer needs are dramatically different	Cell phone relative to land line
Low-End Disruption	Immediate low-end encroachment	Affects immediately on the existing low-end market	Discount relative to department stores

Usually a new-market disruption product is targeted to those who did not have the money nor the skill to buy and start using the mainstream product (Christensen & Raynor 2003, 102). Southwest Airlines opened a fringe-market by providing transportation for those customers that otherwise would have driven, which is consistent with Table 1 findings – fringe-market is changing the customer needs only incrementally (Schmidt & Druehl 2008, 363). On the other hand, low-end disruption is more immediate and happens in the same market. It starts diffusing upward like discounts relative to department stores (Schmidt & Druehl 2008, 351).

Although Danneels (2004), Govindarajan & Kopalle (2006) and Yu & Hang (2010) are suggesting that high-end disruption approach should complement DI theory, Schmidt & Druehl (2008) explains why low-end encroachment could start from high-end but still should be labeled as a low-end disruption: Cell phones were high-end products in the beginning but the disruption did not start from the high-end. It started from the detached low-end market diffusing upwards when the cell phones were offered for students with lower price and good-enough performance. The starting point was indeed a detached high-end market which can misguide us labeling the low-end disruption as high-end disruption. This discussion is quite confusing and in my view the “high-end disruption” terminology helps to understand that DI could be initially a high-end product or service. To summarize this Christensen (1997) used only the low-end or low-end new market disruption approach but i.e. Danneels (2004), Govindarajan & Kopalle (2006) and Yu & Hang (2010) added the high-end disruption to complement the theory when Schmidt & Druehl (2008) argued that DI always encroaches from the low-end but could be first a higher priced product with U-curve shape demonstrated in the Figure 4.

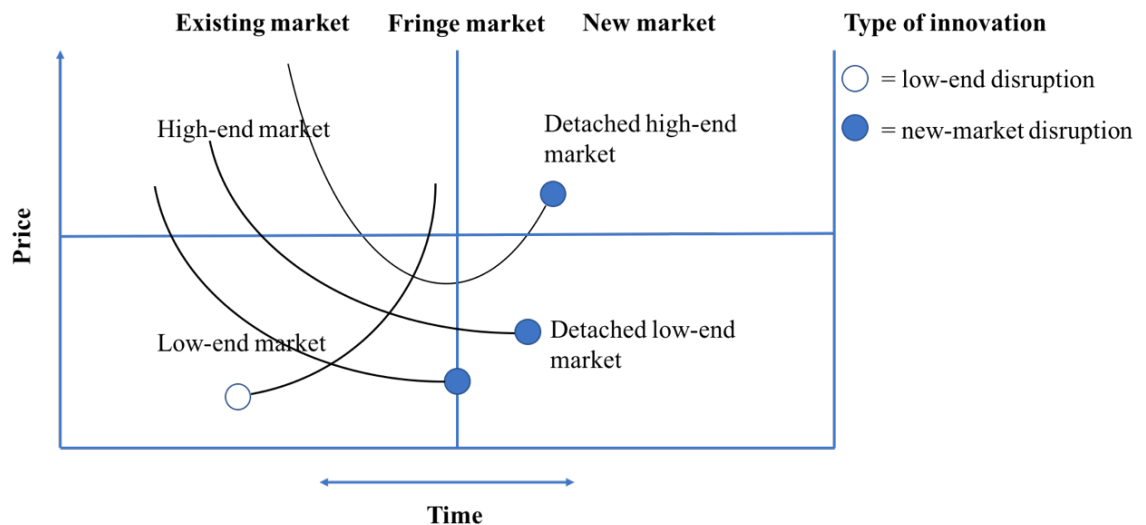


Figure 4 Disruptive innovation's types of encroachment curves

Figure 4 adds one window (top right) into Table 1's findings by highlighting the fact that detached-market disruption can also start from high-end market but the encroachment starts always from the low-end. It offers a demonstration to critics that DI could be a high-end innovation at first but if it is a true disruptive innovation by its nature it always encroaches from the low-end.

2.2.4 Responding to disruptive innovations

Previous chapters have identified the key characteristics of disruptive innovations, but this chapter takes more practical approach of utilizing DI for managerial use. Responding to new innovations has been generally related to organizational abilities such as dynamic capabilities (King & Tucci 171, 2002). Baiyere's (2014) DIVE-model is used here to explain how the threat of potential disruptive innovation (PDI) could end up being disrupted disruption (DD) or how could the disrupter help the progress of PDI to become DI (see Figure 5).

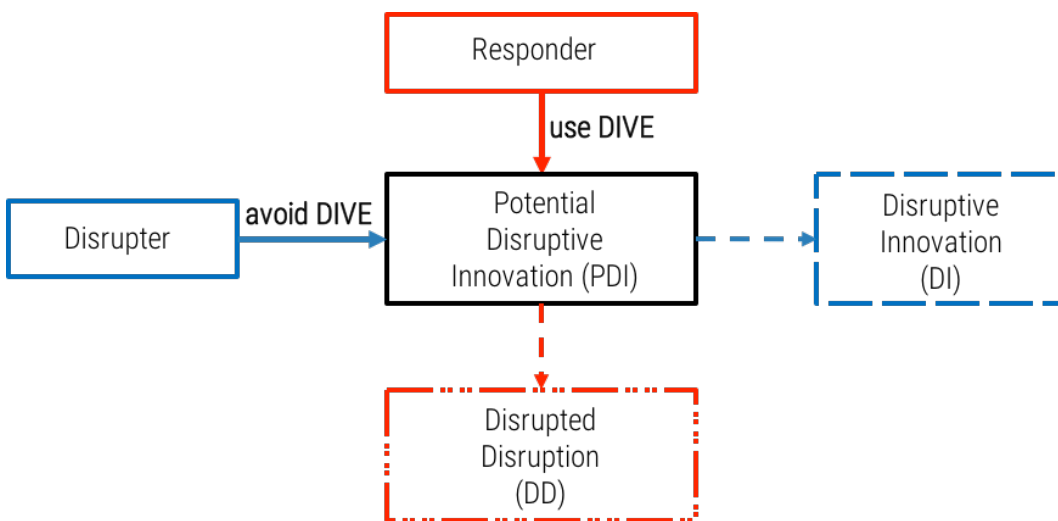


Figure 5 DIVE-model as operationalizing DI (Baiyere 2014, 143)

DIVE-model is based on four propositions: Direct competition, Ignore, Velocity of adoption and Entrants. First, responder should add direct competition if a PDI is noticed. The more direct competition, the less disruptive threat. Second, responder should not ignore PDI because the more PDI is ignored, the more it has time to develop. Third, responder should slow down PDI's velocity of adoption since the speed of adoption has direct impact on the scope of threat. Fourth, responder should observe entrants with high interest because ignored entrants are the typical disrupters due to a less direct competition. Disrupter should use all four propositions as the other way around avoiding direct competition, help the progress of PDI getting ignored, speeding the PDI's velocity of adoption and be an entrant if possible. DIVE-model is one of the few models operationalizing DI theory for managerial use.

Charitou & Markides (2003, 57–63) presents five different responses, which were identified in their research that involved 92 companies, in which two-thirds had responded to threat of DI. The first identified response was to focus in traditional business knowing that DI, especially if it is a disruptive business model innovation (DBM) usually take only some part of the market share but rarely push incumbents out of business.

King & Tucci (2002, 184–185) found out that incumbents are in fact capable of surviving PDI's threat because they have valuable experience from the market. Focusing in traditional business does not ignore PDI, but it focuses more in one's current business model. The second response ignores PDI totally. Some PDIs in the same industry does not necessarily have to be threats for one's market. Ignoring PDI could be risky and requires a careful assessment of comparing existing market with the new offering. If assessed right, ignoring PDI could keep the focus in the right direction. However, ignoring PDI is also the reason why some incumbents were disrupted. The third response suggests attacking back by disrupting the disruption as seen in the Figure 5. This response emphasizes the possible threat, which requires actions from incumbents. (Charitou & Markides 2003, 60.) Apple competed against Samsung, another high-end producer, for many years by both improving their smartphone models. This led to increasing prices and sustaining innovations in smartphone markets. After years of overlooking the need for affordable smartphones, companies such as Huawei, LG, Lenovo and many others introduced more affordable smartphones offering good-enough performance with low-cost. How did Apple response? First it focused on their traditional business investing in high-margin markets, but later introduced their iPhone model SE with affordable price and good-enough performance. It was a clear attempt to disrupt the disruption.

The fourth response embraces PDI by adopting it into one's business, which leads to "playing two games" at once. It is not attacking and disrupting the disruption but rather utilizing it for one's own disruptive use (see Figure 6).

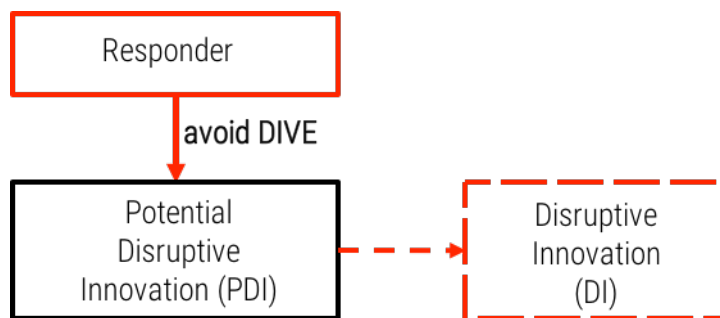


Figure 6 Responder as disrupter (complemented from Baiyere 2014, 143)

Responder could be a disrupter by avoiding DIVE and follow the disrupter trajectory instead of disrupting the disruption. Adopting PDI while continuing in traditional business is very hard for incumbents that usually requires a separate business unit, which has an autonomous decision making ability to promote PDI while developing sustaining innovations in their traditional units (Charitou & Markides 2003, 61–62). This is consistent with Christensen & Raynor (2003, 191) suggestion of disruptive innovations requiring an autonomous business unit to acquire new capabilities that helps to launch new-growth business.

The fifth response takes the actions to embrace PDI fully and forget the existing business. It is the extreme way of adopting PDI, one having the interest to join PDI with every resource one has to scale and grow the DI to become a success. Embracing DI fully requires a risky decision from visionary managers. All five responses could work for one's advantage and every response should be based on careful strategy and assessment of PDI relative to one's market. Different approaches towards responding can be explained by companies' differing ability and motivation to react (Charitou & Markides 2003, 62–63). Henderson (2006, 7) argues that senior management is rarely equipped with sufficient information to respond to disruptive threats since it is very difficult to compare existing technology with disruptive technologies. This makes a call for responding to DIs with some other organizational areas such as organizational culture and structure that could prepare an organization for responding to disruptive threats if needed.

Organizational culture is a critical component for firm's success (Yu & Hang 2010, 442) and it is an important tool for managers to execute tasks for their vision and strategy (Tushman 1997, 19). According to Govindarajan & Kopalle (2006, 17) culture promotes disruptive innovations through entrepreneurship, risk taking, flexibility and creativity. Innovation research usually emphasizes that size of the organization impacts on its research and development's (R&D) effectiveness and studies show that smaller firms are more effective introducing disruptive innovations (Yu & Hang 2010, 443). Although, if the disrupter or the responder is a large organization, a separate autonomous business unit helps to commercialize and develop one's innovation by structuring processes and values such as cost structure differently (Christensen & Raynor 2003).

Chesbrough (2010, 362) refers to Christensen's concept of entrants challenging incumbents and emphasizes that innovation barriers are real and companies need to adopt business model experimentation minded attitude to respond better against uncertainties. He further suggests that companies need to identify internal leaders who take the organization through business model change by continuing with their existing business model while embracing the new one. Only this way organization could avoid getting trapped by old business model, but change resistance could still evolve. Rajaniemi (2010, 112) argues that change resistance can be interpreted also as innovation resistance. He found in his study that organizations were more often willing to take risks than prepared to eventually execute them (Rajaniemi 2010, 130). One way to help employees to overcome the change is to have a visionary leader in organization who communicates and promotes perseverance through whole organization. Without a determined and visionary leader organization could encounter structural barriers for innovations. (Rajaniemi 2010, 181–184.) Originally introduced by Kazt & Kahn (1966) the concept of negative entropy suggests that if change requires more resources (energy) than organization (organism) have, execution of change becomes impossible. Being an established firm

without enough resources, responding to disruptive innovations would be rather challenging while they struggle already with resource allocation when responding to DIs according to Christensen & Raynor (2003).

2.2.5 Summary of the theoretical framework

Theoretical framework presented a literature review of prior disruptive innovation theory. Three root type innovations of technology-, radical- and business model innovation were explained to emphasize the importance of disruptive innovation being different depending on its root type. The core of DI was presented using Christensen's (1997) original theory and the evolution of the theory was used to complement Christensen's concepts. Two important complements were identified. First, disruptive innovation stems from technology- and business model innovation, BMI as the most common root type for disruptive innovations (Christensen 2015). Second, high-end disruption should be included in DI theory although there are still differing views on high-end disruption. This thesis utilized Schmidt & Druehl's (2008) high-end approach, which suggests that DI could start from high-end, but the encroachment would always begin from the low-end. DI theory was also operationalized by using Baiyere's (2014) DIVE-model and Charitou & Markides' (2003) five different responses towards DI. When DIVE was compared to Charitou & Markides' research, an adapted DIVE-model was identified, in which the responder becomes also the disrupter.

Responding to innovations have been generally related to organizational capabilities (King & Tucci 2002) and DI takes a lot of its elements from competence and dynamic capabilities theory. DI theory provide tools for both disrupter and the responder, which are both important for this thesis since the established firms are treated the responders. By looking the established firms as responders does not exclude their potential to be disruptive emphasizing Charitou & Markides' (2003) findings.

Table 2 summarizes the key elements of DI theory attained from Christensen (1997); Christensen & Raynor (2003); Christensen (2006); Tellis (2006); Govindarajan & Kopalle (2006); Markides (2006) Schmidt & Druehl (2008); Yu & Hang (2010); Christensen (2015) and Baiyere (2016).

Table 2 Key elements of complemented disruptive innovation theory

Disruptive innovation's key elements

Usually cheaper, simpler, smaller, more convenient and initially underperforming
 Appeals to emerging or insignificant markets, with price sensitive customers
 Relative process instead of an event
 Offers new features and values, opening new markets
 Encroaches always from low-end market
 Stems from business model-, technology- or radical innovation
 Requires a new set of skills and capabilities
 Failure and learning are intrinsic for DI's success
 Has a high risk of failure
 Entails significant first-mover advantages
 Improves steadily its performance and start displacing incumbents

Sustaining innovation's key elements

Encroaches from high-end market
 Overlooks and ignores DI
 Struggles with resource allocation when encountering DI
 Requires a separate autonomous business unit when responding to DIs
 Avoids risks and concentrates on profitable business
 Possess the capability of responding to disruptive threats

Table 2 can be used as a summary for managerial purposes, to identify true DI characteristics and compare DI with SI to avoid misunderstanding of the rather complex theory.

3 RESEARCH METHODOLOGY

3.1 Characteristics of the research and data collection

To build a deeper understanding of the Baltic sea shipping markets I decided to reach out shipping companies that operates in Finland and in the Baltic sea area. These shipping companies were close enough geographically to make the interviews face-to-face. Baltic region was a natural choice also because of the ecosystem launched in 2016 which aims for the world's first autonomous marine transport system in the Baltic area. (Autonomous ships ecosystem 2016).

Qualitative methods are concerned with interpretation and understanding (Eriksson & Kovalainen 2008, 5) and tend to focus on small amount of cases and tries to analyze them thoroughly (Eskola & Suoranta 1998, 15). Weinberg (2002, 1–2) relates qualitative methods as discovering something instead of focusing on information and this thesis is purely discovering the potential disruption in shipping. I decided to acquire data using qualitative methods by using interviews since the research topic requires more overall understanding of the phenomenon and there exists not enough data yet to explain and test hypothesis to make statistical analysis (Eriksson & Kovalainen 2008, 5). Interview is simply a situation where interviewer discovers target interviewee's motives and attitudes towards the researched topic (Eskola & Suoranta 1998).

In overall, enough data of disruptions exists that could have made the quantitative research possible, but the specific focus is in the shipping industry asks for discovery instead of measurement. The hypothesized disruption in shipping is such a new phenomenon that deeper analysis provides interesting view with a speculative approach. However, as Weinberg (9–11, 2002) suggests that research methods should not be set as opposite ways of studying assumptions, but it should be explained why a specific method was used and address the critics explicitly, thus this thesis is quite limited taking a view of only seven firms in Baltic area that might consider smart-shipping very differently than some other shipping markets in other regions. Therefore, the results of this thesis should be contrasted carefully on other shipping companies and markets in other regions, although the same phenomenon is hypothesized impacting globally.

3.2 Data collection process

After series of literature reviews and writing some part of the framework it was clear what questions should be asked from the interviewees and what kind of companies and people should be contacted. I wrote my first draft of the interview questions in Febru-

ary, which were amended after supervisor gave her comments. The final list of the interview questions is attached in the appendix (p. 83). Framework of this thesis was intentionally kept as modifiable during interviews to ensure a possibility to adjust the framework and theory after data collection. Disruptive innovation theory structured the framework for the questions, but also other topics were covered. The list included questions that did not relate directly to DI because I wanted to have better overall understanding of markets and issues around DI. This gave me deeper knowledge of the shipping markets in the Baltic sea since I did not have much knowledge in that area before starting the research process. Some questions were also purposely targeted to have wide perspectives following the idea of May's (2002, 204) suggestion of "*always leaving room to discover the unexpected and uncover the unknown*".

After drafting the interview questions, I began searching for shipping companies that operates in Finland. My aim was to reach top management from each company to get data from decision makers who are part of strategy making and ideally innovations, hence it made it harder for me to contact them, but I managed to get all seven interviews with top managers and got two of the interviews scheduled quickly. I started my interviews in March 2017 and the last interview was kept in June 2017. The first interview helped me to learn and improve my interview methods giving me more confidence to proceed with the interviews and ideas of developing interview's structure.

The first interview set up with Rolls-Royce, Ship Intelligence gave me more information about the hypothesized disruption in shipping. It built the basic understanding about the potential disruptive innovation characteristics of smart-shipping, which was later reflected on the other six interviews. Other interviews were not scheduled in any specific order thus they were organized as in the order of potential interviewees accepted my invitation. Only one company declined or did not have time for the interview and two companies was not reached after multiple tries resulting in total of seven interviews and eight interviewees, one interview including two persons at the same time. I knew from the beginning that I would be needing at least five interviews, but tried to get even 10 interviews. The more different views, the more overall understanding of the shipping and the potential disruption. One interview gives only one subjective view and each interview adds the final story and overall understanding (May 2002, 211).

Interviews were conducted as semi-structured theme interviews thus the questions and themes were set beforehand, but each interview was slightly different. This was due to my desire of keeping interviews as open as possible, which lead more to in-depth discussions than structured interviews. Every interview had their own kind of way of developing but I succeeded in getting answers for each theme from every interviewee. Some interviewees had clearly their own interest in some specific topics leading to different emphasis in different parts of the interviews. For instance, some were more interested in environmental issues, when some were more technology orientated. Seven in-

interviews generated seven hours and 24 minutes of recorded material, one interview lasting approximately one hour. Recorded material was transcribed usually after each interview leading to total of 102 pages of transcript. A lot of the data was collected that was not usable for my thesis directly but the information helped me to understand the shipping markets and target companies better.

3.3 Analysis methods

First a careful work with data collecting and pre-actions were made to ensure a good basis for results and analysis. Quoting May (2002, 16) "*luck is the residue of design*" stresses the importance of careful and planned work at pre-stage before analysis to avoid luck factors in finding results from data. Koskinen, Alasuutari, Peltonen (2005, 231–232) provides instructions for pre-stage analysis by emphasizing three important tasks that were used in this research to familiarize myself to overall data. First, a careful and repeating reading of collected data helps to understand the overall features and making notes during reading process further helps to identify the important or interesting parts of the data. This takes usually a lot of time especially when the size of the data is big as it was the case in this research. Second, notes help to identify preliminary themes that should be based on rational reasoning to avoid excessive work. I printed my whole data and used post-it notes and coloured pencils to make the notes. At this point the themes are only preliminary and helps to identify the central issues. Third, when more focused reasoning is attained and research questions and purpose of the thesis is clear, data can be extracted to a separate file. Before extraction, preliminary themes should be assessed carefully by determining, which themes are important for the research. I based the themes on identified disruptive innovation topics and for those identified themes that repeated in every interview. Eriksson & Kovalainen (2008, 129) argues that data coding is usually derived from theory or empirical data, but I used both since they both include views that are important for the research. After deciding themes I coloured sentences with a different colour that belonged to certain themes and when whole data was processed, I created separate files for each theme and reached a good starting point for making the analysis.

Analysis for this research was based on content analysis methods, which is one of the qualitative study methods (Eriksson & Kovalainen 2008, 130). Understanding the content fully after careful reading can solely build interesting and justifiable interpretations (Koskinen et. al. 2005, 241). Tuomi & Sarajärvi (2009) describes content analysis by creating a verbal and explicit description of the researched phenomenon by structuring data collection in tight and clear form. The purpose for this method is to provide a reasonable and solid information integrity even from scattered data. Tuomi & Sarajärvi

(2004) divides content analysis for three categories that are empirical-based content analysis, theory-guided content analysis and theory-based content analysis. This research takes its impacts mostly from theory-guided content analysis since the disruptive innovation theory guides most of the choices to structure the analysis. However, the analysis takes impact also from empirical-based content because the target companies as responders are important part of the study. Theory-based or theory guided content analysis structure is usually tested in new context as it was the case in this research testing potential DI in the context of shipping. (Tuomi & Sarajärvi 2009.)

DI theory only guide this study's analysis but empirical data support the purpose of this research by giving insights of shipping markets and subjective views on target companies' position in their markets. Empirical-based content also helped to form the responder approach when describing the target companies as responders for potential DI. Since empirical data builds part of the analysis, fully theory-based content analysis was not an option. In content analysis, topics that deviates from others and belong to same group are clustered and labeled with a content name (Tuomi & Sarajärvi 2009). This was done by extracting the data into separate files and labeling the names for each cluster. After first round of clustering, a cluster was further divided into smaller themes inside one cluster by extracting the data from word-files to excel files. This was done due to a large data material and more specific analysis was only possible by breaking one cluster to even smaller clusters.

3.4 Reliability and validity of the research

Koskinen et. al. (2005, 242) argues that when the analysis is based on people's subjective stories instead of fact-based data, the analysis leads to comparing and structuring these interpretations rather than creating new information. Hence this research's analysis is more of a structured story based on eight marine sector persons compared and tested against DI theory. Tuomi & Sarajärvi (2009) argue that content analysis aims to provide a solid information integrity from researched topic, thus this research is an attempt to develop a solid integrity of hypothesized disruption. It is hard to generalize this research's results because of low number of perceptions total of seven target companies and eight interviewees.

Validity of the research is hard to evaluate in qualitative methods. Validity includes internal- and external validity, in which internal validity means logical and contradictory perception and external validity meaning perception's generalized features. This research is conducted through careful actions and analysis is based on consistency. All the interviews were recorded and transcribed carefully. Analysis was based on clustered themes that helped to form an explicit and solid integrity. Internal validity could be

evaluated as reliable and consistent since any other researcher would end up on the same results if the same data is used. The validity could be criticized by subjective decisions of themes that were based on theory guided content. There could have been other themes that are relevant for this research hence it comes down to researcher's own decisions. Although most of the themes were determined by recognizing repeating topics inside the whole data. Internal validity can also be criticized because of only one method was used to gather data and validity could have been better by using other methods such as quantitative survey. (Koskinen et. al. 2005, 254–257.)

Qualitative methods are usually criticized by its nature of not being able to produce reliable generalized perceptions (Koskinen et. al. 2005, 263). Although the purpose for qualitative methods are usually to study small amount of cases thoroughly (Eskola & Suoranta 1998) and focus on discovering interpretations (Weinberg 2002). Therefore, this study presents a content-based analysis after small amount of marine companies and their top management. This study includes only companies operating in Finland and mostly in the Baltic and North Sea area, which is also one reason why this study should be generalized with cautions. Although, if Finnish based Baltic area shipping is assessed, this study makes a rather good effort in identifying the interpretations of hypothesized disruption by shipping companies since the target companies presents a major part of the Finnish Shipping industry by turnover. In overall, the external validity is hard to evaluate, but if used Eskola & Suoranta (1998) suggestion of research being externally valid when research subject is introduced exactly the way it is, this research is valid.

If validity is hard to assess, it is easier to evaluate this research's reliability since all the stages that were part of data gathering and analysis were conducted carefully and in this chapter, the overall description of the research was introduced. Transparency of the methods used and data gathering provide reliable results. Even though the topic of this thesis takes major impact from Rolls-Royce's vision of autonomous ships and origins of the interest towards this topic started from working at Rolls-Royce, Finland as a summer trainee this study takes an objective view. DI is addressed as a potential DI leaving room for any contradictory view including critics. (Koskinen et. al. 2005, 255–259.)

3.5 Target companies and the interviewees

All seven target companies operate in marine sector and have a business unit in Finland. They offer a wide range of perspectives for the research, one complementing another by giving different views from different business segments. Marine system supplier, Ro-Ro, container-, bulk- and passenger shipping are involved. They all have operations in the Baltic Sea shipping market. One way of collecting data would have been

choosing one market segment, but the Finnish based Baltic Sea shipping market is limited. All target companies are operating in the Baltic marine transportation system thus they are suitable for this research. Target companies are presented shortly and summarized in the Table 3. Summary presents the target companies' main business segments in shipping operations although some of them have many operations and business models. For example, Containerships transports cargo using, sea, rail, road and river transportation.

The information used in the descriptions are collected from the target companies' homepages and from some secondary materials i.e. power point presentations got from interviewees or public documents such as company's annual reports. Turnover figures are data from last year 2016. Interviewees are described shortly to emphasize their roles in the target companies to demonstrate the founding of empirical data. Interviewees are dealt anonymously as promised to every interviewee beforehand, which helped to discover even more ideas, attitudes and insights.

Table 3 Summary of the target companies

Target company	Turnover (2016)	Business segment in shipping operations	Location (HQ)	Founded	Number of interviewees
Rolls-Royce, Ship Intelligence	- (321 M€)	Supplier of marine systems	Turku, Finland	2015	1
ESL Shipping	71 M€	Bulk shipping	Helsinki, Finland	1949	1
Langh Group	16 M€	Bulk, container shipping	Piikkiö, Finland	1973	1
Meriaura Group	54 M€	Bulk shipping	Turku, Finland	1986	1
Bore	41 M€	Ro-Ro shipping	Helsinki, Finland	1897	2
Containerships Group	198 M€	Container shipping	Helsinki, Finland	1966	1
Viking Line Group	520 M€	Cruise, cargo, passenger shipping	Mariehamn, Finland (Åland)	1959	1

Rolls-Royce, Ship Intelligence

Rolls-Royce Ship Intelligence unit operates under the Finnish Rolls-Royce Oy Ab with net sales of 321 M€ as part of the group's marine operations, which is one of the leading suppliers of advanced marine power propulsion system and deck machinery. Rolls-Royce equipment are installed in over 30 000 commercial and 70 of the world's marine forces vessels worldwide and R-R global network consists of 50 centers in 28 countries. Rolls-Royce Marine is offering its expertise and mission critical systems primarily for offshore, merchant and naval market sectors.

Ship intelligence unit locates in Turku, Finland and it was established in 2015. The new unit is offering products and services that will enhance vessel performance and operations by harnessing the power of data. Ship intelligence consist of three units that

are health management, energy management and remote & autonomous operations. Rolls-Royce has over 20 years of experience of using equipment health management in aerospace sector, which means that analyzing billions of data points every day, R-R can predict the probability of failures with confidence. This level of experience offers tools and benefits also for marine sector. Ship intelligence is a response for R-R visions of new era in shipping that means more integrations between ships and production processes or logistic chains achieved by new digital technologies and the power of data.

Interviewee from Ship intelligence has a major role regarding to innovations and technology and brings a lot of insights and visions into the research from the system supplier's role. This interview sets the starting point for my thesis hypothesizing the potential disruption, which will be reflected upon with shipping companies' view.

ESL Shipping

ESL Shipping established in 1949 is part of the ASPO group located in Helsinki, Finland and is the leading carrier of dry bulk cargoes in the Baltic Sea region, 43 per cent of the net sales of 71 M€ coming from steel industry and proven to be profitable despite of the challenging market situation. It has 14 tailored vessels, of which the company owns 13 ships. ESL Shipping offers reliable, safe and flexible deliveries regardless weather and ice conditions as sustainable as possible. ESL Shipping is a strong niche player with deep understanding of the flow of goods and deep knowledge of selected clients, routes and materials. Vessels are designed to survive in difficult operational environments such as arctic and icy conditions and they are designed to be capable of loading and unloading at seas. ESL Shipping is responding to increasing environmental regulations and has ordered two the world's first LNG (liquefied natural gas) fueled large dry bulk carriers that decreases 50 per cent of the ship's CO₂ emissions. Sustainable business model along with more interest in the arctic areas by infrastructure and mining projects makes ESL Shipping a strong and competitive dry bulk carrier also in the future.

Interviewee from ESL Shipping is part of the top management and has a long experience in shipping. The interviewee being as part of the decision making offers a significant point of view from ESL's bulk shipping markets. This interview helped me to build the overall understanding of the bulk business and the differences between different shipping business segments.

Langh Group

Langh Group locates in Piikkiö, Finland having a long history beginning from the 1973. Langh Ship, part of the group is transporting steel, bulk and containers and its fleet is designed to operate in challenging Northern areas. Group also includes steel carriage and bulk container innovator Langh Cargo Solutions, scrubber designer and producer

Langh Tech and industrial and ship cleaning services Hans Langh. Group's turnover was 16 M€, Langh Ship owning five ships that are all chartered to Finnish shipping companies. The experience of many decades gives family-owned Langh Group the edge in technological solutions and group being a small and medium enterprise gives them the flexibility to react quickly in changes.

Interviewee from Langh Group has a top management position and brings a great value to my research with a long experience in shipping industry. Interviewee adds a wider perspective to my interview themes instead of focusing only in digitalization. This interview offers a different kind of perspective from family-owned small and medium enterprise.

Meriaura Group

A family-owned Meriaura Group in Turku, Finland includes Meriaura, VG-Shipping, Auramare and Gaiamare with turnover of 54 M€. The Group is specialized in bulk cargo transportation, crew and ship management, biofuel development and production, ship designing and environmental technology and it was established in 1986 by a sea captain and his friends. Since then Meriaura has rapidly increased their number of ships and employees. Meriaura Group owns total of six ships and charters the rest of their ships. VG-Shipping works more as a technical operator with crew management and safety systems and Meriaura handles commercial operations specialized in demanding project cargo and transporting industrial bulk and raw materials. Meriaura Group works for many sustainable development projects and one of their ambitions is developing and implementing new sustainable forms of energy. Group's core mission is to be in the frontline in developing sustainable shipping.

Interviewee from Meriaura Group has a central role in the group's businesses and has a lot of insights especially of crew and ship management operations. His long history in the group offer a long-term view on research questions especially related to environmental and manning issues and adds one valuable piece of the overall story.

Bore

Bore headquarters in Helsinki, Finland and was recently acquired by Spliethoff group. Bore has a long history in Finnish shipping, founded in 1897 the company has experienced many changes during its lifetime, i.e. moving from passenger ship markets to general cargo transport provider and eventually fully focusing in Ro-Ro shipping market. Now Bore has turnover of 41 M€ and eight ships suitable for the Ro-Ro shipping market in the Baltic Sea and North Sea areas and the fleet is designed for year-around purposes with ice class classifications. Bore is concentrating on cargo shipping, providing their resources and capabilities for line operators. The company is constantly developing and participating in new greener solutions for shipping such as the new alignment

with Finnish engineering company Norsepower, installing rotor sails onboard Bore's Vessel M/V Estraden. Sustainable shipping and eco-compatible solutions are in the core of Bore's strategy, which makes them competitive also in the future when shipping industry is expected to face more and more environmental regulations.

Interviewees from Bore were both top managers having a lot of insights of how they see the Ro-Ro market now and in the future. They also had a great input in other interview topics adding even wider perspective for my research. This was the only interview with two interviewees – having two standpoints from one company makes the collected data more solid and with more time and resources the desired case would have been two interviewees from each target company.

Containerships Group

Containerships is one of the world's oldest container shipping companies established in 1966 and owned by a Finnish family. It is headquartered in Helsinki, Finland and operates in 21 countries. Containerships is a one-stop-shop providing every supply chain service for their customer's needs from warehousing to re-packing. It has an integrated door-to-door logistic system offering all kinds of containers with inter-modalism concept using sea, road, rail and river container transportation to deliver the goods between Russia and the Baltic, Europe, UK, Ireland and the North Sea and, also between North Africa and the Mediterranean. Their vessel fleet consist of 12 vessels, eight of them operating in the Baltic Sea and the rest in the Mediterranean Sea. With 198 M€ net sales and with a strong foothold and history in the container business, Containerships is one of the major transportation players in Finland. Containerships complies with the environmental legislation and is investing in technologies that helps to reduce emissions and wastewater. It has ordered four LNG-ships and is also investing in LNG-driven trucks, which means that Containerships will be the first company in Europe to have a fully LNG-based logistic chain.

Interviewee from Containerships is part of the top management and has a long experience in the shipping industry. Insights from top management point of view serves reliable information about the container shipping, which is an important business segment to include in smart-shipping study.

Viking Line Group

Viking Line is the market leading cruise and ferry line in the Baltic area headquartering in Marienhamn. Viking Line Group consist of five wholly owned subsidiaries. It was established in 1959 and since then over 50 ships have sailed under the Viking Line's name. Group focus in cruise, cargo and passenger shipping between the northern Baltic Sea countries. Viking Line has now seven ships with net sales of 520 M€, sales coming from ticket, cargo and on-board sales. Viking line's mission is to provide sustainable

and regular ferry service for everyone. Over half-century time-period Viking Line's ships have seen dramatic changes so it was interesting to have insights how they see their own market segment developing in the future.

Interviewee from Viking Line is part of the group's top management having a significant role in the company adding a valuable view to the story with a long experience in passenger shipping. This interview concludes my data collection with having insights only from top managers that are in the core of making decisions and strategy in different Baltic marine transportation markets.

4 RESULTS AND ANALYSIS

This chapter presents acquired data in a form that helps to identify answers for the research question of *How do established firms see the disruptive threat of smart-shipping and how could they respond?* First, established firms position themselves in the markets since they are under the scope of potential disruption as responders. Second, established firms give views on how does the smart-shipping or its extremity of autonomous shipping could be disruptive. Third, established firms provide their market view for the next 10 years, which builds the overall market framework. Thereby this chapter can be divided into three categories that are the 1) *Established firms as responders* 2) *Smart-shipping as disruptive innovation* and 3) *Shipping's future as market view*.

4.1 Established firms as responders

4.1.1 Organizational structure and culture

Target companies are very different by their size and structure. Larger companies have more divisions, even units for innovating and smaller companies have simpler and focused structure. Most of the interviewees see that organizational structure has direct impact on innovation capability but emphasizes the fact that it does not depend on the company's size but rather in the way how the company is structured. Family owned companies have usually the capability to make quick decisions regardless the size of the company and listed companies have their certain responsibility towards investors. Traditionally large companies have more bureaucracy and slower decision making but target companies had solved their structure well and insured they are fast in reacting to changes regardless their size. Although one interviewee noted: "*...as a top manager I can make the decisions and feel like we're quick at reacting but employees don't necessarily agree with us being fast*". Larger companies may need to have specific roles or units to promote innovations: "*most of our patents are born in units that are only meant to develop new things*" and smaller companies can manage with less structure: "*Isn't it so that most of the innovations come from small and medium-sized enterprises?*". The word "rapidness" repeated itself through whole data. No matter what the organizational structure, rapid decision making helps to come up with new innovations and increase one's competitive skill according to interviewees.

Few specific structural arrangements had helped target companies to be more competitive. First, most companies focused on their core business and bought other expertise e.g. ship designing from outside. Information systems and IT were usually out-

sourced. This structural choice seemed to be very common and signs of shipping companies changing their model was not observed. Second, two companies had changed their cost structure by replacing their fully Finnish crew with mixed manning achieving better margins by lowering their manning costs. Third, one company had enough workforce at their port terminal who were not unionized hence if trade union calls a strike, they still have their operations running.

One interviewee said that marine business is usually quite conservative as I expected before the interviews but the gathered data proved the other way. Many of the answers were based on their opportunity-seeking and innovative organizational culture. Two interviewees told that their innovative atmosphere comes through structuring the organization in a way that employees have the possibility to test their ideas. Many views agreed on having the courage, quick decision skill and innovativeness in the whole organization starting from top management leading the way. Interviewees have even insisted their employees to come up with new solutions, which has led to an open organizational culture.

“We are quick and we don’t see threats as threats but opportunities. In seafaring people have always said that we have done this 50 years and will do the same the next 50 years but we don’t agree on that...we are constantly trying to find ways to turn possible threats into our own use, in fact we’re quite fast doing that”

One of the key components in innovative culture is to have the right mindset, which welcomes challenges as they would be solvable possibilities. This includes having the mindset especially in top management but also in the whole organization. Target companies often participate in pilot programs that require constantly good attitude towards developing, which is easier when the whole organization has the right mindset and the desire to learn.

4.1.2 Strategy planning

Studying disruption in the context of shipping is interesting because shipping industry usually requires heavy investments and ship’s life cycle is long up to 20–30 years according to interviewees. Even if shipping companies could be quick in adopting new innovations they have certain limitations such as their investments in newbuildings. Therefore, many shipping companies limit their risk by balancing between shipowning and chartering. If any disruption would happen in target companies’ markets their strategies help to form a decent understanding of how fast they could react.

Target companies are planning their strategy for the next 5–7 years as it is their “*foreseeable future*” in average but with some exceptions. Family owned companies tend to look even up to 25 years: “*family company’s quarter is usually 25 years when it’s three months for a listed company*”, even their main strategy work focused in a shorter period.

“We can’t really plan plausible strategy further than 10 years because strategy without numbers is poetry”

Strategy planning was mainly varying between 1–10 years. A listed company is forced to make short-term strategies beside its long-term strategies. One company matched its strategy timeline with ship classification period, which is done approximately once in a five year. Some companies believed that changes in shipping are quite slow in overall and they plan the next 7–10 years. One company made their financial modeling for the next 10 years. As one interviewee had just been in their board meeting, where strategy was planned until the year 2023: “*world is changing fast so you can’t put too much effort on what to do in ten years*”. Many interviewees agreed that long-term strategy would be ideal for them but the world has changed in a way that everything is connected and everything happens fast, which shortens time horizons and makes strategy planning difficult. Shipping in the past has had more long-term agreements, which have provided more stable environment for shipping companies. Now they have to invest e.g. in digital solutions but at the same time their customers are shortening their purchasing cycles hence the problem of making big investments.

When discussed about target companies’ strategies some specific areas of interest were identified. One could think that following rivals and focusing on competition would have provoked discussion, but clearly there are other fields that are more important in shipping such as following customer base, ongoing trends and transportation streams. Common questions were: “*what are the trends in shipping, which kind of ships are needed in 10 years... should we sell ships, invest in new or used ships...what is the market view for us, do we have enough cash flow and investment capability?*”. Knowing what happens in customer’s industry, helps to predict the future. For example, a manufacturing company may encounter challenges when dealing with CO₂ emissions, which could directly affect in transporting volumes. If the trend of environmental awareness will continue, some changes in customer side is inevitable as it is also for shipping companies through regulations and customer demands. One interviewee regards environmental issues as possibilities, which can be involved in strategy work by predicting the coming changes even five years earlier and have the solutions ready as soon as possible. The knowledge of market behavior in the near future could help to determine the length of chartering agreements.

One specific area of interest in strategy work is observing the transportation streams: “*we’re constantly scanning the development of traffic and transportation streams and if any deviation is observed we start to investigate the reasons behind the change...so we can react*”. Two interviewees consider a possibility where more commodities could be produced locally in the future since increasing environmental awareness can add value to local processes decreasing e.g. pollution and that could affect shipping. If the transport streams are changing towards more local transports, it could offer great possibilities for short-sea shipping companies.

Changes in consumer behaviors have direct impact in shipping. “*new generation thinks another way*”. Younger generation buys more from online stores and up to 60–70 % of passengers book their trips online. Environmental aspects are showing as added value for consumers that could be leading to greener transports since products have to include e.g. their CO₂ emissions in their packaging. Questions that could be taken into consideration: how younger generation see their consumption? Could their consumption increase or decrease? Could locally made items have more value? Could 3D printing have impact in shipping? Especially passenger ships are challenged by their younger generation of consumers who all have smartphones and a constant need for internet connection: “*in the future consumer behavior will have a major effect in shipping – yes ro-ro business will probably still exist but what is the consumer behavior?*”. Changing consumer behavior is one key area of focus when building new strategies around shipping.

Most of the interviewees see that one has to evolve constantly and staying put is not an option. They are searching for ways to expand their services and new kind of services are seen as growing market space in shipping. One way is to change the earning model from fully cost orientated model to service model by decreasing the overall costs for the customer. One target company for instance, has already got its first steps in terms of acquiring earning by decreasing their customer’s costs. They have developed a service where their ships load and unload cargo at seas. Baltic Sea harbors are such shallow that bigger deep-sea ships cannot enter there and require help from other shipping companies. By loading and unloading these bigger ships, the charging model has changed from only cost-based to service-based pricing.

Target companies are mostly high-end service providers in their markets and compete with other values than only cost. They cannot compete against low-end producers and try to offer other values such as qualitative crew and qualitative operations. Although two of the interviewees noted that their competitive capability requires them to move from fully Finnish crew to mixed manning, which helps them to be more competitive. Energy efficiency is also one key driver to improve competitiveness, which plays a big part of the shipping companies’ strategies.

All target companies consider cannibalization as an important action when the market situation requires it. They all plan many years ahead and look for any indicators that could affect in their business. Sustaining innovations have developed ships constantly, which have always kept shipping companies ready for changes in their markets. Interviewees consider cannibalization as necessary because if they would not be willing to do it, others would replace their service. It is easier for one to self-cannibalize than letting someone else to do it. When discussed about core business cannibalization, some argued that cannibalization should be considered as changing the core business instead of cannibalizing it. Usually core business is something that cannot be cannibalized easily, but some part of the business can be changed: *“we were partly in bulk business, container business and Ro-Ro business and after that we have kind of cleaned all these operations and decided to focus in Ro-Ro segment”*. If autonomous vessels would be entering into markets, two firms were ready to explore the possibility of changing their manning service with alternative services such as selling their expertise or even provide manning for shore centers further suggesting that shipping companies are ready to cannibalize themselves if needed. It is not easy to make decision to cannibalize certain business and sometimes it is not reasonable and sometimes it is: *“...you have to find a balance of terror since there’s no unequivocal answer for that”*.

Bankruptcy of Lehman Brothers in 2008 led to the world-wide economic crisis that is still affecting in the shipping industry and some interviewees told that cargo markets were at bottom-low earlier this spring. Shipping problems started in 2008 but increased afterwards: *“world economic and shipping market economic doesn’t always go side by side, they have different cycles”*. This is consistent with Stopford (2009) that sea trade is not equal to world economy but both have generally same business cycles. Cargo markets shrank and many ships were forced out of the markets, which led to an overcapacity of ships. Some specific business models like passenger shipping at Baltic Sea avoided the collapse. The problem of overcapacity dived deeper because many cargo ships were ordered at the time of economic crisis began and shipyards delivered the ordered ships between 2009 and 2012. A major problem after overcapacity had evolved. Many of the new ships went straight to the hands of banks. Overcapacity forced shipping companies to use demolition market and took off their burden by scrapping their older ship reserve: *“ships that aren’t even 10 years old have been scrapped, the record is probably a seven years old container ship...”*. Offshore business is experiencing the same kind of ship overcapacity since the oil prices started to fall in 2014. In a Finnish perspective shipping industry seems to be recovering fast thanks to e.g. Meyer Werft’s cruise ship deals but as one interviewee notes: *“you have to remember that cruise ship market is kind of a small niche-market after all”*.

The next goal for shipping industry is to have the supply and demand in balance. One of the skills in shipping business is to buy and sell ships at the right time. Now the ships

can be bought with low costs that could be a potential investment if the markets are to recover soon. We have witnessed bankrupts like the Hanjin Shipping earlier this year and more companies are seen near bankruptcy. More consolidation will take place and the large overcapacity problem is evading, hence shipping's supply and demand could be in balance soon although none can predict when exactly. Some niche business models may benefit from other business segment's problems: "*smaller Ro-Ro ship business has a better position to negotiate its newbuilding terms when bigger players are struggling and shipyards are empty by their order books*". In overall, target companies were quite optimistic regarding the future's cargo markets and shipping economy.

4.1.3 Innovation barriers and enablers

When asked about innovation barriers four themes including resources, change resistance, authorities and customer procedures were identified. Resources were related to recruiting and development projects. Smaller companies do not have enough resources to recruit IT specialists or establish new divisions for innovations keeping their focus in their core business. Larger companies face recruitment problems even though they have the resources, but bureaucracy especially at the time of bad market situation keeps putting barriers on new recruitments. Whether it is about resources or strategy, shipping companies are currently challenged by integrating themselves with technology and IT: "*we aren't a tech company, we're only a ferry company*". Target companies seemed to have many development projects going on but their resources do not allow them to participate in every project. They must focus in few pilot programs thus it is important to pick the right ones.

Target companies encounter change resistance every time they develop or adopt new innovations. Change resistance is assumed to be around as long as people are involved in the processes. It is a normal state of mind for people to handle new uncertain things.

"Our new voyage of information system...we've had change resistance and still have coming from the sea captains who feel that no technology can replace their expertise"

Experienced sea captains see themselves better in e.g. route planning than any system could calculate, but one interviewee suggests that ongoing change challenges both the system and the captain leading to even better outcome.

Authorities such as trade unions have been barriers for shipping companies to develop their innovations. Highly regulative shipping industry also puts some challenges for

new innovations. One of the interviewees with a long history in shipping makes a rather direct statement about authorities as a barrier:

“In Finland, technical development could’ve improved hugely but trade union has dragged the development by keeping the worker numbers high...traditionally there were seven guys lifting the sacks and we still have seven, although we could manage with only one”

Many ports have developed due to automation and the need for manual work has decreased significantly. Finnish authorities in overall are described as slow reactors to changes keeping new innovations limited while many other European countries have reacted better for changes in their ecosystems.

Sometimes shipping companies are forced to be less innovative because of their end customer procedures. End customers such as cargo owners usually sets their own requirements and demands for shipping companies even if a shipping company has better solutions to offer. Cargo owners sometimes have the desire to operate their own logistic unit increasing the complexity of overall logistic chain: *“customers shouldn’t have any interests to intervene in many of our operations, but they do”*. Therefore, a smaller shipping company is usually in a position where adoption is the only choice.

Target companies see cooperation as an important function for shipping players since many of the larger changes such as increasing the industry’s standardization cannot be done alone and need the support from other companies and authorities. Finland is seen as a society of trust where many ideas and innovations can be developed in collaboration. On the other hand, one interviewee notes that even though we have good collaboration in Finland, most of the companies seek only their own benefit and uses the system to promote their own interests. But for the most part interviewees agree that cooperation is one major driver for advancing the overall Finnish shipping interest. The new ecosystem for autonomous vessels led by DIMECC is a proof of trust and collaboration, which furthers every participant’s agenda.

Authorities are often barriers of innovations but also very important actors to enable innovations and increase efficiency. Port authorities make a big deal in ship efficiency to have the ships processed as fast as possible. Tekes – the Finnish Funding Agency for Innovation and VTT – Technical Research Center of Finland were brought up as important stakeholders to promote innovations. Without them many Finnish innovations would not have become reality. Third party companies are also helping shipping companies to come up with new solutions by inventing new technologies that can be tested in ships. Ships offer good test-platforms for pilot programs, which works for both parties’ advantage. Norsepower’s rotor sail technology was recently tested in Bore’s ship, which is a good example of Finnish companies joining together to develop innovations.

When asked about the things that will not change in shipping even if there would be major changes ahead, few topics were identified among the interviewees such as the overall transporting trend, the way how loading and unloading is done, the demand for specific business models, the need for maintenance and the challenging regulatory environment. Sea transport is here to stay even though air-, road- and rail transports are competing against shipping all the time. Shipping is still the most efficient way of transporting cargo in volumes. The cargo volumes that are being transported with ships are dominating the overall transport markets and cannot be replaced by any other transport vehicle according to interviewees. Some specific goods require better frequency than container ships can offer and e.g. fresh food container shipping is replaced more and more with trucks. In overall, there seems to be nothing that can stop containerization to continue expanding while still leaving space for specific business models like larger bulk transports or project transports continue their businesses: *“Nobody wants to have 20 000 tons of bulk in forms of 1000 containers in their backyard”*. Need for spot- or project transport will continue and shipping will include many business models now and in the future.

One view considers shipping logistics’ ecosystem as such a big entirety that it slows down any considerable change happening in the near future and further suggests that at least bulk cargo will be loaded and unloaded vertically for a very long time since any change in the way cranes are operating would require too much from end-customer facilitators such as terminals. Dragging Finnish bureaucracy and trade unions are not seen changing anytime soon, which are burdening shipping companies under the Finnish flag thus reducing their competitive ability keeping e.g. stevedoring work and crewing costs high.

Some maintenance is always done during transports and if automation will replace crew with machines, maintenance still requires manual work but it would have to be done at ports stressing the importance of manual maintenance also in the future. Therefore, automation is not seen as replacement for manual maintenance at least in the next 10 years.

4.2 Smart-shipping as disruptive innovation

4.2.1 The characteristics of the potential disruption

In a wider perspective, the potential disruption happens through digitalization, which makes remote monitoring, remote controlling and proactive maintenance possible. Also, the navigation with better situational awareness systems, decision support systems and

automation will take bigger role in shipping: *“at the beginning automation will take care of some part of the tasks like steering the ship for a while and this kind of stuff but in ten years we’ll see entirely remote controlled autonomous ships”*. This will probably change the design and the size of the ships since shipping tasks could be divided among with many ships instead of having multipurpose ships. One example of having benefits from smaller autonomous ship was the need of having more flexible and smaller ships with better frequency. With current legislation, it is hard to listen to customers because smaller ships are forced to include almost the same amount of crew as bigger ships and therefore manning costs among with the balance of capacity and cost-efficiency are eating the profits of smaller ships. The overall shipping development points more towards sustaining innovations with incremental changes than true disruptive innovations and a deeper analysis is needed.

What makes the radical change in shipping is the digitalization. What digitalization means in shipping is that ships are not seen as single tools anymore, instead ships are going to be considered more as a part of the end customer’s whole process:

“You have to make sure that cargo, the process what it serves is organized as optimally as possible and then we are speaking about this industry 4.0. thinking”

Industry 4.0. thinking connects shipping actors more tightly together by improving the communication between ships and other process owners. A ship cannot afford to be a *“black box”* in the future when connectivity through internet of things is one the key values promoting efficiency. Sustaining innovations keep decreasing the energy consumption in ships, which is one major cost driver in shipping but industry 4.0. thinking suggests that the connectivity of processes could be offering even greater benefits at least in some business sectors such as manufacturing. For example, a mass production of cars balancing with their inventory flows could require car components exactly on time and greater cost savings are obtained when the whole process works. It is not about having one singular part of the process cheaper such as the shipment.

“it could be that a company has too big inventory so the ship can slow down the speed because the process says so there’s no hurry but on the other hand the process can address the need for speeding the shipment or even change the destination in real time – but it’s the process that needs to be controlling ships whether the ship serves for transportation or manufacturing process”.

One identified challenging business segment for acquiring better margins with better quality through connectivity was passenger shipping because usually upgrades into ships were considered investments that could not be taken back from paying customers. Passengers were kept as a very price sensitive segment but in some sense almost all the interviewees considered their end customers similarly price sensitive, which only makes a call for different kind of approach towards passengers as the car manufacturing example presented only a scenario for manufacturing process. Smarter solutions could make cost savings in other areas even if the customer's willingness to pay stays the same. The main reason why smart-shipping is on its way is the offered overall cost-benefits compared to existing business models, otherwise it would not be coming and it could be offering great opportunities for those companies who are willing to change.

If a digital revolution is to happen in shipping it will lead to more standardized ships that serves the overall processes. Standardized ships are argued to suit best for container shipping and that could have effect also in bulk business by putting more bulk cargo into form of containers because of its increased cost-benefits. One of the trends in shipping is that more cargo is shipped using containers but there is still a need for mass bulk cargo transportation: *“with more standardized ships, container shipping could be disrupting the bulk business”*. When discussing about disruption one interviewee suggested that standardization could in turn prevent further disruptions and more efficient ways to change standardized shipping. Although one view emphasizes the diversity of shipping by stating: *“it's not about whole shipping changing – even today we don't have only one business model but we have different business models”*. Hence it is not necessarily about choosing between smart-shipping and traditional shipping since there is likely business for both although some part of the smart-shipping's ICT-systems will inevitably increase its presence also in traditional shipping markets.

As emphasized in disruptive innovation theory (Christensen 2015) DI is a process and the theory applies whether the process takes different time. Therefore, the length of smart-shipping's encroachment is not changing its potential disruptiveness although the velocity of adoption could determine its impact (Baiyere 2014). Current financial situation and overcapacities in shipping are slowing the potential disruption. Freight rates are so low that containers are sold even below marginal costs. It is hard to introduce innovations such as autonomous ships to the markets when there are too many ships already and low freight margins but as one interviewee regards this issue: *“economy usually heals itself”*.

4.2.2 *Identified challenges for autonomous shipping*

Challenges presented here describe the extremities of interviewees' perspective on smart-shipping since usually the challenge was brought up when discussed directly about autonomous shipping. Five different areas were identified when analyzing challenges. These challenges were related to general, environmental, technological, safety and standardization issues. In addition, target companies overlooking the potential threat of autonomous shipping was widely observed, which supports its potential of being DI. Extreme approach such as the discussion of autonomous shipping emphasizes some challenges that could be related to smart-shipping and offers performance attributes that can be used for drawing trajectories the same way e.g. Figure 2 demonstrates with hard disk drive capacity performance.

As a general challenge legislation was considered being one bigger problem for autonomous shipping. The International Maritime Organization (IMO) is the umbrella organization above shipping: “...*taking care of the long reaching regulations, a big international actor that doesn't turn quickly*” and without IMO's interest in autonomous technologies, innovations in that sector have no chance to succeed. Although, regulations can be changed in over time, hence they are regarded only as retardant factors.

Reduced costs are important values that firms look from new innovations, which is not any different in smart-shipping's case. New smarter offerings are not seen compatible for shipping markets without them giving the overall cost-benefit compared to existing shipping services. Although autonomous shipping can be considered as multiple technologies instead of one solution and cost-effectiveness could be served through customized optimization:

“You need to know what really saves money and what doesn't... what is the cost for such autonomous vessel compared to traditional or semi-traditional way of operating ships that could mean only cherry picking the technologies that makes the biggest difference in terms of cost savings”

Autonomous ship's suitability for specific ecosystems was challenged: “*ecosystem is so important...even if you could invest billions of euros in a solution such as high performance ship, that wouldn't automatically mean that it would succeed because of the ecosystem's nature*”. This issue appeared often when speaking about interviewees' specific business models and further suggests the importance of system innovations in shipping connecting different actors such as authorities, ports, ships and shipping companies together.

Environmental aspects set a strong challenge for autonomous technologies mostly due to target companies' challenging operational environments in the Baltic-, North Sea and Arctic Ocean area. Climate change has increased the amount of extreme weather conditions such as heavy storms, which can cause more blackouts although blackout can occur in any circumstances. Most of the interviewees underlines the icy conditions especially in the North Sea and the Eastern Gulf of Finland one of the biggest challenge for autonomous vessels:

“We had a terrible winter with unpredictable ice conditions, the question is how could you drive that autonomous vessel with a joystick by not knowing how the ice reacts...we have a challenging archipelago and a challenging environment here”

“You don't have to go further than the North Sea to face a situation where your ship is in the middle of ice rafts that are three meters above the sea, seven meters under the sea 10-meters total, how you go through that and use reverse and so on...there's a lot to do before managing that with unmanned vessel”

Some specific locations such as Kiel Canal and Thames river were brought up as difficult territories that requires immediate and precise actions because of the physical space limitations, traffic lights and busy traffic. Communicating with sluice pilots and other actors remotely would increase the complexity. Tide flows at Thames were considered extremely challenging even for professional sea captains.

Most of the technological concerns relates to those immediate actions that needs to be taken care of when encountering problems at sea. “What if” questions are commonly asked when discussing about autonomous technologies. Those questions relate usually to situations like blackouts when the anchor needs to be dropped immediately: *“one of our captains had only few seconds to react and drop the anchor when one of our ships recently encountered a blackout...and when you have a blackout you can't do anything”*. If an anchor could be dropped remotely, what if the technology fails again? The uncertainty on connectivity issues makes the decision makers suspicious. Also, the role of maintenance is considered challenging for autonomous ships since there is always some maintenance done during short routes so how could artificial intelligence replace that? Areas with busy traffic such as England's canal and Kiel Canal require a lot of communication between ships, which puts a lot of pressure on remote communication technologies.

Traffic density is one of the main concerns challenging overall shipping safety especially if autonomous ships are placed in highly intensive shipping areas like Baltic and

North Sea (see Figure 7): “in these areas we have enormous traffic, check AIS how many ships are there circling around the Baltic Sea...to put a fully autonomous vessel there is a bold and crazy plan”.

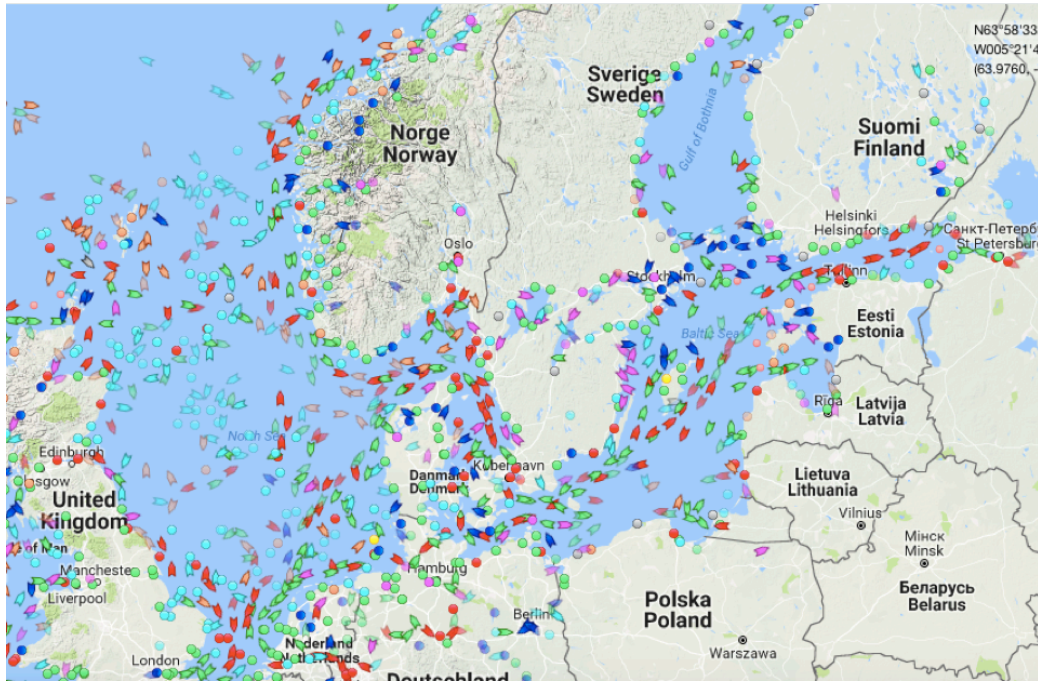


Figure 7 Marine traffic at Baltic and North Sea (marinetraffic 2017)

The picture shows AIS (automatic identification system) footage of overall marine traffic at Baltic and North Sea at randomly picked day, illustrating the density of marine traffic here at Baltic area. Collisions between ships are seen possible even with manual controlled ships and not to mention between totally unmanned vessels and some were concerned of larger ships heading towards coasts without a functioning connection. Hence the lack of trust on technology such as connectivity problems is piling the pressure on safety discussion. I would argue that if the traffic lights were invented now, quite many would be questioning their reliability before starting to trust in them. Now, most of us pass the green lights without any concerns. Therefore, automation requires technology and time before trust can truly be achieved and quite often people make mistakes and not the technology.

With passenger ships, the safety concerns are at a different level. There seems to be no way of operating ferries without crew on board since the crew is the main responsible in challenging situations like fire rescue or other types of evacuations. And of course, different kind of external threats in the world like terrorism sets a totally new level on safety demands when operating with passengers. Especially the captain and the chief engineer are trained thoroughly to operate in these challenging situations under pressure and the service-crew are not seen as possible replacements in case of limiting

the deck crew: *“it’s more or less the same that in my mind in technical perspective you could send already an Airbus A350 from Helsinki to fly without any crew but I don’t think they will because putting 300 people on board without anybody isn’t just something anyone would like”*.

Shipping industry with its thousands of different shipyards with their own interests usually concentrate on how to make a *“box with a propeller as cheap as possible”*. It is easier for airline industry where only two major airplane manufacturing companies are handling the production. There are lots of different types of business models inside shipping industry and that challenges the standardization: *“...we have been forced to customize our fleet for icy conditions and to match them for our customers’ specific needs so it’s hard to think that there could be this global leasing company providing standardized ships for us to start operating with”*. But if the shipping is heading towards autonomous shipping, standardization is a necessary and welcomed upgrade for the industry because today resources are wasted in searching for different kind of spare parts from all over the world.

One of the key elements in disruptive theory is that the sustaining innovations overlook the possibility of DI encroaching their business. These challenges presented in this chapter summarize some of the main reasons why established firms are not seeing autonomous ships as a rational investment yet (see Table 4).

Table 4 Identified challenges in autonomous shipping

General	Environment	Technology	Safety	Standardization
Legislation (regulations)	Weather (storms)	Connection (blackouts)	Traffic (density)	Industry (diversity)
Cost-benefits	Icy conditions	Maintenance	Collisions	Customization
Ecosystem	Difficult territories	Communication	Passengers	Different interests

In addition, many views were suggesting that autonomous technologies are not seen as a threat at least in 10 years: *“fully autonomous vessel is just utopia”*. One interviewee argued that the concept of autonomous ship does not offer significantly more space for cargo if compared to new container vessel designs and most of the interviewees argued that autonomous ships do not work yet in their specific business segment. For example, it is hard to increase smartness for bulk cargo and ro-ro segment is not seen as a business where autonomous ships could enter soon: *“bigger autonomous ro-ro ships operating between London and Rotterdam, I doubt it”*. Autonomous vessels were not expected to enter the markets soon because of the long up to three years of ship manufacturing process and time required to solve technology and the design issues. One reason for the established firms overlooking the potential threat of autonomous vessels are the alterna-

tive ways of reducing costs such as manning costs by e.g. not keeping the Finnish flag in a ship hence the dilemma is which investments have the best returns.

4.2.3 Identified possibilities for autonomous shipping

Despite of the numerous challenges that mostly relate to smart-shipping's extremity of autonomous vessels there seems to be positive view on increased automation. Interviewees signaled directions where autonomous ships could offer great benefits and came up with suggestions of business segments that could fit into autonomous operations. These perspectives show a green light for smart-shipping's development in overall even if there are many challenges to be solved. Two interviewees thought that digital breakthrough in shipping and even autonomous vessels are here within 10 years and these changes should be included in recruiting processes in the future. Some signals were found that supports the fact that target companies consider autonomous technologies as an actual possibility in the future:

“These manning services that we have – you could think we are totally against autonomous technologies because they destroy our business but in the other hand it only changes the business...we have to go along with it otherwise it all dies quickly...so if we now place crews into ships maybe in the future we have to look for the possibilities of placing them into command centers who knows”

One interviewee continued with similar approach and widened the manning example to cover overall know-how of shipping operations such as management, manning and technic. In the future, their company could be looking possibilities of switching from pure steel to services valuing the shipping know-how: *“you're always going to need experts”*.

Autonomous shipping could offer great cost-benefits by standardizing the components required in shipbuilding. One of the current challenges without standardized components is that adjusting add-ons in the older ships based on new regulations is expensive and even irrational. Shipbuilding could be done also differently allowing more space for cargo. One interviewee pointed out that the crew is expensive especially under the Finnish flag and therefore the reduced costs through less manning would offer better cost-efficiency. More careful view suggested that automation could decrease some part of the crewing costs. There could be better ways for lashing cargo that could decrease the amount of deck crew needed. One interesting view relates to changes in society. The availability of having skilled crew is even harder so it is not only about doing things

more efficiently: “*our society has changed in a way that people don’t really want to spend months isolated and that narrows our recruiting pool*”. This emphasizes the actual need for autonomous technologies.

Some fringe-markets were identified as potential starting points for autonomous shipping such as cable ferry and ferry markets, ferries having a battery pack installed allowing environmental friendly operations. Short-sea shipping with simpler routes was considered as a possible autonomous shipping business for moving passengers or inventory from A to B using a lighter diesel fuel instead of heavy gasoline to get more pushing power in harder environments. Although one interviewee had a strong objection on autonomous passenger shipping as explained in the previous chapter. Short-sea inventory shipping suggestion could be a potential fringe-market for autonomous vessels since the legislation could be ruled under one flag state and different environmental challenges could be avoided. Recently Yara, a global firm specializing in agricultural products announced that they will start building a fully electric and autonomous 100–150 TEU open top container vessel between three ports in southern Norway (Yara 2017). Currently Yara is transporting their products from their plants with diesel trucks that requires up to 100 journeys per day between plants and ports.

Containers were seen the most suitable type of cargo for autonomous ships according to interviewees. Especially if the standardization will take more place in shipping, smaller container ships especially feeders could be made identic, which could advance the autonomous shipping. Ro-ro business was noted as a challenging segment for autonomous ships but on the other hand one interviewee said: “*ideally if there would be autonomous ships and they would work – yes they would fit into ro-ro business model*”. One example of autonomous shipping’s potential market was related to marine survey services that operates quite straightforwardly at seas. Those ships could easily be controlled remotely removing the need for the crew.

4.2.4 Differences at target company level

One key factor of understanding how target companies differ by their position when dealing with DI is their current role of being the disrupter or the responder. In this study, Rolls-Royce is treated more as the disrupter because it is the company who is driving the change towards smart-shipping and even autonomous shipping among with few companies that are not involved in this study. Therefore, Rolls-Royce as the supplier of marine systems provides a large part of the gathered visions of how smart-shipping could be disruptive. The other six target companies are treated as the responders who provide large part of the information of the smart-shipping’s challenges and the possibilities in their own business segments.

There were few observed differences of how the responders differ positioning themselves against DI. Smaller-sized companies were more willing to cannibalize their business if needed when larger companies changed the concept of cannibalization more towards changing the business. This might be due to the complexity of how larger companies have even longer reaching processes and more stable market position. Even though in this study, the larger companies had solved their reacting-capability by structuring their businesses and decision making in a way that helps to respond in rapid changes. Larger companies also possess the required resources to react if needed and therefore they might not be dealing DI as threatening as the smaller-sized companies. Most of the responders were interestingly positioning the effects of wider change in other business segments instead of seeing the DI affecting in their own business. This was observed by noticing that interviewees handled the topic of DI usually by suggesting that the changes will most likely take place in some other shipping markets than in their own.

4.3 Shipping's future as market view

4.3.1 Overall changes in shipping

Interviewees offered many insights on how they see shipping changing in the next 10 years and few common topics were identified such as changes in overall processes, possible trends in shipping and environmental issues largely related to regulations.

Constantly changing legislation bringing especially new environmental regulations into shipping were labeled as welcomed but also consuming and expensive rules. There are many regulations that are needed but then there are directives that cannot be solved yet properly such as ballast water handling but still required from shipping companies. Emission directives are forcing shipping companies to buy new ships or make upgrades into older ones but it is not very cost-efficient to add new technologies into older ships, which is the reason why new LNG, renewable biofuel and biodiesel ships are entering fast into markets. As one interviewee explained: *“LNG ships are coming because LNG is the only fuel that already fulfills the emission directives for the next 10 to 15 years”*

The increased number of directives is changing the shipping fast and these environmental pressures are considered as one of the biggest change factors in the coming years even though digitalization was involved in the discussions. Environmental responsibility is valued high but it is still not something that many end customers are willing to pay for more. As one interviewee notes, environmental aspects are still appearing as a compliance, because shipping companies could make a lot related to environment but it is

lacking the profitability aspect. Although this might be changing and signals of increasing amount of interest in environmental awareness is already seen. Companies like Ikea, Procter & Gamble and Heinz are examples of global firms that value the eco-friendly transporting but there is still not yet any added prize one could get by being “greener”. Much of this environmental awareness comes directly from end-consumers’ appreciated values. A recognized change is already happening in Scandinavian, end customers being more aware of environmental issues allowing greener transporters to have a better bargaining power against cheaper flag states. Hence environmental responsibility could be acting an important role in the future when companies are selecting their shipping partners, hopefully having a focus in the whole logistic chain: *“it’s not reasonable to sail with greener ships and continue with black trucks so customers will need to concentrate more on the whole chain’s green values”*. Environmental pressure can also breed new innovations into markets. One example is the new renewable wind energy innovation from Norsepower that has developed a rotor sail solution saving up to 5–10 percentages of fuel consumption depending on the size of the ship while decreasing e.g. the amount of carbon dioxide emissions. If their pilot projects will succeed, the innovation will have a great impact on shipping.

Sustaining innovations keeps improving the product in its existing market replacing the older product by encroaching from high-end markets (Schmidt & Druehl 2008). What are the sustaining innovations in shipping? If the innovation is the ship, improvements in the ship itself should be looked. Interviewees have a lot of insights of sustaining innovations that are currently affecting in shipping and one clear example of sustaining innovation was identified:

“...when 2600 TEU ship was developed to 3000 TEU ship with a little trick and further when 4500 TEU ship was introduced, the business for 3000 TEU ship was incorrigible gone, so that was something we recognized...new ship was just too overpowered that you just had to get rid of the old one”

Electric solutions are trending in shipping and will most likely continue replacing other energy sources. Wind energy e.g. Norsepower’s innovation could be seen developing and improving energy consumption efficiency. With the help of computer measuring LNG and other biofuels are replacing gasoline fuel in response to new environmental regulations. All kind of friction management innovations like different surface paints in ships are being developed and new ultra-wave technologies are trying to replace the traditional anti-fouling paint to reduce costs. Many companies are struggling with ballast water discharging that is not working properly, which makes a call for new better solutions. Technology has constantly made energy solutions more efficient, which is

one of the key areas for sustaining innovations since efficient energy consumption leads to cost savings. Environmental innovations can be seen more as compliance following the current regulations rather than searching for cost savings. Sustaining innovations are making the ship designs different and more efficient with better cargo capacity. Better cargo handling solutions are also currently under the development because extreme weather conditions put a pressure on cargo safety. Automation has led to a development of route planning offering great advantages for sea captains to optimize routes and ensure better safety, as one interviewee confirms this by mentioning that they have improved their ships' reliability for customers considerably with the help of automation.

Whether these specific new innovations will reduce some costs, overall logistic integrations were kept as the key drivers to promote efficiency in the future. The need for integrations are of course dependent on the business model and those actors who have more functions also at shores value integrations higher. Integrations were seen as much bigger opportunities than investing in expensive ships with partially unpredictable life cycles. The growing need for precise on-time deliveries for manufacturing purposes increases the value of functioning overall logistics. Tighter integrations with subcontractors increases also ship productivity since the whole process must work to keep ship's operations active as much as possible. Every minute the ship is not in use the more money is wasted. Even though standardization is a big challenge for the shipping industry, it would decrease the down-time of ships e.g. by offering the right spare parts when needed.

After the latest economic crisis started in 2008, many ships ended up in the hands of banks and since then they have been selling ships back to shipowners and balance could be seen soon in the markets. Nevertheless, there is still overcapacity of ships in the markets and target companies see that more consolidation will happen in the future to solve part of the problem. Consolidation will also increase organizations' capabilities of reacting to changes like the digitalization. Hanjin Shipping Co. Ltd, largest South-Korean container liner company bankrupted earlier this year, which is a proof that container businesses have been struggling many years. Yet more bankrupts could happen in the near future and the over-capacity will diminish over time. In overall, cargo markets are seen recovering in the following years.

New digital solutions will help the integrations to become possible through better ways of connecting different actors and optimizing every step of the process. Internet of things (IOT) will take more foot-hold in shipping and the new way of doing business will be possible due to the connectivity. Artificial intelligence (AI) will replace more human work at seas and at shores. Automation will be one the most visible change in shipping. Fully automated terminals are already in use and as one interviewee noted, automated terminals offer very cost-efficient terminal operations. At first, automation could steer ships for some part but eventually remote-controlled ships and even auton-

omous ships could become reality. All interviewees see the digital change but are not agreeing how much digitalization will change shipping in the next 10 years. Some argue that totally unmanned autonomous ships are utopia and some think that autonomous ships are here within 10 years at least in some business segments. Most of the interviewees see incremental steps possible and this way the approach of smart-shipping seems to be more relevant instead of focusing in the extremities like autonomous ships.

There are many types of business models among with the target companies interviewed and most of them see more upcoming changes in other business models than in their own. Most common view on business model changes was that container business will see much smarter solutions in the future since the container itself can communicate without anyone typing the information into systems. Thereby target companies trust that container shipping will be the first one to have a bigger impact from digitalization and others will follow slowly. As one interviewee highlights: *“in container shipping we’ll see rather revolutionized things as it should be but with transporting e.g. sand you have certain limits that are involved”* meaning that it is hard to add smartness into bulk cargo. On the other hand, smaller amount of bulk transports has already been replaced by containers. If bulk will continue to move into form of containers there might be at least some bulk businesses in a verge of change.

“...people have always believed that bulk will not move into containers but now let’s say the past six or seven years, bulk containers have increased the most, more flours and dusting goods are shipped with containers”

A recognized trend in system transports especially in paper- and wood industry, has already started to replace bulk shipping with containers. If interviewees are right that container shipping will be affected the most by digitalization and in the future more bulk cargo will be shipped using containers a wider change in two business segments could be happening.

One trend in shipping has been the growing ship size. Container ships have become such large that *“none would’ve believed 20 years ago that we have 20 000 TEU ships these days”*. The technology has developed so that a bigger ship does not require considerably more crew than the smaller ships and at the same time they offer more cargo space. The trend will possibly continue in some areas but at least here in the Baltic area interviewees see that harbors are not deep enough for larger ships. Gdansk might have the deepest harbor allowing Maersk’s 16 000 TEU ships to dock when only 3000 TEU ships enter Finnish Harbors. This discussion highlights the importance of ecosystem.

“...those harbor investments that needs to be taken care of before those monster-ships could enter...it’s like this Airbus A380, it was supposed to be a great success but many of the orders have been cancelled because its required additional arrangements such as bigger airports, which turned out to be too much in certain routes”

It is not only about ship size, it is also about frequency in shorter routes. Large vessels require too much time to load and unload decreasing the ship’s frequency. Transport e.g. from Helsinki to St. Petersburg takes 16 hours, to Riga about 20 hours thus ships cannot spend too much time at ports when the transport itself takes such a short time. But then again, you must have large-enough ship to balance with your current capacity and future expectations.

4.3.2 New roles and actors

When covering the topic of shipping changes, one interesting specific area points to the roles of shipping especially to cargo owner, broker and shipowner roles. One view suggests that in the future cargo owner could take more part in managing the cargo process by controlling ship transports themselves. The need stems from overall process, in which cargo owner has the interest to e.g. optimize the shipment by either speeding up or slowing down the transport for different reasons. It does not necessarily mean that the cargo owners have the interest to start owning ships but it might change the role of ship operator. Ship operator could be the cargo owner, a third-party company or even the ship manufacturer who runs the maintenance and other operations.

There are two types of brokers, one is a cargo broker and the other is a newbuilding broker. Newbuilding broker is like a consultant, whose role is hard to digitalize but cargo brokers could be replaced more easily with digital solutions or in other words, new kind of digital cargo brokers could enter markets. Six of the interviewees thought that cargo brokers could be losing their existing role in the near future since new digital platforms could offer more efficiency and transparency leading to decreasing transport costs and increased volumes. Two interviewees thought that cargo brokers will not be replaced anytime soon: *“...if you concentrate 24/7 in a job you have so much more knowledge and skills compared to someone who just types something into computer...it just doesn’t work yet”*. More careful view suggested that cargo brokers have special knowledge, which they could sell as a service in the future but their role will still diminish over time.

There were three views on future's shipownership. The first suggests that financial sector will take more part in owning the ships by leasing the ships for operators, which is the case in airline industry. But it is not about changing the whole industry.

“We see that there will be changes but it doesn't mean that everything changes. Some shipowners will stay the same, I don't see how only one model could fit into the entire industry...there are many different ship types doing different tasks so it could be that the current model suits for some businesses, some requiring new kind of models”

The second view is that major global companies from other industries such as Amazon could invest in ships to improve their logistics but would need to acquire a shipping company to have the required expertise. Many companies have failed when entering to shipping business mainly because it is a complex business requiring a lot of experience. The third view defends the current model and argues that banks are too far from shipping to be interested in owning the ships even though many ships are still in their hands due to the economic crisis. Shipping is just too complicated business for financial sector. Banks do not want to take the risks that operators are currently carrying and are happy to finance operator's business as long as they see it profitable.

Current cargo market situation could be inviting new entrants to join shipping since many of the old actors are facing bankrupts or have too much debt burdening their investing capabilities. Current cargo markets are not seen as very tempting markets to enter because of the low cargo freights, but on the other hand now when the future seems brighter and used ships are sold cheap a new player with good investment capability could invest on new ships or buy used ships with low prices. As one interviewee suggests that we will see new players in the financial side, entrants that have not been in the industry before.

“Seafaring is such a crazy and funny industry that anyone with enough fate and cash could enter here and now the cost for ships are at the all-time lowest”

One interviewee compared the current situation in shipping with the case of British Airways versus Ryanair. British Airways being a large company with more traditional business model and Ryanair coming with new IT solutions and being more flexible operator. This could be the case also in shipping, new entrants being more IT orientated and offering new values for customers but still requiring a lot of expertise from existing shipping companies.

Specific business models in hard environments like icy areas or passenger shipping in the Baltic area are not seen suitable markets for new entrants but container shipping e.g. between China and USA could be a line where a new possible entrant such as Amazon could have the interest to start operations. Now these lines are sold under the costs, which does not tempt new entrants. Interviewees agreed on that new players need the expertise of existing shipping companies and therefore would need to acquire a shipping company before starting a shipping business. There are a lot of shipping companies near bankruptcy available for acquisition, hence good investments if the cargo markets are soon to recover.

Amazon and Uber were examples of new players tossed into the interviews when speculating about new entrants in shipping markets. They were both kept as potential large global organizations entering in shipping markets but with some restrictions. Amazon was an example of large company with good investing capability and potential willingness to expand its logistics to shipping: “...e-commerce sales are constantly increasing so when you’re buying from Amazon why wouldn’t you want the delivery also from them if they would have this service”. Another view regards this as a possible direction but also asks how much would Amazon would benefit from its own shipping. If they could lower few cents for one pair of shoes, would it be enough for them? This comes down to the fact that does Amazon or some other global firm see this as a profitable business model.

Uber works as an example of a new digital cargo broker. Whether it is Uber or someone else, most of the interviewees see the possibility of new player entering in broker business. The need for better efficient broker system is real since the ships are operating with a lot of empty capacity. If a digitalized platform could help shipping companies to fill the empty capacity, that would have a great impact on the cargo shipping profitability. This need is a continuum for a trend that started about 10 years ago. Internet tenders offered 30% cost savings for shipping companies and it has proved to be working. One of the interviewees noted that they have attained up to 40% of their largest customers by using internet tenders. Now all the large global companies like Procter & Gamble and Ikea have developed the same kind of platform for their own use.

It is not easy to enter in shipping and that is why new entrants need the help of existing companies. Ships are very expensive and require a lot of capital, which raises a lot of questions, how should the new player enter the markets.

“What I know from the past 50 years many new companies have entered shipping industry because it has always been intriguing business due to its taxation reliefs. In Finland, at least Salora a radio company and Isku a furniture company and many construction companies bought ships so

that they could make 25% depreciations but all struggled and disappeared because they didn't know the business"

Uber as a digital broker could be objected by highlighting the importance of the ecosystem: *"...if we would have Uber in shipping, a way to have any ship picking goods from customers, it would be very hard to get it approved by the customers"*. This is due to the fact, that *"the shipments usually tend to have a reasonable high value and someone not trustworthy failing the delivery could end up being very expensive for the cargo owner"* hence they use reliable operators to ensure the shipment's safety. Therefore, Uber could be working better for private persons than for companies with high volumes. Uber is also criticized for its legal aspects since it is already struggling against laws in different countries and shipping with its complex and demanding regulatory environment does not make it the easiest industry to enter.

4.3.3 Data as competitive advantage

I used the word "big data" when conducting the interviews but as one interviewee noted the original idea of big data involves people in the data collection process hence "data" is used in this thesis, a lot of data. Passenger shipping is the only exception involving passengers as one important data source. All the interviewees see that ships are already collecting lots of data and more data could be collected. Data about energy consumption, engines, routes and much more. Data can be used for e.g. proactive maintenance and route planning. The problem is that shipping companies are not usually information technology (IT) specialists: *"we are good at fixing all kind of machines and bend the iron but we are awfully bad with bits"*. Smaller shipping companies focus in their core business and do not have the resources to invest in IT. Especially in container business data is already a big part of the processes but there is still much to do when searching for better ways of structuring the data. Shipping companies are entering the same information into different systems in every port. Manual work is still playing a big role in shipping at shores and at seas and the system is clearly dragging behind its potential.

Usually shipping companies outsource their IT. Many target companies mentioned a Finnish company named NAPA, which has developed a voyage information system for their use. The system provides data of ship trim, speed, consumption and much more. All interviewees see that there is already the technology to collect data and lots of potential to use it but not yet enough concrete actions for utilizing the data: *"in our type of business data utilization is exploited surprisingly rarely"*. One interviewee regards this issue also by guessing that if they will not come up with data processing solutions by

themselves, companies like ABB, Wärtsilä or Rolls-Royce will offer the solution within five years.

Shipping companies are not collecting data only for their own use but also for their customers. Depending on the business model there are different interests towards data. Customer who is paying for the energy consumption and charters ship and crew from shipping company has the interest to measure energy consumption data and further even intervene in operator's process by either slowing or speeding the transport thus saving money by optimizing the process. Data solutions have only started impacting in shipping's commercial side offering new values for customers. If we turn this other way around, one interviewee suggested that a shipping company could save costs by collecting data from engines giving them the proactive role of predicting the time of required maintenance instead of having "make of recommendations" from the system providers since usually the recommendations are safe predictions instead of real time data of e.g. engine's condition.

Data must be structured better according to interviewees. Data is not any valuable if it is not in usable form or irrelevant data is collected. There seems to be a gap between collecting data and utilizing data. Four important areas were identified regarding data as a competitive advantage. First, collecting data is important, second knowing what data is needed limits the irrelevant data, third knowing how to refine data for usable form is the hardest part and fourth, exploiting data can offer new set of values for customers and commercialization has only began in this space in shipping.

5 DISCUSSION

5.1 Smart-shipping as disruptive threat

After studying the key characteristics of disruptive innovation, an understanding of the Baltic- and North Sea shipping markets was reached through seven interviews. Smart-shipping with its extremity of autonomous shipping is the DI that is hypothesized disrupting shipping through increasing connectivity. One could ask, why it is important to study disruption in the context of shipping? First, the knowledge of DI is useful for every industry by providing one theory of new entrants encroaching incumbents' business – an issue that has long roots in innovation research, Schumpeter being one of the original researchers by introducing business cycles and the creative destruction theory. And second, shipping is broadly considered as conservative business with long history and traditions. This makes it more vulnerable to new threats especially to disruptions. On the other hand, shipping was considered highly dependent on ecosystem including ports, authorities, ships, ship operators, shipowners and cargo owners, which makes it an industry that is hard to be seen disrupted quickly hence giving the shipping companies more time to react.

Martin Stopford (2015) one of the most influencing marine analyst writes: “*Naval architects are still designing ever bigger ships, but the economies of scale diminish with each size increment*”. This view could be converted to DI theory by suggesting that naval architects are still developing sustaining innovations, while their return on investment diminish with each improvement. Stopford continues by suggesting that: “*The focus of smart-shipping is not on the design of the ships, it is in the way we use them*”, which in DI terminology could mean that smart-shipping's focus is in the new business models that could disrupt shipping. Baiyere (2013, 8) used Amazon as an example where two types of root innovations ended up disrupting bookstores. Amazon introduced a new business model of selling books online using their radical innovation of new-to-the-world platform. In smart-shipping the similar situation can be identified: new business models serving cargo owners (connected) using new-to-the-world ships (platforms) disrupting shipping markets. Christensen (2015) argued that smartphones were not itself disruptive but the disruption evolved from the new way of connecting to internet, which was a business model innovation. Hence smart ships could be compared to smartphones suggesting that smart ships will be a consequence of developing traditional ships with number of sustaining innovations, but the new way of connecting ships to different processes makes a strong proposition of smart-shipping being a disruptive business model innovation. Interview data supports this by emphasizing that the potential disruption happens through industry 4.0. thinking by connecting ships with other

ships, ports and customer processes and serving the customer's overall processes, thus generating new business models that encroaches e.g. multipurpose ships' business.

DI is usually cheaper, smaller, more convenient and usually underperforming (Christensen 1997). One interviewee suggests that autonomous ships must be more high-end by their quality and initial pricing model but they should offer greater overall cost-benefits. Following this idea, we could be looking the cheaper price as overall costs of one's process instead of the initial investment required or apply Schmidt's & Druehl's (2008) high-end approach meaning that smart ship could start as a high-end product but the encroachment would start from the low-end. One critical question is that does DI have to be a low-cost product or service? Low-cost is not the same as low-end, for instance DI could be low-end by its performance attributes. As Christensen writes: "DI is *usually* cheaper". Low-end can mean performance attributes that are inferior compared to high-end. The underperforming features could be in smart-shipping's case the identified challenges presented in the Table 4 (p. 52) or capacity as the same way Christensen (1997) demonstrated the hard disk drive disruption. In hard disk drive example, smaller disk drives opened new markets such as PC and notebook markets, which required less capacity (Mb). As one interviewee noted that shipping's future would possibly have many different ships and business models instead of multipurpose ships. This could mean that traditional size and capacity would lack the future's market demand if for example a smaller smart ship would operate with different ways thus opening new markets (see Figure 8).

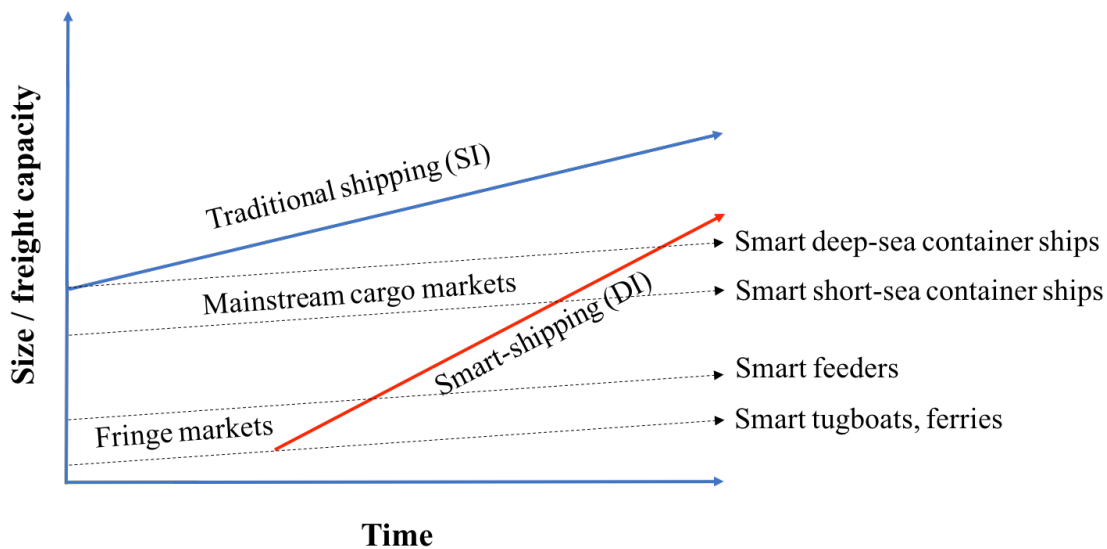


Figure 8 Demonstration of smart-shipping's DI trajectory

Figure 8 is only for demonstration purposes to show what is being hypothesized. There is not any specific timeline in the demonstration, but as Christensen (2015) said,

DI is the same whether the process takes different time, thus more important is to study the phenomenon of smart-shipping as DI and give tools for shipping managers to predict the trajectories. Disruption could start from fringe markets such as smaller-sized smart tugboats and ferries encroaching upwards attaining feeder market's attention and continue encroaching upwards first in the short-sea shipping markets and last in the deep-sea container shipping markets. Yara was identified as a company, which has started a project of localized autonomous inventory shipping that could be an example of potential fringe-market. Demonstrated markets were identified from the interviewees' views on smart-shipping's possibilities. Demonstration includes only container shipping as a mainstream market, because interviewees strongly suggested that container shipping is the first market where smart-shipping and even autonomous shipping could first have bigger impact despite its many challenges. If bulk cargo will continue moving to containers, this demonstration could also have impact in the bulk business. Ro-ro business could be seen following smart-shipping after the technology starts satisfying customers' primary dimensions and it is good-enough for ro-ro operations even in the highly dense areas. Even though many suggestions pointed at passenger shipping being one possible market for autonomous ships, it might be the last market to change towards unmanned vessels, but the concept of smart-shipping could affect with so many levels through connectivity. For instance, passenger ship transporting cargo and passengers, serves two different processes, both having a lot of potential to be more efficient when the ship is connected more tightly to the processes.

The performance-axis that was demonstrated with size and capacity in Figure 8 could be replaced by identified challenges in autonomous shipping. It should be emphasized that autonomous shipping is the extremity of smart-shipping meaning that DI's encroachment upwards could improve smart ship's automation incrementally decreasing the number of crew, which ultimately could lead to unmanned vessels in some business models. Autonomous vessels were highly overlooked by interviewees due to its extreme promise, but some challenges were identified that could be utilized as the knowledge of mainstream market values. This knowledge could be used for DI's advantage by identifying the Achilles heel that require improvements before DI could challenge the mainstream products and services. Most of the identified challenges in autonomous shipping relates to technology such as connection problems and the need for manual actions in specific occasions. Icy conditions were brought up by every shipping company as a major challenge for autonomous technologies. One could ask how this information helps the study of disruptive innovation in shipping context? Icy conditions are seen such a major challenge for autonomous ships and the ice classification for ships as a mainstream value in the Northern areas. Therefore, autonomous vessel as DI is underperforming compared to traditional ships with manual steering hence icy conditions are one development area, which DI's encroachment curve tries to solve. When DI starts to per-

form better also regarding to primary performance dimensions such as ice classification it starts to disrupt incumbents (Druehl & Schmidt 2008).

One direction of the potential disruption relates to low-cost digital applications that could come along with smart ships as the same way as smartphones offered a platform for applications. This could mean that smart-shipping would lead to a volume of less expensive add-ons like software and other useful applications such as more transparent broker platforms, which in turn could decrease the freight rates by limiting the amount of broker commission and lead to more effective cargo capacity usage. Interview data supported this possible change in cargo broker business where new digital cargo brokers were seen possibly disrupting the traditional broker business. Again, if smartphone was a sustaining innovation, but the business model of internet access was disruptive, it opened a way for new disruptors such as app- and game developers disrupting all kinds of industries such as healthcare and gaming. In smart-shipping, the ship could be a result of sustaining innovation, but its connectivity could make it disruptive relative to existing business models, further opening new possibilities for app- and software disruptors who mainly would be new entrants in shipping business. One disruption generating new disruptions.

Sustaining innovations were presented in the framework of this thesis as DI's opposite type of innovation focusing in high-end encroachment in the existing markets. Figure 3 (p. 21) illustrated sustaining innovation with the help of iPhone models and analysis suggested some directions of future's sustaining innovations in shipping that are being developed. One interviewee provided a very clear example of sustaining innovation in shipping by illustrating a scenario, when their old ship with lower capacity was forced out of the business because incremental changes in technology made the ships bigger. This cycle continued and has been continuing also in the deep-sea shipping but as Stopford (2015) argues, economies of scale diminish with each size increment. The concept of sustaining innovation in shipping helps to understand smart-shipping's trajectories when DI's opposite innovation, sustaining innovation is recognized and understood. Most of the sustaining innovations in shipping relates to energy efficiency that is improved through many innovations.

All interviewees saw that a lot of data is being gathered but it could be utilized much efficiently. Shipping companies are not IT companies but they recognize the need for integrating themselves more with IT solutions. The gap between current data utilization and its potential creates a possible new market for IT orientated disrupter. There are already many data providers but a concrete need for more transparent and convenient solution with better user experience was identified.

One interesting direction relates to the concept of loading and unloading cargo at seas. If it would become more common, larger deep-sea ships could continue their operations, even grow their size and smaller-sized smart ships e.g. feeders could help their

transportation process in local areas. Automated smart-ships loading and unloading deep-sea ships, removing their need for entering smaller ports. Loading and unloading cargo at seas might be one of the hardest operations for ships, thus the lack of understanding of its process and difficulty limits the constraints of such ideas.

5.2 Responding to disruptive threats

Even smart-shipping could be disruptive, the velocity of adoption, one of Baiyere's (2014) DIVE-model (p. 24) components, would be a challenge for the disrupter since it is not only selling an innovation for one party, but selling an innovation for many parties such as authorities, ports and customers. If the change would be slow, it would directly impact in the direct competition because the incumbents would have more time to react and counter back and DI would have less chance to be ignored. Being an entrant could lead more likely to being ignored at first, and avoid direct competition, but the velocity of adoption would be challenging because of the lack of experience from the shipping industry. Nevertheless, even if the disruption in shipping would develop slowly, disruptive innovation is a process and its features does not change even the process takes different time (Christensen 2015).

Shipping requires heavy investments, which could be one slowing factor for new entrants disrupting shipping markets but on the other hand heavy investments on new ships by the incumbents could be burdening their reacting capability. Although if incumbent is uncertain of the market situation, it can balance between different lengthed chartering agreements and shipowning. Because the overall ecosystem seems to be such important in shipping it seems that using DIVE-model is much easier for responder to disrupt the disruption than disrupter to make a potential disruptive innovation to become DI, which is consistent with findings of DI having a high risk of failure (Christensen 2015). Ecosystem's importance makes also the sociotechnical approach suitable for shipping context, which emphasizes the sociotechnical regime and landscape involving policy makers, scientists and other special groups affecting in innovation's encroachment. Sociotechnical approach offers a wider perspective for a complex shipping market but DI does not claim that sociotechnical issues should not be considered, instead it focuses building its own theory with more linear approach.

The current economic situation in shipping could be creating a potential environment for new entrants to disrupt shipping. Established firms do not have the same amount of resources to react since many of them are near bankruptcy or have operated with low-margins for many years. Shipping economics was seen to be in much better place in five years. New entrants were not seen joining shipping now when the margins are below costs, but on the other hand some saw it as an opportunity. Now when incumbents are

struggling with their resources their reacting capability is not as good as it might be in few years and some ships or even shipping companies could now be bought with cheap price. Some views consider shipowning changing by arguing that in the future ships could be leased and this could make new players different by their business model. Some argued that banks are not seen as potential leasing companies because shipping was emphasized as a very hard business being too far from financial operations. Analysis only came up with speculations that a large global company such as Amazon could be a potential new entrant by either buying existing shipping company or by leasing new ships. Before the leasing model could be possible some interviewees argued that shipping would require much more of standardization to make the ships and their spare parts similar.

Yu & Hang (2010) and Tushman (1997) suggest that organization culture is an important component for firm's competence and Govindarajan & Kopalle (2016) further continue by suggesting that organizational culture promotes disruptive innovations. Target companies seemed to be very open minded having a strong innovative culture with quick decision skill. Based on the analysis target shipping companies are ideal companies to promote disruptive innovations or react as responders. As Yu & Hang (2010) argue that smaller firms are usually more effective introducing DIs. Most of the target companies are smaller shipping companies and larger ones have solved their decision making or organization structure in other ways to react rapidly. Conservativeness was not tightly linked with interview data at least as much as expected and Finnish based target shipping companies could be generalized as small-, quick- and innovative actors. Target companies are innovative especially by their organizational culture, but it should be clarified that innovative culture in the overall analysis seemed to be showing more as an opportunity-seeking. Smaller-sized shipping companies are very quick in adopting new innovations when they see them as profitable business. One important question is that when the change requires actions, are the companies ready to execute them? Rajaniemi (2010) found in his study that people are usually more willing to take risks than execute them. Analysis of target companies showed that companies follow shipping innovations rather quickly but it should be emphasized that DI usually offers significant first-mover advantages.

Strategy discussions offered some interesting insights of how target companies see their markets and what is considered important in strategy making. When established firms are compared to new entrants, strategy discussion helps to describe the established firms and their interests, which helps to address their current values and motivation to respond to certain threats. Environmental issues' role turned out to be big. Environmental issues can be described as compliance in shipping and constantly tightened regulations are putting heavy pressure on target companies. Environmental awareness was considered as one potential factor that could have impact in shipping through changes in

consumption. If transportation streams would be changing towards more short-sea and localized shipping, there could be high potential for smaller and flexible ships that have better frequency. As Christensen (1997) demonstrated in his hard disk drive example that smaller disk drives opened new markets, it could also be the same in smart-shipping. External drivers such as changes in consumption leading to change in transportation streams and ultimately to the need for more effective smaller-sized ships. Traditional smaller-sized ships could be disrupted by much efficient smart ships that serve the cargo owner by connectivity of processes and traditional larger-sized ships could lose some of their markets to short-sea ships.

New entrants usually fail to disrupt established firms (Christensen & Raynor 2003). Analysis identified the complex shipping that challenges new entrants. In shipping, new entrant would need to acquire the knowledge from existing shipping actor. There could be many reasons why entrant firm succumbs even though senior managers of established firms are rarely equipped with sufficient information to response to DIs (Henderson 2006). Kazt & Kahn's (1966) concept of negative entropy provides some answers why certain organizations fail to response to changes, although it could be that usually established firms have the resources but as Christensen & Raynor (2003) argue established firms struggle with resource allocation to respond to DIs. New digital products and services are very different by their structure (Nambisan et. al. 2017) and their initial investment required and the speed of the process is changing (Baiyere 2016). Digital products do not seem to compete with same way hence it could make the traditional response harder. This could be seen directly in shipping if new digital cargo brokers would start encroaching in the traditional broker market.

6 CONCLUSIONS

6.1 Key elements of this thesis

The purpose of this thesis has been to discover smart-shipping's potential of being a disruptive innovation and furthermore study the relation between disrupter and the responder. Research question of "*How do established firms see the disruptive threat of smart-shipping and how could they respond?*" emphasized three important aspects. First, it was important to study the DI theory and its core elements. Second, DI was related to shipping and especially to potentially disruptive smart-shipping. And third, target companies were studied as established firms, Rolls-Royce more as the disrupter and the six shipping companies more as the responders. This thesis aimed to provide managerial tools for understanding the disruptive innovation and further operationalize DI for managerial use, either for disrupter's or responder's use.

Research was conducted by using interview as the qualitative method. Analysis was done by using theory guided content analysis methods which aims to develop a solid information integrity from the collected data where different perceptions together build the overall story. Theory guided content analysis emphasized the DI theory through the process of analysis. Total of seven companies and eight interviewees build the empirical data, all the companies having operations in the Baltic area. Target companies were mostly small and medium-sized shipping companies that felt being innovative and rapid when they encountered changes. In overall, all target companies were identified as opportunity-seekers with strong innovative organizational culture.

Smart-shipping worked as a more approachable concept than autonomous shipping since the target companies had already solutions in active use that could be included in part of the smart-shipping's umbrella. Smart-shipping also describes better the current development of shipping and was identified as the disruptive business model that could disrupt established shipping firms. Hence the thesis was built under the concept of smart-shipping while autonomous shipping had still a major impact in this study as being an extreme innovation. Smart-shipping's terminology was not used in the interview questions but were addressed in overall by discussing about technology and digitalization.

The largest change was identified relating to integrations between different actors that are involved in the same process. Manufacturing companies integrating themselves with ships and shipping companies, as systems self-guide their operations. Eventually cargo owner could have more access to intervene in shipping process. Before these larger changes could be possible, shipping would require more consolidation and more bankrupts before any balance between supply and demand could be declared.

The potential disruption was discovered to happen through digitalization, which leads to automation and eventually to new business models. New business models could be evolving by organizing the cargo process differently using the principles of industry 4.0. thinking, optimizing e.g. a car manufacturing process by self-operative ships. Interviewees suggested that autonomous ships could start operating in ferry and short-sea shipping markets, in which ships and ferries would be operating in shorter routes and in easier environments under the same flag legislation. This was demonstrated in the Figure 8 following Christensen's (1997) example of hard disk drives. Baiyere's (2014) DIVE-model was identified to favor the responder in the shipping industry since shipping was considered such an ecosystem-based industry that disrupter would be challenged especially by the velocity of adoption thus allowing more time for responders.

6.2 Theoretical implications

Earlier studies of DI were reflected into the context of shipping and responding to DIs was emphasized. Baiyere's (2013) DIVE-model was used to operationalize the concepts of DI and the DIVE-model was complemented with Markides & Charitou's (2003) findings of responder embracing the DI by making it for responder's own use. DI's key elements are not dependent on the business type. Therefore, e.g. Christensen's (1997) classic hard disk drive example works as a good demonstration for shipping markets. The results indicated that Finnish shipping companies are innovative by their organizational culture regardless their organization structure. Smaller shipping companies position themselves better towards potential disruption of smart-shipping by being more willing to cannibalize their business if their competitive skill requires it. Although larger companies have the better position of having resources to react.

In this study, Rolls-Royce as the supplier of marine systems opens the disruption discussion by introducing their concept of autonomous shipping. Rolls-Royce sets the direction of how they think their concept will disrupt shipping and this study takes a lot of its influence from Rolls-Royce's visions. Further smart-shipping with its extreme innovation of autonomous shipping was identified as a disruptive business model innovation. This implication was turned into demonstration of smart-shipping's disruptive trajectory. Other target companies were treated as possible responders and they provided a significant list of possibilities and challenges for autonomous vessels. The list of challenges related to the mainstream market values that smart-shipping as DI needs to solve before encroaching upwards in the shipping markets.

6.3 Practical implications

Even though it is not yet possible to predict the timeline for smart-shipping encroachment, by identifying it as a true DI makes a call for shipping companies to not overlook smart-shipping. This thesis provided managerial tools for companies to respond to DIs and the results of this study recommend shipping companies to consider their position related to smart-shipping. Shipping companies should keep investing in their sustaining innovations and profitable business while placing some resources to follow the smart-shipping's development and eventually choosing between disrupting the disruption, joining the disruption or ignoring the disruption. Traditional shipping will most likely have its place for a long time and there will be a lot of business models instead of a one model, thus making each shipping company's own market analysis important.

All target companies are already operating in the maritime sector and they can be described as established firms. According to Christensen (1997) these established firms usually struggle with their resource allocation when responding to DIs. Therefore, this study emphasizes the dilemma that managers of established firms have to balance with sustaining innovations and disruptive innovations by ideally setting an autonomous unit for responding or advancing DI.

6.4 Limitations of the study and calls for further studies

The results of this study should not be generalized globally, but instead this thesis makes a rather good attempt to describe Finnish based shipping industry and how shipping companies here in the Baltic area see the smart-shipping. Empirical data was collected from top managers, which worked well as this thesis concentrated on larger topics although a wider scope of taking also employees part of the data gathering could have added different views especially on the organizational culture discussion. Also at least two viewpoints from one company could have made the data more valuable, but only one company with two interviewees was organized. Interview as a method is a time-consuming way of discovering something and a survey targeted for more companies and more employees could have increased the reliability of the results by generating a larger amount of data to support the results. This thesis takes place in a rather early phase thus relying strongly to interviewees' visions and speculations. It would be interesting to make a longitude research after five years at the time when interviewees see shipping economics being in a much better condition. If smart-shipping's encroachment is now starting from the low-end markets it should have some signals of disruption in five years. Although the timeline of the smart-shipping's encroachment is hard to predict.

This thesis took part in highly technology orientated change, in which digital technologies are presenting a major part. As Stopford (2015) regards this issue by suggesting that fourth wave in shipping is on its way due to advanced ICT-technologies. Industry 4.0. thinking with big data are going to be part of the reasons why these new self-operative systems are seeing their daylight (Lee et. al. 2015). I recognized the technology relativeness from the early beginning, but did not concentrate much on technology issues, thus only acknowledging technology's role. On the other hand, DI theory was first built around technologies and most of its early studies concentrate on product innovations, which can be seen in the reference list, many of the academic journals used are published in Journal of Product Innovation Management. Christensen's (1997) classic example was a technology based model, which emphasized disk drives being disruptive by their design and not by their business model. Business model innovation approach complementing DI theory is a major change in DI's evolution, which has led to Christensen (2015) acknowledging that most of the recent DI's are disruptive by their business models. This study only regards new digital products and services changing the speed of the process and cost structure of new innovations (Baiyere 2016) and further studies of digital disruptions are needed. Digital disruption is such a new phenomenon that there are not enough of academic studies available yet. New digital platforms such as Uber, Spotify, Netflix and Airbnb are examples of claimed digital disruptions that should be studied carefully to complement DI theory by new root innovation type that is a digital innovation.

I began to write this thesis one year ago without any earlier knowledge of disruptive innovation and I did not know much about shipping markets, Rolls-Royce being my only touchpoint for marine industry as I worked there as a summer trainee. This journey has been such a learning experience. The first months and the end of the year 2016 was spent with learning and reading earlier studies of DI. The study became to find its place when I conducted the interviews at spring. Interviewees welcomed me with sincere interest towards the topic of this thesis and taught me a lot about shipping. Much of the data collected helped me to understand the differences between target companies' business models. All interviewees had a long history in shipping or in marine industry, which helped me to get in-depth discussions with them. This helped me to draw kind of a timeline how these established firms had developed until now and how they see their future.

REFERENCES

- AAWA 2016, Advanced Autonomous Waterborne Applications Initiative.
 <<http://www.rolls-royce.com/~media/Files/R/Rolls-Royce/documents/customers/marine/ship-intel/aawa-whitepaper-210616.pdf>>, retrieved 5.11.2016.
- Arthur, Brian W. (2009) *The Nature of Technology: What it Is and How it Evolves*, The Free press, A Division of Simon & Schuster, Inc. New York.
- Autonomous ships ecosystem 2016, DIMECC Oy. <<http://www.dimecc.com/dimecc-services/autonomous-ships-ecosystem/>>, retrieved 3.11.2016.
- Baiyere, Abayomi (2014) Disrupted Disruptions: Lessons from potential Disruptive Innovations that never disrupted. *Proceedings of the 25th International Society for Professional Innovation Management Conference*, Dublin Ireland.
- Baiyere, Abayomi – Salmela, Hannu (2013) Review: Disruptive Innovation & Information Technology -Charting a Path, *Proceedings of the 24th Australasian Conference on Information Systems (ACIS 2013)*. In Deng, H. and Standing, C. (eds) December 4-6, Melbourne, Australia, 1–11.
- Baiyere, Abayomi (2016) *Discovering the Role of Information Technology in Disruptive Innovations, Enabler, Sustainer or Barrier?*, University of Turku.
- Baker, William E., Sinkula, James M., Grinstein, Amir, Rosenzweig, Stav (2014) The effect of radical innovation in/congruence on new product performance, *Industrial Marketing Management*, Vol. 43, 1314–1323.
- Baumard, Philippe (2014) Tearing down the façades of radical innovation, *Industrial Marketing Management*, Vol. 43, 1324–1334.
- Charitou, Constantinos C. – Markides, Constantinos (2003) Responses to Disruptive Strategic innovation, *MIT Sloan Management Review*, Vol. 44 (2), 55–63.

- Christensen, Clayton M. – Rosenbloom, Richard S. (1995) Explaining the Attacker's Advantage: Technological Paradigms, Organizational Dynamics, and the Value Network, *Research Policy*, Vol. 24, 233–257.
- Christensen, Clayton M. (1997) *The Innovator's Dilemma*, Harvard Business Review Press, Boston, MA.
- Christensen, Clayton M. – Raynor, Michael E. (2003) *The Innovator's Solution: Creating and Sustaining Successful Growth*, Harvard Business Review Press, Boston, MA.
- Christensen, Clayton M. (2006) The Ongoing Process of Building a Theory of Disruption, *Journal of Product Innovation Management*, Vol. 23, 39–55.
- Christensen, Clayton M. (2015) What is disruptive Innovation, *Harvard Business Review*, 44–53.
- Christensen, Clayton M. – Bartman, Thomas – van Bever, Derek (2016), The Hard Truth About Business Model Innovation, *MIT Sloan Management Review*, Vol. 58 (1), 31–40.
- Eriksson, Päivi – Kovalainen, Anne (2008) *Qualitative Methods in Business Research*, SAGE Publication Ltd, London, UK.
- Eskola, Jari – Suoranta, Juha (1998) *Johdatus Laadulliseen Tutkimukseen*, Vastapaino, Tampere.
- Ettlie, John E. – Bridges, William P. – O'Keefe, Robert D. (1984) Organization Strategy and Structural Differences for Radical versus Incremental Innovation, *Management Science*, Vol. 30 (6), 682–695.
- Finkelsten, Sydney & Sanford, Shade H. (2000) Learning from Corporate Mistakes: The Rise and Fall of Iridium, *Organizational Dynamics*, Vol. 29 (2), 138–148.
- Geels, Frank W. (2002) Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study, *Research Policy*, Vol. 31 (8– 9), 1257–1274.

- Geels, Frank W. – Schot, Johan (2007) Typology of sociotechnical transition pathways, *Research Policy*, Vol. 36, 399–417.
- Geels, Frank W. – Kern, Florian – Fuchs, Gerhard – Hinderer, Nele – Kungl, Gregor – Mylan, Josephine – Neukirch, Mario – Wassermann, Sandra (2016) The enactment of socio-technical transition pathways: A reformulated typology and a comparative multi-level analysis of the German and UK low-carbon electricity transitions (1990–2014), *Research Policy*, Vol. 45, 896–913.
- Govindarajan, Vijay – Kopalle, Praveen K. (2006) The Usefulness of Measuring Disruptiveness of Innovations Ex Post in Making Ex Ante Predictions, *The Journal of Product Innovation Management*, Vol. 23, 12–18.
- Govindarajan, Vijay – Kopalle, Praveen K. – Danneels, Erwin (2011) The Effects of Mainstream and Emerging Customer Orientations on Radical and Disruptive Innovations, *The Journal of Product Innovation Management*, Vol. 28, 121–132.
- Henderson, Rebecca (2006) The innovator's dilemma as a problem of organizational competence, *Journal of Product Innovation Management*, Vol. 23, 5–11.
- Katz, Daniel – Kahn, Robert L. (1966) *The Social Psychology of Organizations*, John Wiley & Sons, Inc., New York.
- King, Andrew A – Tucci, Christopher L. (2002) Incumbent entry into new market niches: the role of experience and managerial choice in the creation of dynamic capabilities, *Management Science*, Vol. 48 (2), 171–186.
- Koskinen, Ilpo – Alasuutari, Pertti – Peltonen, Tuomo (2005) *Laadulliset Menetelmät Kauppatieteissä*, Vastapaino, Tampere.
- Lee, Jay – Bagheri, Behrad – Kao, Hung-An (2015) A Cyber-Physical Systems architecture for Industry 4.0-based manufacturing systems, *Manufacturing Letters*, Vol. 3, 18–23.
- Lepore (2014), The New Yorker. <<http://www.newyorker.com/magazine/2014/06-23/the-disruption-machine>>, retrieved 12.11.2016.

Localytics 2017 <<https://www.localytics.com>>, Retrieved 25.07.2017

May, Tim (2002) *Qualitative Research in Action*, SAGE Publications Ltd., London, UK.

Marinetraffic 2017, <<https://www.marinetraffic.com/fi/ais/home/centerx:9.0/centery:56.2/zoom:5>>, Retrieved 14.08.2017, 14:25.

Markides, Constantinos (2006) Disruptive Innovation: In Need of Better Theory, *The Journal of Product Innovation Management*, Vol. 23, 19–25.

Mensch, Gerhard (1979) *Stalemate in Technology: Innovations Overcome the Depression*, Cambridge, MA, Ballinger.

Moazed 2016, Techcrunch.com. <<https://techcrunch.com/2016/02/27/why-clayton-christensen-is-wrong-about-uber-and-disruptive-innovation/>>, retrieved 16.11.2016.

Morison, Elting E. (1966) *Men, Machines, and Modern Times*, Cambridge, MA, MIT Press.

Nambisan, Satish – Lyytinen, Kalle – Majchrzak, Ann – Song, Michael (2017) *Digital Innovation Management: Reinventing Innovation Management Research in a Digital World*, MIS Quarterly, Vol. 41 (1), 223–238.

Rajaniemi, Jani (2010) *Organisaatiorakenne ja Innovatiivisuus*, Tampereen Yliopistopaino Oy, Tampere.

Rogers, Everett M. (1983) *Diffusion of Innovations, 3rd edition*, The Free Press. A Division of Macmillan Co., Inc. New York.

Sahal, Devendra (1985) Technological Guideposts and Innovation Avenues, *Research Policy*, Vol. 14, 61–82.

Sandberg, Birgitta – Aarikka-Stenroos, Leena (2014) What makes it so difficult? A systematic review on barriers to radical innovation, *Industrial Marketing Management*, Vol. 43, 1293–1305.

Schmidt, Glen M. – Druehl, Cheryl T. (2008) When is a Disruptive Innovation Disruptive?, *Journal of Product Innovation Management*, Vol. 25, 347–369.

- Schumpeter, Joseph (1939) *Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist Process, First edition*, McGraw-Hill Book Co., New York.
- Schumpeter, Joseph (1962) *Capitalism, Socialism and Democracy, Third edition*, Harper & Row, New York.
- Stopford, Martin (2009) *Maritime Economics, Third edition*, Routledge, New York.
- Stopford, Martin (2015) <<http://splash247.com/shippings-smarter-path-stopford/>>, retrieved 02.09.2017.
- Tuomi, Jouni – Sarajärvi, Anneli (2009) *Laadullinen tutkimus ja sisällönanalyysi*, Tammi, Helsinki.
- Tushman, Michael L. (1997) Winning through innovation, *Strategy & Leadership*, Vol. 25 (4), 14–19.
- Tushman, Michael L. – Anderson, Philip (1986) Technological discontinuities and organizational environments, *Administrative Science Quarterly*, Vol. 31 (3), 439–466.
- Työelämä2020 (2017) <<http://www.tyoelama2020.fi/en>>, retrieved 15.05.2017.
- Weinberg, Darin (2002) *Qualitative Research Methods*, Blackwell Publishers Inc., Malden, Massachusetts, USA.
- Wernerfelt, Birger (1984) A Resource-based View of the Firm, *Strategic Management Journal*, Vol. 5 (2), 171–180.
- Yara (2017) <<https://www.km.kongsberg.com/ks/web/nokbg0240.nsf/All-Web/4B8113B707A50A4FC125811D00407045?OpenDocument>>, Retrieved 20.08.2017.
- Yara (2017) <<https://www.km.kongsberg.com/ks/web/nokbg0238.nsf/All-Web/98A8C576AE FC85AFC125811A0037F6C4?OpenDocument>>, Retrieved 20.08.2017)

Yu, Dan – Hang, Chan Chien (2010) A Reflective Review of Disruptive Innovation Theory, *International Journal of Management Reviews*, Vol. 12, 435–452.

APPENDIX

Interview questions

These questions were used as the basic structure for each interview. All questions were covered but some of them came up as part of the earlier questions, thus giving me the choice of jumping over some irrelevant questions to avoid repeating answers.

BACKGROUND QUESTIONS

1. How long have you been working in company X?
2. What is your job title?
3. What is your company's core business?
4. How would you describe your role as a part of X's development and innovation functions?

THEME 1 ORGANIZATION & INDUSTRY

1. Do you think that an organizational structure generally affects in creating innovations?
2. Does your organizational structure support in creating innovations? (for example, specific units or job positions)
 - 2.1. How does it support it or why not? Can you be more specific?
 - 2.2. Does digitalization play a part in your recruiting?
3. How far does your strategy look at?
4. How would you describe your organization's agility to react in threats?
 - 4.1. How do you recognize these threats?
 - 4.2. Are there any tools to recognize threats?
5. Do you believe that organization's size affects in innovating- and reacting ability?
6. What kind of structural changes has your company gone through in the last few years? If at all?
7. What kind of changes do you expect to be seen in the next 10 years in shipping?
 - 7.1. Do you think that ship owner's role is the same after 10 years? If not, what kind of role it would have?
 - 7.2. What about brokers role in the future? Any changes?
8. What kind of challenges does your industry set that you haven't been able to respond yet?
9. What is expected from shipping companies in 2027? 10 years from now.
10. What kind of shipping companies are successful after 10 years?
11. What is the economical view in the marine industry? How does it affect in your business?
12. How do you think the relation with shipping and other industries will develop in the next 10 years?

THEME 2 INNOVATIONS

1. Has the development in technology shaped shipping companies in the recent years?

- 1.1. Is big data being utilized as efficiently as possible?
2. How do you see new technological possibilities changing your core business?
3. What kind of innovations do you expect to see in shipping industry in the next 10 years?
 - 3.1. What is the one major factor that will change shipping in the coming years?
4. Could innovations invented in other industries also be utilized by you or by shipping companies generally?
 - 4.1. What for example? Business models like Uber?
 - 4.2. Do you actively search for new business opportunities outside of your core business?
5. Will new innovations and technology bring also other players to shipping markets? What kind of players?
6. Could the current economic and market situation in shipping invite new players to join shipping business? For example, the debts of the current players?
7. Do you address your new products and services mainly to your current markets or totally new markets? Or both?
8. How does new digital innovations affect in your pricing models? (low-end vs. high-end products)
9. Do you see new digital innovations more as a threat or as a possibility? Why?
10. Which one affects the most in shipping company's profitability: the development in ship technology or integrations with other logistic actors?
11. What are the current excessive costs that a new technology could ideally reduce?
12. What are the things that will not change in shipping even technology develops radically?
13. And what are the things that should be changed when it's possible?
14. How soon do you think that a digital revolution could happen in shipping?
15. How does environmental aspects like the climate change or regulations affect in your business?

THEME 3 BARRIERS OF INNOVATION

1. What are your biggest challenges in promoting innovations?
 - 1.1. How have you reacted in these challenges?
 - 1.2. Are there any specific ways that have helped you work towards innovations?
2. Are innovations hard to sell for the top management?
 - 2.1. Or other stakeholders?
3. Do you feel that your new innovations are supported with sufficient resources?
 - 3.1. What does help to get the resources? Or on the other hand, makes it more difficult?
4. How does cooperation (with rivals) could promote innovations, if at all?
 - 4.1. Who are the other important partners when pushing innovations forward?
5. Could one shipping company introduce business model innovations without competition?
6. Does determination and innovativeness walk side by side or can there be any innovativeness without a visionary leader?
7. Have you encountered change resistance when promoting innovations?
8. How would your company react in cannibalizing your core business to promote a new business model? What factors could support cannibalization?