DESIGNING AN ECOSYSTEM TO FACILITATE DATA-DRIVEN CHOICES FOR THE MARITIME SECTOR

Graduation report - Koen Emous

TU Delft kpn

PREFACE

The report in front of you is my graduation report for my master Strategic Product Design, which I have been working on for the past few months. Within this thesis, I worked for KPN to investigate how they could increase their contribution to the maritime sector. Matching the large, conservative sector that the maritime sector is, with the very Dutch-oriented KPN provided the necessary challenges in recent months. These challenges made my project interesting and fun to work on, of course always with the necessary ups and downs along the way. In this respect, I have always been very grateful that I had the opportunity to go to the office and the faculty a lot, despite the prevailing corona measures. This allowed me to talk to fellow students or fellow interns and spar about my project. In addition, the change of working environment helped me to stay motivated and to work on my project every day. This report is the result of those days of hard work, but I must also express my thanks to certain people for making this possible.

First of all, I would like to thank my chair and mentor for all their feedback and support over the past months. EJ, thank you for always being available for a half-hour of coaching and always reassuring me that I was doing the right thing. Niya, thanks for helping me to remember to trust the process and always being open to discussing the project and my progress. The feedback and coaching of both of you helped me to make decisions and progress, but also made sure I considered the strategic and technical side of the project.

I would also like to thank Jeroen, for providing the opportunity to collaborate with KPN for my graduation. Besides, I would like to thank you for sharing your enormous network, both inside and outside of KPN, and for providing many critical notes. This kept me on my toes and made sure I always had points I could tackle to improve the project further.

I would also like to thank all the people involved at KPN, who were always open to helping me and discussing my project. I would especially like to thank Jan-Rijk for the many meetings, in which you always had an open mind and it always helped me to see things as they were. This has benefited the project enormously.

I would also like to thank my family for carefully reading through my entire report and providing me with feedback. In particular to my sister, your accurate feedback has made everything better written and more understandable for every reader.

Besides, I would like to thank Barbara for her unconditional belief in me and for always being there for me when I need feedback on my work and visuals. It helped me to stay motivated and to finish the project as I did.

Finally, I would like to thank my roommates for supporting me throughout my project and listening to me when a long day had passed.

Enjoy the read!

Koen

EXECUTIVE SUMMARY

The maritime sector will have to deal with various challenges in the time to come, like sustainability and competitiveness. To deal with these challenges, there are several opportunities to improve through the use of data and technology. The first part of this report examines the developments taking place in both the global maritime sector and the Dutch seaports. In general, we see that major changes are afoot within the maritime sector. Data is starting to play an increasingly important role in decision-making. With data, new insights can be generated and specific parts where quick wins can be made can be tackled. By optimising processes, efficiency can be increased, allowing more to be achieved with the same effort. This helps the sector to stay competitive. The sector is facing declining interest from employees and emerging local production, making transport a less important factor. To remain competitive, processes are being automated and cooperation between different companies is increasing. This allows innovations to be applied more widely and ultimately achieve more. The more important role of data also leads to risks concerning security and privacy. Soon, the sector will have to learn to deal with these risks.

KPN is a large, Dutch telecommunication company that serves a large part of the Dutch consumer and business market and is one of three companies with a Dutch mobile network. As people's perception of mobile communications changes, KPN is seeing a decline in revenues from consumers and is having to introduce innovations despite receiving little additional revenue in return. As more companies can deliver connectivity, KPN is focusing on delivering extra services to companies on top of their connectivity. This way, KPN tries to create the financial space to keep their network up to date and to add new functionalities. In addition, KPN distinguishes itself within the Dutch market by operating in a climate-neutral way. KPN is now using the knowledge it has gained to help other companies make their businesses more sustainable. KPN believes that the use of technology can ensure that companies can operate in a climate-neutral way without compromising their business.

By deploying KPN's capabilities within the insights gained from the analysis, the KPN Fleet ecosystem was designed. Within this ecosystem, KPN offers a platform to all kinds of maritime stakeholders, enabling them to make optimal use of the opportunities offered by data and new technologies. By involving all stakeholders in an ecosystem, every one of them can help each other get the most out of their processes and innovations. Data can be shared safely and quickly, allowing all stakeholders involved to use this data to optimise their processes or services. This further increases the quality of all services delivered within the ecosystem, which ultimately benefits all stakeholders involved. It also offers KPN the opportunity to use its capabilities and thus add extra value within the maritime sector. Within this report, more details about KPN Fleet are highlighted. In addition, a roadmap is presented to help KPN implement KPN Fleet and expand it in the future.

KPN Fleet helps KPN to expand their position in the maritime sector and increase the value they add to society. This allows them to remain relevant in the future and generate more revenue. In addition, KPN Fleet is fully in line with its vision of using technology to help other companies become more sustainable while improving business. Besides, it could help generate knowledge or experience for KPN to apply in other sectors they are active in, like automation or data spaces. In doing so, KPN can strengthen their strategic advantage in multiple sectors. Furthermore, the concept includes the development to collaborate with various companies that is seen in the market. So, it both fits KPN as the customers it is serving.

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01 INTRODUCTION

Introducing the relevant aspects of the project

This chapter will focus on introducing the different aspects of this graduation project. First, the relevance of the project will be explained. Secondly, the client of this project, KPN, will be introduced. The third section will provide the context of this master thesis, followed by the problem statement that is focused on during the project. Lastly, the final section discusses in detail the project approach and structure of both the project and the report.

1.1 Project Relevance

Ground for the project

If greenhouse gas levels continue to rise, the prediction is that the global average temperature will rise by 4°C during the 21st century (IPCC, 2021), with rising sea levels and changing weather conditions as a result. Continuing like this is simply not possible. To ensure that the Earth remains liveable, we as a population will have to reduce our greenhouse gas emissions. This will require a lot of innovation and every sector will have to look at how to reduce emissions. This also applies to the freight transport sector.
The emission generated by this sector accounts for 2.7% of global greenhouse gas (Lister, 2015). The sector's high contribution to emissions also means that there is considerable scope for reducing emissions and making a substantial contribution to combating climate change. The call to become more sustainable within the sector is growing and the sector itself knows that it cannot avoid it.

Besides the growing call to become more sustainable, another problem the sector has to deal with is the shortage of personnel able to operate the ships. It is less and less popular to be away from home for such long periods as happens when one works on a ship (CILT, 2019). Adding to this the fact that connectivity on these types of ships is minimal only exacerbates the problem. Due to the limited influx of new, young people, the workforce is ageing rapidly. As a result, it is expected that shortages will only increase in the future. To ensure that more people are enticed to come and work on a ship, it will be necessary to look at how people can be away from home for shorter periods, fewer people are needed or how the connection with home can be improved.

For both problems, automation could offer a solution. To automate processes, the need for connectivity and data transport will also increase. This need makes the sector highly interesting for KPN. Therefore, this graduation project investigates how KPN can support the maritime sector in making data-driven choices that can lead to automation.

1.2 Company Introduction

Dutch telecommunication company KPN

This graduation project is done in collaboration with Dutch telecommunication company KPN. KPN started as the Koninklijke Staatsbedrijf der Posterijen, Telegrafie en Telefonie (PTT), which was a company providing the post, telegraphic and telephony services in the Netherlands, owned by the Dutch government. In 1989 the company was privatised and in 1998 the postal activities were demerged into an independent company, TNT Post Group. Since then, KPN has been solely a telecommunications supplier and its name has been changed to Koninklijke KPN NV (KPN, n.d.- a). KPN is both active in the business-to-consumer (B2C) as well as business-to-business (B2B) market, both focussed on the Netherlands. Within the B2C market, KPN provides telephony, both fixed as mobile, internet and television for its consumers, while for the B2B market KPN provides telephony, internet, television, but also end-to-end solutions for its customers. For this graduation project, the focus will be on the B2B market.

B2B market

Within the B2B market, KPN offers various services such as mobile connections, internet, telephone communication, television and end-to-end solutions such as Internet of Things, digital security, cloud and workspace, and smart solutions. In addition, KPN has Fieldlabs to explore opportunities within different sectors. KPN has five Fieldlabs on the sectors rural, industry, mobility, urban area and care (KPN, n.d.- b). Within these Fieldlabs, KPN is collaborating with technology experts, clients and suppliers to optimize the technology. By doing so, KPN is developing new business propositions based on its principle 'Business first, technology second' (KPN, n.d.- b).

For the B2B market, KPN is switching to an approach where they work together in an ecosystem with technology partners, clients and suppliers to improve the customer relationship and value (KPN, n.d.- c). Within this strategy, the 'accelerate to grow' strategy, KPN wants to enlarge their contribution and be better connected with its customers. To do so, KPN is investigating the business possibilities in a variety of sectors. Within this search, KPN will have to think more in terms of what the customer or market wants instead of what the technology can do (internal analysis at KPN, 2021). Besides, KPN is also looking for an opportunity to recoup the investment in the construction of the 5G network. KPN is looking primarily at companies, where the new network can offer benefits for which companies are willing to pay extra (KPN, 2020-a). For consumers, the 5G network provides limited additional possibilities and therefore they are less willing to pay extra for it. This is also the result of consumers seeing connectivity as a commodity, which limits the opportunity to earn back the investment even further. For this reason, KPN must investigate the possibilities of deploying 5G within the various sectors.

The green connector

Sustainability is an important focus point for KPN, so they call themselves the green connector. Sustainability is one of the five themes KPN is working on. Within these themes, KPN searches for ways in which they can make a valuable contribution (KPN, n.d.- d). By deploying technologies and ensuring that these technologies can be connected, KPN is trying to minimize the impact on the environment. KPN sees technology as a tool to decrease the environmental footprint of businesses.

KPN has been climate-neutral since 2015 and is now focusing on reducing the CO_2 emissions of its clients (KPN, n.d.- e). To reduce its impact on the environment even further, KPN wants to be circular by 2025 and therefore all of its product components and raw materials should be reusable or recyclable (KPN, 2020-b). To make this happen, KPN made its suppliers sign a Code of Conduct that forces them to become more sustainable (KPN, 2018).

To help other companies become more sustainable, KPN provides various ICT services that can help with this. Accenture Strategy (2016) studied various Dutch sectors to identify where the

most profit can be made. This gives KPN the tools to look for the opportunity how they can help other companies become more sustainable. Automation in the maritime sector is such an example, making the project even better aligned with the interest of KPN.

A more extensive overview of KPN by applying the Resource-Based View (Wernerfelt, 1984) can be found in Appendix G.

Maslow Pyramid

In Maslow's pyramid, people's needs are arranged in hierarchical order. According to Maslow (1943), people only strive to satisfy the needs higher up the pyramid when the needs lower down have been satisfied. Therefore, all human needs can only be satisfied by starting with basic needs. If we look at the Maslow pyramid, KPN is in the tough place of operating on the necessity side of the pyramid (Figure 1). Being a necessity has the downside that customers are not willing to pay extra money for such a product or service (Kemp, 1996). KPN, on the other hand, can innovate to improve the quality of life for their clients and satisfy needs higher in the pyramid, the more luxury needs. This enables KPN to expand its business by delivering these services. Eventually, when they have done so successfully, the newly added service will eventually turn into a necessity again and the process starts over again. The view of people on what is a luxury and what a necessity changes over time (Kemp, 1996). This process is well shown in the service of having internet access on a mobile phone. At the start, people thought having internet access on your mobile phone was a luxury, nowadays people cannot live without it and see it as a necessity.

KPN's take on the project

This graduation project is for KPN a possibility to investigate the opportunity to contribute to and think about their proposition for the maritime sector. The project, therefore, fits in perfectly with the aspects mentioned earlier. It allows them to innovate in the quality of life of stakeholders within the maritime sector because at the moment the connection on these ships is very minimal and therefore the connection with the home front is a lot more difficult. In addition, automation can relieve the crew of certain heavy tasks. Within this graduation project, KPN wants more clarification on what is going on in the maritime sector and how they can facilitate these developments.

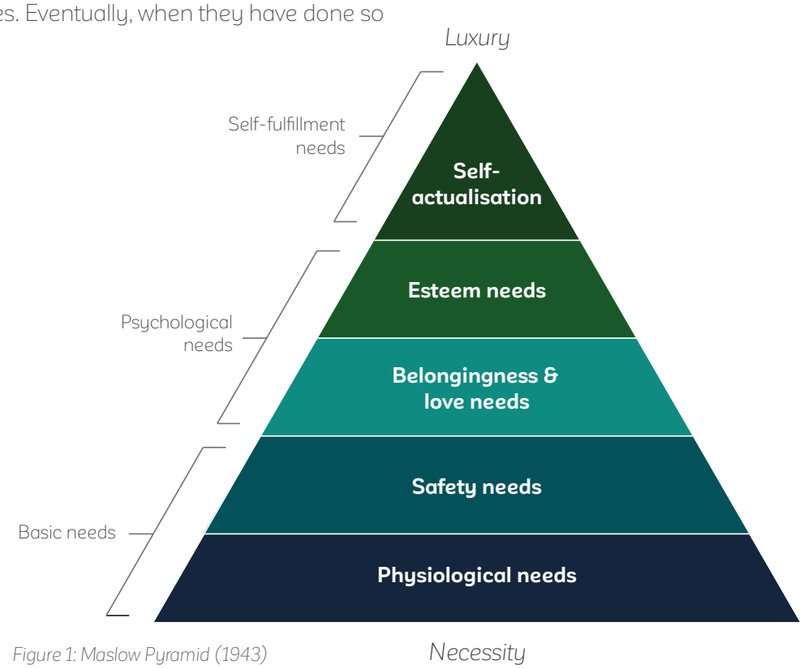


Figure 1: Maslow Pyramid (1943)

1.3 Context of the Project

Sea freight transport

The sea freight transport sector has an important position on a global level due to its major contribution to the global economy. Currently, 80% of the world's trade weight is transported by ship (Lister, 2015). However, in addition to its major contribution, the sector is facing many challenges and changes. The freight intensity, the ratio of freight tonnage to GDP, has been declining slowly for years. Meaning that the economy is increasingly opting for less heavy industry and other goods that require transport towards lighter manufacturing and services and therefore also reducing the demand for maritime transport (Arora, Bhattacharjee, McConnell, Murnana & Panda, 2020). In addition, Covid-19 has had a major impact on the demand for maritime transport, between the UK and EU there was 38% less demand for example (Mordor Intelligence, 2020). As a result, companies within the sector are looking for ways to increase their competitiveness compared to other forms of transport. Working together across the sector is an approach to reduce costs and become more competitive (UNCTAD, 2018).

Because the greatest gains and developments are in world shipping, it will be dealt with first in this report. In order for the final design to better reflect KPN's strengths, the focus will be on the Dutch maritime sector after highlighting the developments.

Figure 2: The global sea freight transport

1.4 Problem Statement

Scope of the project

As discussed earlier, the freight transport industry is currently facing two major issues that need to be resolved, namely, the increased sustainability requirements and the difficulty of attracting new personnel. Automation of the maritime sector could help to improve both. For KPN to create value and contribute to the transition towards autonomous sailing, it must first gain a better understanding of the industry. This needs to include the current situation, but also the developments that are currently going on. This will provide them with the tools and knowledge to develop the right value proposition. To provide KPN with that knowledge, the first research question of this graduation project is as follows;

What are the current developments within the freight transport industry in terms of automation?

In addition to knowing the developments that are being worked on, KPN also wants to actively contribute to this new future. Therefore, KPN is looking for ways to use their expertise and facilitate the maritime sector with this transition. For KPN to better understand their opportunities, the second research question of this graduation project is as follows;

How can KPN facilitate the transition towards automation within the freight transport industry?

By answering the formulated research questions, the most promising opportunities can be highlighted and a value proposition for KPN can be developed to enter the freight transport industry.

1.5 Project Approach

Structuring the project

To keep an overview of this 20-week project and structure both this graduation project and the report, the Double Diamond method from the British Design Council (2005) is used. This method consists of four phases (see Figure 3) and incorporates the different design phases needed for this project. In line with the method, the project and report are divided into four different phases, namely discover, define, develop and deliver.

Phase 1: Discover

This phase aims to gain a better understanding of the graduation project and get a clearer picture of the context, so both KPN and the maritime sector, in which this graduation takes place. This helps me to better work on the content of my thesis, but also to better understand the various components. For this, it will be necessary to understand the developments within the maritime sector (Chapter 3) and seaports (Chapter 4), but also the current situation regarding autonomous sailing (Chapter 5). This will be supplemented with literary research that can provide tools within the design process (Chapter 2).

Phase 2: Define

The analyses and insights gained in the previous phase are used in the Define phase to formulate a design brief (Chapter 7). In this design brief, the global direction on which the Develop phase will focus is indicated. Within this design brief, a future vision will be formulated and the possibilities for KPN to engage within the maritime sector will be presented. To make sure the design brief provides the guidance that is needed during the Develop phase, a design goal will be formulated as well.

Phase 3: Develop

With the guidance of the design brief from the previous phase, the Develop phase will be aimed at ideating for that opportunity (Chapter 8). By including a variety of stakeholders, the ideas can be evaluated and iterations can be made to improve upon the first ideas. All to deliver the best possible solution for all the stakeholders involved.

Phase 4: Deliver

During the Deliver phase, the best ideas are bundled in the final concept (Chapter 9) and the roadmap towards the final concept will be made (Chapter 11). Besides, the business model considering this concept will be presented (Chapter 10). This phase is aimed at presenting it and ensuring that KPN has the tools and information to continue with the design of this graduation project.

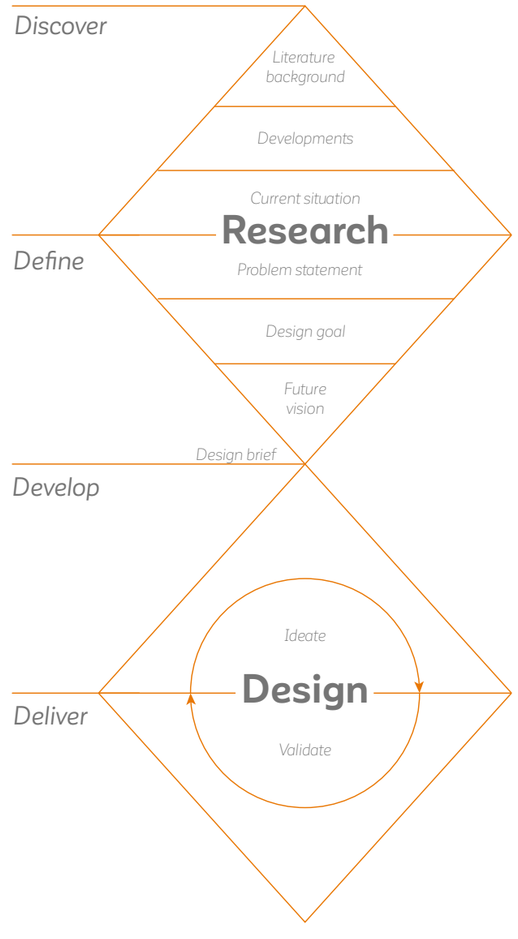


Figure 3: Double Diamond Model (2005)

02

CHANGING MARITIME SECTOR

Relevant literature research concerning the project

To get a better idea of how technology can help to make the sector more sustainable and how such a radical change can be brought about, this chapter describes a literature review. This chapter is divided into three sections. First, it explains how sustainable transport can be achieved by deploying new technologies. The second section discusses the influence of autonomous sailing on maritime freight transport. In the third section, this knowledge is supplemented with the theory of how a transition from one system to another can take place.

2.1 Sustainable Transport

Definition & challenges

Maritime shipping is seen as the most efficient and cost-effective way of transporting large quantities of goods over a long distance. This makes the water an attractive option when things need to be moved. On the other hand, shipping also has negative effects on the environment (Pérez Lespier, Long, Shoberg &Corns, 2019). To be sustainable according to the definition of the World Commission on Environment and Development (Thomsen, 2013), a process must fulfil the needs of the current generation without compromising the possibilities for future generations to meet theirs. Currently, 80% of the world's trade weight is transported by ship, so shipping plays a major role in world trade, but also has a large global environmental footprint. Emissions from maritime shipping are twice as high as from air travel and contain approximately 2.7 per cent of global CO_2 emissions (Lister, 2015). Container shipment is accountable for 25 per cent of these emissions. This makes it very important to make the shipping industry sustainable.

Currently, almost all ships are powered by fossil fuels, but in addition to being bad for the environment, the rising price of these fuels means that many maritime services are no longer affordable (Newell, Nuttal, Prasad &Veitayaki, 2017). Since fuels are a major cost item of today's shipping industry, making it more sustainable can also help make waterborne transport more competitive. Before that happens, there are still some challenges to be solved. These are challenges of policy, ownership, financing and management, rather than technological ones (Nuttal, Newell, Prasad, Veitayaki &Holland, 2014).

There is also increasing pressure from consumers to deliver sustainable products. To meet this, the International Maritime Organization (IMO) has set the goal to reduce emissions by at least 50% by 2050 compared to 2008. Their ambition is to increase this reduction to 100% in 2050. Taking into account the long service life of ships, the first zero-emission ships will have to enter into operation in 2030 (Lloyd's Register &UMAS, 2019). Therefore, the next ten years are of great importance and steps towards these ships need to be taken. Ultimately, in 2050 there will be a fuel mix that can meet the needs of the current generation without compromising future generations needs.

In addition to new fuels playing a role in this transition, new technologies will also be important. Therefore, the following paragraph explains the relationship between technology and sustainability within sea freight transport. As this graduation project is focused on automation, the fuels that have the potential for the future will be discussed in Appendix D. Besides new fuels, other strategies can be applied to become more sustainable as a sector. These strategies for sustainable ecosystem innovation will be highlighted in Appendix B.

2.2 Autonomous Sailing

The influence on sea freight transport

The next step in the sea freight transport sector is to automate processes with the ultimate goal of an autonomous vessel. An autonomous vessel is a ship that can operate safely and efficiently in a real-world environment while doing operations of direct commercial value and which can be manufactured, maintained, deployed, operated and retrieved at an acceptable cost relative to the value it provides (Rødseth, 2017). The implementation of autonomous sailing can have a far-reaching impact on the industry. This impact depends on the level of autonomy that the ship adopts. Within the maritime world, a distinction is made between six levels of autonomy (see Figure 4) (Lloyd's Register, 2016). In this, level zero is a ship where there are no autonomous processes present and everything happens manually up to level six where the ship operates completely autonomously without the supervision of a human being. Within this thesis, the autonomous ship is defined as level four, in which ships operate completely autonomously, with only supervision in some circumstances. The maritime world is gradually working towards this autonomous vessel.

Autonomous shipping can contribute to the improvement of the financial, sustainability and safety aspects of the transport sector, but also influence the human aspect of the sector. Combined these changes can increase the competitiveness of sea freight transport compared to other modes of transport.

Financial impact

The financial impact of autonomous shipping is mainly due to the reduction of the crew required to operate a ship. Besides this reduction, it also provides opportunities to optimise the design of the ship (Kretschmann, Burmeister &Jahn, 2017). Logically, an autonomous ship saves

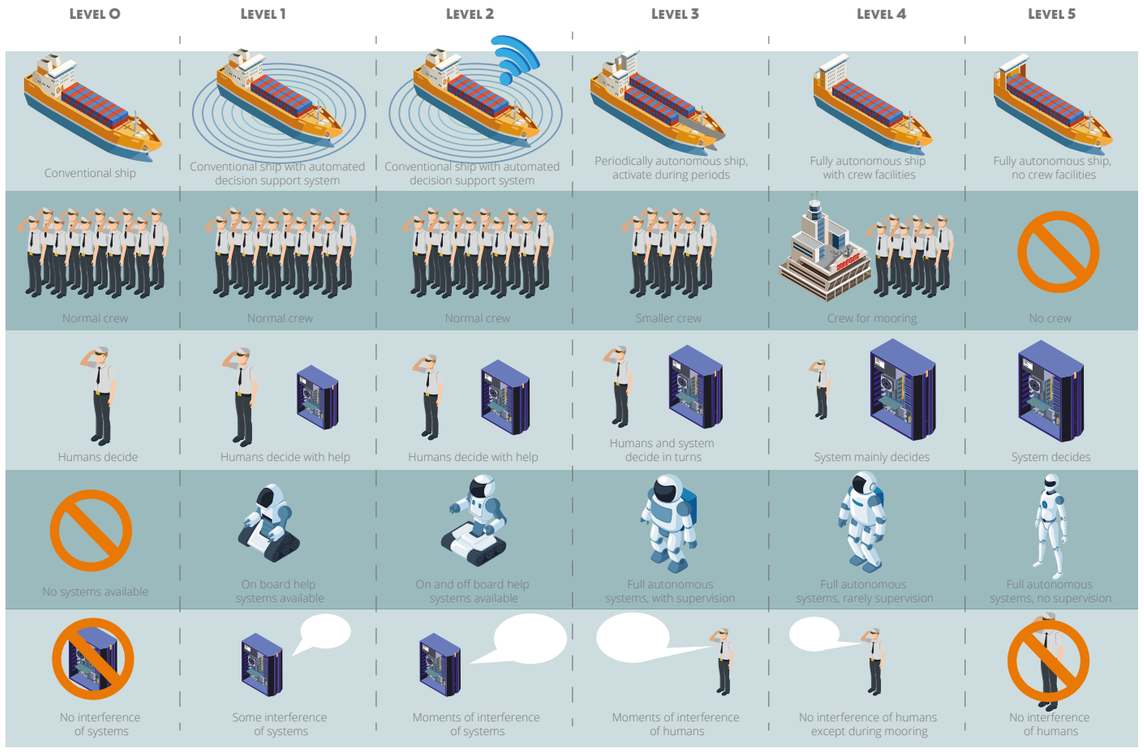


Figure 4: Autonomous sailing levels (own illustration based on Lloyd's Register (2016))

on the salaries of the crew who are no longer needed and are only moved to shore in a limited measure when operating in a shipping network (Ghaderi, 2019). Secondly, savings are made on the supplies needed on board, which are reduced by the elimination of people on board, such as general supplies (e.g. medical, cabin, safety equipment) and maintenance of lifeboats and sleeping quarters. Thirdly, an autonomous ship can save on fuel consumption by reducing drag and lowering its speed (Kretschmann et al., 2017). The drag reduction can be accomplished because the shape of the ship can be optimized for drag since humans do not need to be taken into account in the design anymore. Lowering the sailing speed is possible because, without people, the welfare of people does not need to be taken into account and the savings on sailing quicker is limited due to the absence of onboard salaries (Kretschmann, 2015). These savings make that the costs of an autonomous vessel, in the long run, are about 20% lower than a conventional vessel (Akbar, Aasen, Msakni, Fagerholt, Lindstad &Meisel, 2021).

Sustainable impact

Secondly, the impact on the sustainable aspects of autonomous sailing is related to the fuel savings that can be achieved, but also to the elimination of the use of the crew on board (Rødseth, 2017). As mentioned earlier, fuel consumption can be reduced by sailing slower. In addition, autonomous ships are equipped with sensors, which makes it possible to monitor everything better and to optimize the performance of various systems and the energy these systems consume (Alvik, Eide, Endresen, Hoffman &Longva, 2009). The energy savings from not having a crew on board can be achieved due to the absence of energy consumption from the accommodation part, life support and personnel safety systems (Rødseth, 2017). These savings can further reduce emissions and increase the sustainability of maritime transport.

Safety impact

Thirdly, the autonomous vessel also has a safety impact on shipping. Safety can be influenced because human errors are excluded when a ship is operating on its own. In shipping, most accidents are caused by human error and therefore accidents can be reduced with autonomous ships (Akbar, et al., 2021). However, it should be noted that unfortunate events not related to human error, such as fire or mechanical problems, may have a greater impact if there is no crew on board (Wróbel, Montewka &Kujala, 2017). The crew also prevents accidents, but the limited data makes it difficult to determine whether removing the crew has a negative or positive effect on safety.
This is also reflected in the literature on whether ships become more susceptible to piracy. Some say that the absence of a crew makes ships more vulnerable to piracy (Rødseth, 2014), since there is no crew onboard to act against it. Others conclude that the absence of the crew makes ships less vulnerable because there are no people on board to take hostage (Arnsdorf, 2014; Mooney, 2015). In any case, operating autonomously increases the risk of cyber security threats; all systems onboard are connected and therefore at increased risk for a cyber attack (Hogg &Ghosh, 2016). These uncertainties will have to be taken into account towards the future by the companies involved in the development of autonomous ships and will have to be investigated further at a later date.

Human impact

Finally, the autonomous ship also brings a change in the human aspect of shipping. The main consequence of removing the crew from the ship is that the jobs within shipping will change and other skills will be required. It is expected that low-skilled people will be replaced by higher-skilled people, due to the increased knowledge needed to operate autonomous ships (Hogg &Ghosh, 2016). This will partly address the current shortage of skilled people (Ghaderi, 2019), but will also create new shortages of other skills such as ICT skills (CILT, 2019). By moving these jobs to shore, however, these jobs become more attractive to more people, which will make attracting new staff easier (MUNIN, 2016). The exact consequences on the human aspect can only be determined when the technology is further developed and implementation can start.

As a transition will be needed for automation to happen, the following chapter will discuss how such a transition can take place.

2.3 Transition Theory

From regime to regime

To automate the sea freight transport sector, a transition to a new system will have to take place. Based on Geels (2005), the transport sector is seen as a societal function, which is performed by a socio-technical system. Systems consist of aligned elements like knowledge, regulations, infrastructure and supply networks. To gain more knowledge about these types of systems and how they go through transitions, these have been researched.

Socio-technical transition

Besides transport, communication, housing, food and energy supply, are also social functions and therefore performed by socio-technical systems. These systems contain various components such as technology, regulation, markets, infrastructure, cultural meaning, maintenance networks and supply networks (Geels, 2005). A sustainable transition can be seen as a goal-oriented transition with limited incentives for individual actors. This limited incentive is because the goal being pursued is a collective good, namely sustainability (Smith et al., 2005). In addition, sustainable solutions have few user benefits and score lower on price-performance ratios. As a result, it cannot be expected that sustainable solutions will replace current solutions without an economic benefit (Geels, 2011). Therefore, sustainable transitions are difficult to bring about in such systems. For this, co-evolution processes are required within these systems, in which changes take place in both technological and other components (Geels, 2005). To properly map these transitions, the multi-level perspective has been devised by Geels.

Multi-level perspective framework

Within the multi-level perspective framework, a transition is seen as a non-linear process resulting from the interaction of developments at three different levels: niches, socio-technical regimes and socio-technical landscape (Geels, 2002) (see Figure 5). Each level has a heterogeneous configuration of elements; the higher the level, the more stable the number of actors and the alignment of the elements (Geels, 2011). Transitions are defined as a shift from one regime to another. Within this, the niche and landscape level can be seen as a derivative of the regime, as these are defined in relation to the regime. The regimes are embedded within the landscape and niches within the regimes.

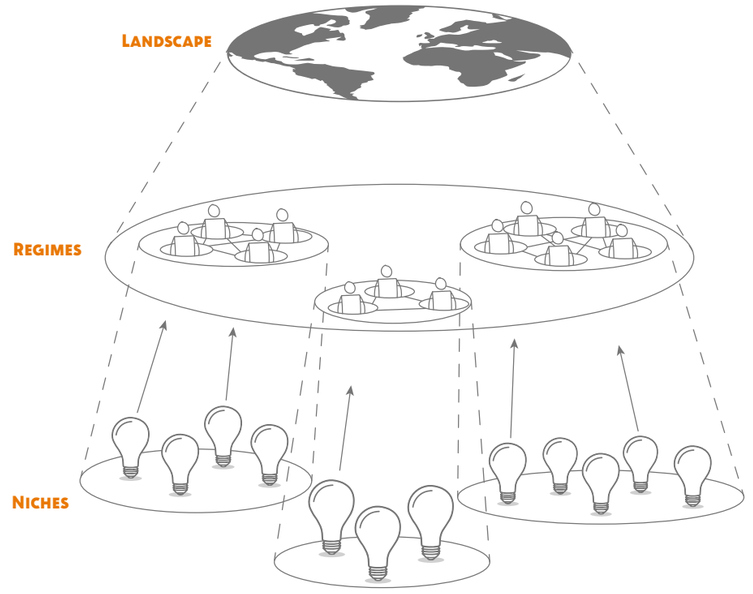


Figure 5: Multi-level perspective framework (own illustration based on Geels (2002))

Socio-technical landscape
The technical trajectories are situated in a socio-technical landscape, also called the macro-level. The landscape consists of a set of deep structural trends, which provide a structure or context for interactions of actors (Geels, 2002). These trends embedded macro-cultural changes and contextual developments, such as globalisation, environmental problems and cultural changes. Changing the socio-technical landscape is harder and slower than regimes.

Socio-technical regime
The socio-technical regime, also referred to as the meso-level, can be seen as a rule-set embedded in the knowledge base, engineering practices, corporate governance structures, manufacturing processes and product characteristics (Geels, 2002). The socio-technical regime provides orientation and coordination to the activities of relevant actor groups and therefore provides stability of an existing socio-technical system. Existing socio-technical systems are characterized by being locked in, which makes innovation occur in incremental steps, by small adjustments accumulating into stable technical trajectories and path dependencies (Geels, 2002; 2011).

Niches
Niches form the micro-level, which are protected spaces, such as R&D laboratories, demonstration projects or small market niches, focused on radical innovations. With the protection of the mainstream market, the niches act as incubation rooms and therefore provide room for learning processes by doing (Geels, 2005). Besides the learning processes on technology, user preference and regulations, the niches create the opportunity to build the social network, for instance, supply chain, needed to support the innovation. The innovation within the niches provides the seeds for systemic change. The niche actors hope that the promising novelties are eventually used in the regime or even replaced (Geels, 2011).

Transition in multi-level perspective
The interplay between dynamics at multiple levels creates system innovation and enables the transition towards a new regime. Within such a transition four phases can be distinguished which need to be completed; emergence, take-off, acceleration and stabilization (Rotmans, Kemp & van Asselt, 2001).

In the first phase, the so-called emergence, radical innovations are emerging in the context of the existing regime and landscape developments in the safe environment of the niches. Actors are engaging in experiments and improving the design to find out the best design and wishes of the users, all to arrive at a dominant design and technical form of the found novelty.
Within the second phase, the take-off, the resources for technical specialisation are provided by using the novelty in small market niches. A community emerges from engineers and producers who are collectively improving the new technology. By improving the technology and learning along the way, the second phase results in stabilization and shaping the final form of the radical innovation.
The third phase, the acceleration, contains the breakthrough of the new technology to mainstream markets and starts competing with the established regime. A breakthrough is dependent on both internal drivers, such as price/performance improvements, increasing returns to adoption or actors pushing for further expansion, but also on external circumstances, also known as windows of opportunity (Geels, 2005). These windows of opportunity could vary from the regime getting under pressure from changes at the landscape level, internal technical problems in the regime to changing user preferences, all not able to be solved by the current technology.
In the last phase, the stabilization phase, the old regime is replaced by the new one. With this transition, changes on wider dimensions of the socio-technical regime take place. The transition often happens gradually due to the lock-in mechanism and the fact that the creation of a new socio-technical system takes time. Important to note is that system innovation is not based on one cause or driver but is the combination of simultaneous processes at multiple dimensions reinforcing each other (Geels, 2005).

2.4 Conclusion

Literature findings

It can be concluded from the literature review that sustainability is very much needed for sea freight transport. It can be seen that the time to achieve this is rapidly running out if the set targets are to be met by 2050. Part of this sustainability can be achieved by implementing new technologies and automating processes.

Besides sustainability, applying technology to automate and optimise processes can help to achieve major improvements in various other areas as well. It can help to improve the financial aspect, sustainability and safety of sea freight transport. In addition, the application of technology also brings about a change in the people required within the process. This makes the coming period very interesting in the field of technology development in the maritime sector.

It should be taken into account that a transition to a new technology takes time and goes through different phases. First, new technology must emerge in the niches. Then a take-off phase takes place, in which the technology is increasingly used within market niches. The third phase is acceleration, in which the technology starts competing with the current regime. Finally, stabilization happens, where the old regime is replaced by the new one.

For my graduation project, I think these are very useful starting points to use when designing a business opportunity for KPN. This should take into account that KPN will be dependent on other parties and should look at how these parties can be involved. Besides, the time needed for the transition to go through different phases will need to be considered. As a result, KPN could also consider entering the transition at a later stage, so that more value can be added.

03 DEVELOPMENTS

Technology scouting to get an overview of the current developments

Currently, various developments focused on investigating the autonomous future can be distinguished. Within these developments, stakeholders focus on their own expertise. By working together, companies try to achieve an autonomous future. This chapter examines the current developments within the maritime world to gain a better picture of the current situation. Four different developments are examined within the chapter. The first section focuses on smart shipping. The second section investigates the servitization of the transport sector. Thirdly, the changes concerning employees are further explained and the final section is highlighting the developments on the Non-Terrestrial Networks.

3.1 Smart Shipping

Automating the process

A development within the maritime sector is smart shipping. This means that different parts of the transport process are equipped with sensors and which are linked to each other. As a result, components can communicate with each other and processes can be optimised or even automated (Lacey, Lisachuk, Ogura & Giannopoulos, 2015). Therefore, data plays an increasingly important role in the process. At the moment, it is expected that 10% of newly built ships will be so-called smart ships, all equipped with the necessary sensors (Lloyd's Register, QinetiQ & University of Southampton, 2017). This is an evolution of what we are seeing now, where current ships are more and more equipped with sensors to enable smart shipping. By connecting different components and monitoring their performance, there are a variety of operational processes that can be improved such as operational efficiency, ship management, decision-making, reducing emissions and improving the safety and maintenance of ships and personnel (Kumar, n.d.). To achieve this, various technologies are used, both onboard and onshore, to eventually strive for automation. Several of these technologies will be highlighted below.
To get a better idea of the challenges, technology applications and opportunities in sea freight transport, this is shown per step in the process in Figure 6. It also incorporates the technologies discussed below.

Adaptive ship routing

One of the technologies used to increase ship efficiency is adaptive ship routing. This looks at how the route the ship takes can be optimised. Using an algorithm, the optimal route can be calculated based on various optimization goals, such as minimum sailing time, passenger comfort, sailing risk or fuel consumption. For this calculation, the algorithm is given a known starting and endpoint, and has to calculate, through an environment where static and dynamic obstacles coexist, the optimal route. For this calculation, the algorithm will use a variety of different data points such as distance, speed, weather forecasts and fuel consumption (Wang & Chen, 2020). In addition to the given data points, previously collected data can be used to make the route more reliable and further optimised by looking at what happened in the past. For instance, Anan, Higuchi, and, Hamada (2017) combined big data and artificial intelligence to visualize ship performance on sea. Combining it with results from weather routing simulation, resulting in improved fuel usage of the ship. By updating the route during the transit time with new data, the ship is less likely to encounter surprises on the route. All to try to achieve the optimal route for a vessel. By sailing the optimal route, money can be saved by minimising travel time and saving on fuel. In addition, danger to the ship and the crew is reduced by avoiding the worst weather conditions (Pennino, Gaglione, Innac, Piscopo & Scamardella, 2020).
Within such an adaptive ship routing technology, various technologies are used that combine to create the optimal route. To delve a little deeper into these various technologies and other applications, they have within the shipping industry, they are discussed in detail below.

Big data and analytics

The sensors placed onboard various ships all generate data that can contain valuable information. This data can be stored both onboard and ashore, depending on the communication possibilities. Besides collecting the data, it must also be analysed so that it can be used. To do this, systems are being developed that can interpret the data in real-time into a usable interface. These systems combine machine learning and natural language processing to give a workable insight to the decision-makers (Lloyd's Register et al., 2017). This is also the biggest challenge of big data: converting large amounts of data into qualitative insights. These insights will eventually be needed for autonomous sailing, but can already offer a helping hand to the crew on board. Currently, the collected data already helps by doing predictive analysis, which can help to prevent delays and improve the overall operational efficiency (Marine Digital, n.d.). The collected data, which is done for several years by proper tracking of shipments, contains a variety of valuable insights, for instance, reasons of vessel losses at sea, losses of containers, reasons for delays or reasons for damage to goods. By combining a large amount of vessel tracking data from real-time satellite systems with historical shipping data, Kim, Kim, and, Park (2017) were able to build a framework of refined case-based reasoning. By analyzing the causes of delays and matching those to tracking patterns of real-time shipments, early detection of vessel delays could be achieved. By improving upon and expanding the data collection and analysis systems, it will help to move ships from digital to smart, after which the step to autonomous sailing can be made in the distant future (Lloyd's Register et al., 2017). To make all this possible, smart software will have to be developed that makes clever use of sensor fusion techniques, big data processing and systems that can convert raw sensor data into actionable information.

Robotics

Within the maritime world, there are more and more developments in the field of robotics. We can distinguish three different robots that will make their appearance shortly: learning robots, practical robots and mini-robots (Lloyd's Register et al., 2017). All of them have a different purpose within cargo transport.
The first, the learning robot, is used for learning purposes, for example, to train personnel or to test conditions. This is to ensure that everyone is best prepared for the job.
The second, the practical robot, is capable of handling an asset within the whole process of transport. This allows a simple or heavy task to be automated, relieving the staff of this task. An example is the firefighter robots, which are able to autonomously detect and suppress shipboard fires (Kumar, 2020). Robots of this kind can also be used, for example, to maintain the correct course, so that the optimal route can be travelled.
The last one, the mini-robot, can be used for inspections in hazardous conditions. This is to ensure that the inspections do take place, but that people do not have to enter a dangerous environment to do so. An example can be found in the Ship Inspecting Robot (SIR) from a student team located in Zürich, which is capable of conducting a visual inspection of ballast tanks and hard to reach parts in cargo vessels (Kumar, 2020). The developments within robotics are closely related to other technologies, such as sensors and remote controls. In addition to these robots, there are likely to be several more in the future (Huntington, 2020). This will allow for more and more automation, bringing the autonomous ship one step closer.

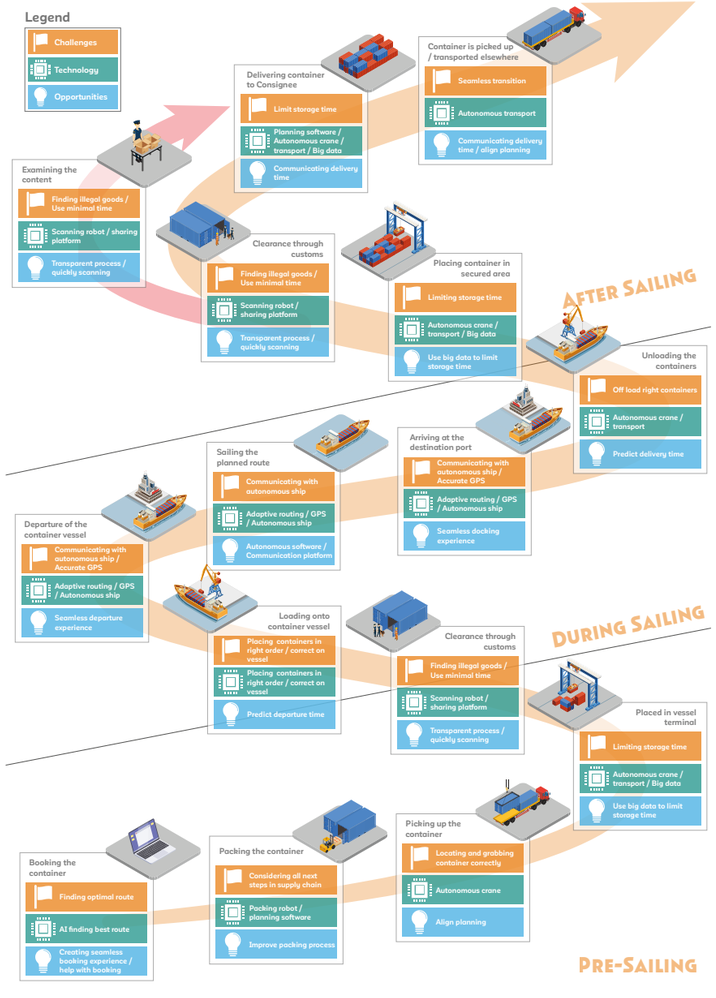


Figure 6: Challenges, technologies and opportunities in sea freight transport (own illustration)

Artificial Intelligence

Within the shipping industry, artificial intelligence (AI) is starting to play an increasingly important role. By using AI, companies can better predict demand, make more informed decisions and respond to changing circumstances. Within the shipping industry, AI has a very wide application in different parts of the process, for example in building ships, the transport itself, but also in the ports. In addition, AI is applied to enable other systems and developments, as previously described in big data analysis and adaptive ship routing. In the end, AI can help companies build in more flexibility, demand-driven pricing, reduce human error and automate processes (Asiana, n.d.).

During shipbuilding, AI can help predict when a ship will be ready for use, taking into account various changing input variables (Zhao, He & Ge, 2014). In addition, AI can also be applied to smaller parts of the construction process, for example when helping to weld a ship. By using image capturing software combined with AI techniques, Sanders, Tewkesbury, Ndzi, Gegov, Gremont and Little (2012) created a system that could take into account various uncertainties and give the right welding seam.

During navigation, AI can help maintain the course. Hu, Du, and, Shi (2015) developed an adaptive controller for use in a dynamic positioning system, which allowed ships to maintain the desired course within the limits set by the system. In addition, AI can assist in fleet risk management, by assessing the risk of vessels based on static and dynamic factors (Balmat, Lafont, Maifre & Pesse, 2009). Finally, AI can also help in port improvement, to optimise the process within it. By using a dynamic learning predictive algorithm, Fancello, Pani, Pisano, Serra, Zuddas and Fadda (2011) created a system where the interval between arriving ships is reduced and resources can be used better. The entire process is optimised while taking into account the accurate demand and operation of the terminal.

In addition to the earlier-mentioned optimisations made possible by AI, there are many other applications in which AI can bring about great improvements. Ultimately, the role of AI within shipping will increase in the future. Ultimately, the goal is to make the sea freight transport sector as competitive as possible compared to other modes of transport.

To conclude, three major technological developments can make the process of cargo transportation by ships smarter, namely the analysis of big data, the deployment of robots and the use of artificial intelligence. These technologies all have their applications within the maritime sector. In addition, they can be combined into concrete examples such as adaptive ship routing. In the coming years, these technologies will only be further developed and there will therefore be even more interesting opportunities to deploy them. Besides the technological developments within the maritime sector, there are also developments to improve the business models companies use to earn money and meet customer needs. The next section will highlight these developments.

3.2 Servitization

Changing business models

Servitization is having a business model that is based on making money from providing services to customers. Within such a business model the product is seen as a tool to deliver the best possible service (a schematic overview can be seen in Figure 7). Besides, taking the products into one's own hands and deploying them within a delivered service can bring various benefits. These benefits vary from revenue and profit growth, improving responses to customer needs, improving product innovation, building new revenue streams and increasing customer loyalty (Baines, Bigdeli, Bustinza, Shi, Baldwin & Ridgway, 2015). Overall, the benefits can be categorized into two groups: defensive (cost reduction) and offensive (business growth) components (Baines & Shi, 2015). Combined these components provide the opportunity to lower the cost while simultaneously growing the revenue, leading to more profit.

Within the maritime world, as in various other sectors, we also see this development towards servitization. This means that companies in the maritime world focus on the overall performance of the fleet and optimise this to the maximum (Ryste, 2020). The different companies all focus on their expertise, which makes it possible to achieve the best possible results. Besides, the transition towards a digital maritime sector enables companies to work towards smart solutions, where value is created by monitoring, controlling, optimizing and automating functions. By doing so, companies are well aware of the needs of their customers and can respond to those (Solem, Kohtamäki, Parida & Brekke, 2021). By doing or arranging the different parts of the transport themselves, more flexibility can be guaranteed towards the customer, for example by using different forms of transport. Servitization can also help counteract the increased inefficiency and complexity within the sector. Expectations from society are getting higher, on sustainability for example, and to cope with this, companies are opting more for cargo transport management solutions. This gives them a good overview of the entire transport chain and therefore the ability to deal with changing circumstances (Mordor Intelligence, 2020).

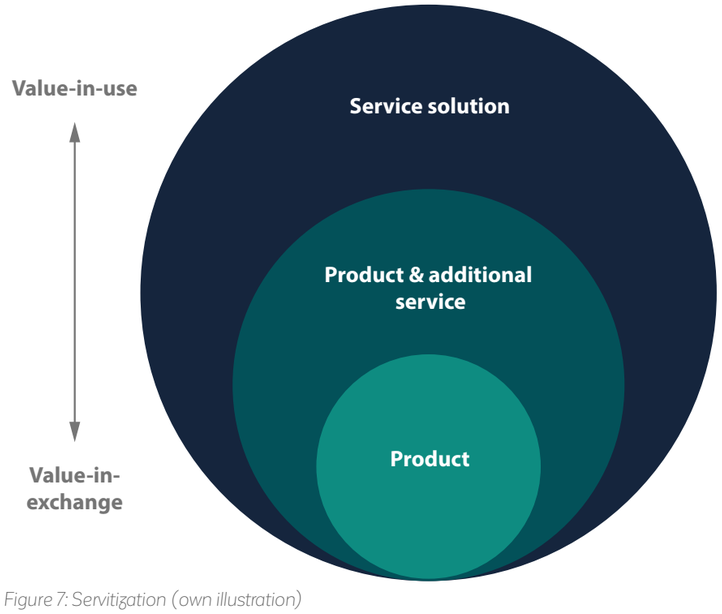


Figure 7: Servitization (own illustration)

3.3 Employee Welfare

More flexibility & improved conditions

The freight transport sector is facing increasing staff shortages due to low wages and difficult conditions such as being away from home for long periods and limited connection to home (CILT, 2019). The limited supply of new personnel is resulting in the workforce ageing fast, which will only exacerbate the problem in the future (Schröder-Hinrichs, Fonseca, Song &Lagdami, 2019). To counteract this, there are developments to improve the conditions in which staff work and to place them more centrally in the operation (International Maritime Organization, 2020). Companies are implementing flexible work schedules, focusing on diversity and improving career opportunities to increase the supply of new employees (CILT, 2019). They are also looking at better training for both new and current staff so that they are better prepared for the task at hand (Lloyd's Register et al., 2017). Finally, automation can also play a role in this, taking over tasks from staff that are dangerous or monotonous (Schröder-Hinrichs et al., 2019). All to ensure that sufficient personnel remain available to ensure that operations do not grind to a halt.

3.4 Non-Terrestrial Networks

Definition & future perspective

In addition to the various developments within the maritime sector, there are also a few developments that are relevant in the field of communication networks. Nowadays, more and more people and products are connected to the internet through cellular networks. The disadvantage of this is that these networks need transmission masts to provide this connectivity. This makes satellites a possible solution for difficult to reach locations such as the sea. Satellite networks have been around for a while, but there are a lot of interesting developments in this area (Rinaldi, Torsner, Pizzi & Andreev, 2020).

A network of satellites, also called a Non-Terrestrial Network (NTN), uses satellites, unmanned aerial vehicles (UAVs) and high altitude platforms (HAPs) that connect using radiation through space. The density is a lot lower, so the radiation travels a lot farther and can travel faster in comparison through the air. These stations then connect to receivers placed on earth so that connectivity can be delivered. The Non-Terrestrial Networks can be divided into five categories: Geosynchronous Earth Orbit (GEO), Medium Earth Orbit (MEO), Low Earth Orbit (LEO), Unmanned Aerial Vehicles (UAVs) and High Altitude Platform Systems (HAPS) (Lin, Rommer, Euler, Yavuz, Karlsson, 2021). The classification is based on the altitude at which the station is located in relation to the earth as shown in Figure 8. In general, the higher those stations are, the fewer are needed to create a network, but the higher the latency and lower the speed is (Giordani &Zorzi, 2021). So if we want

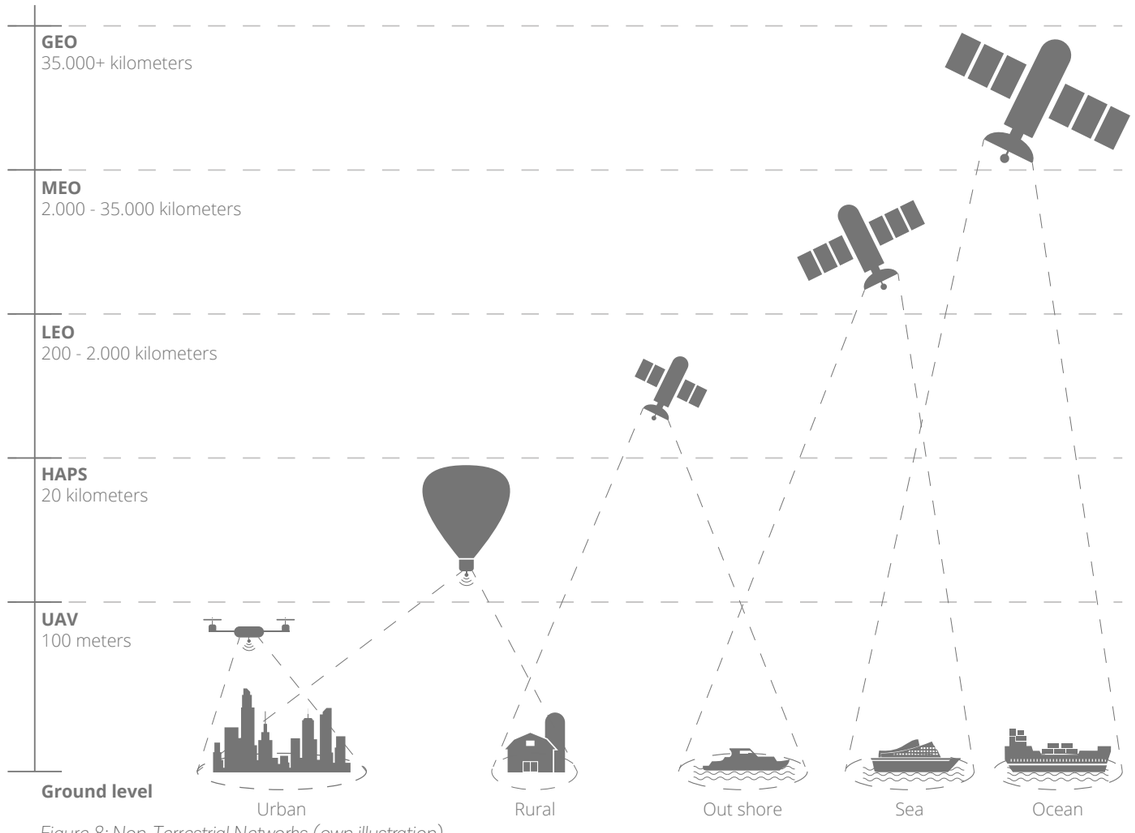


Figure 8: Non-Terrestrial Networks (own illustration)

a network with low latency and high speed, we will have to use more stations closer to the earth. The disadvantage of this is that these stations are more easily visible from earth and the chance of collisions in space increases. A balance must be made here between the required speed and latency and the number of stations to be used.

Currently, there are already companies that provide satellite connections by means of satellite telephones. These are still very expensive and the speeds are often very low, mainly because they are in the GEO. Most developments are currently taking place in the MEO and LEO area. Here, several companies are creating a network that can guarantee worldwide coverage by shooting satellites into the air. The number of satellites planned varies from company to company, ranging from 900 to 30.000 satellites, all with their own advantages and disadvantages (Weitering, 2019; Henry, 2019). At the moment, these networks are still under development, so when they have a connection, they still have the limitation of being stationary. This means that if the location of the receiver moves, the connection will also be lost. The stationary connectivity is due to geofencing. With geofencing, a virtual area is created in the real world, so that when devices enter this area, a programme or application can be activated. In NTNs, this geofencing is used to locate the receivers on the earth. The earth is divided into several virtual blocks. When the receiver is registered, it is determined in which block this receiver must receive service. If the receiver then goes outside the designated block, it loses the connection to the satellite and thus to the internet (Wise, 2021). Only a limited number of customers can be served within a block. By using geofencing, these networks can guarantee service to their customers. By preventing too many receivers in the same block at a certain point, a poor connection for everyone is prevented. Besides guaranteeing the service, it also helped these networks with their licences to deliver connectivity in countries. This prevented that these networks would competing with the local network providers, guaranteeing the position of the local providers. However, this is expected to change in the future so that mobile connections can also be offered.

Besides, developing such a satellite network is expensive, which results in financially strong companies investing in these networks. Combined with extensive knowledge present in these companies, make that they are able to innovate quickly. So, although the satellite networks are still under development, the developments are quick.

In addition, the integration of satellite networks within cellular networks will be considered in the future (3GPP, 2018). This will bring the phase where everyone is always connected to the Internet one step closer. The integration of the networks forces KPN to keep a close eye on the developments within the NTNs. The new regulations will force them to do something with this in the future. This also offers the possibility for KPN to deploy connectivity outside its network in the future.

3.5 Conclusion

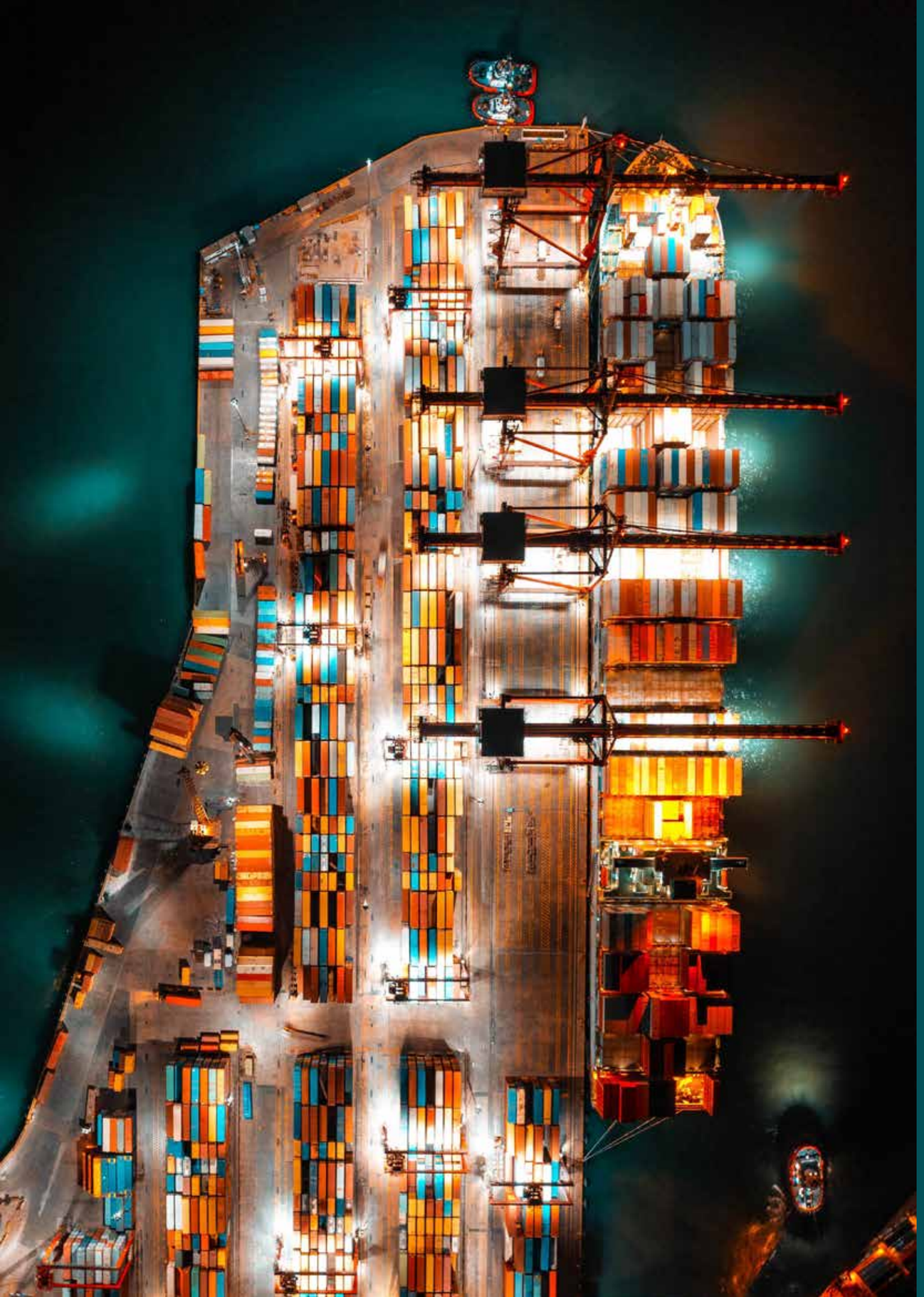
Developments within the maritime sector

A variety of developments within the maritime sector were discussed. It can be concluded that the sector will be subject to many changes in the coming years. This makes the sector a very interesting one to keep an eye on for companies in the years to come. Opportunities will arise for companies to fulfil newly developed needs from consumers.

There are also many developments in the field of smart shipping, many of which offer future potential. It must be said that these technologies do not compete with each other and can coexist well in the future. The autonomous future is, therefore, realistic, even though this will happen step by step. Through the introduction of new technologies, more and more processes can be automated until humans are only needed to verify processes. However, the transition towards that level of automation will take some time.

Secondly, there are also developments in the field of business models and employee welfare. Implementing service-oriented business models is still a major challenge for maritime companies, even though it has great potential to create value within the sector. It, therefore, remains interesting for companies to keep an eye on how this can be achieved. In addition, it is seen that employees play an important role, even when automation is completed, and therefore the conditions for employees are being looked at more and more. The first steps have already been taken, but there are still many opportunities for further improvement.

Lastly, the developments within network creation can be distinguished. With businesses becoming increasingly dependent on the Internet, it can also be seen that connectivity is becoming increasingly important. To ensure that, for example, a ship within the maritime sector is always connected, NTNs are an interesting development. Especially if this development is integrated with cellular networks, allowing for a smooth transition between the networks. This makes it important to keep a close eye on the developments of these networks, to ensure a timely response to the most promising player within the NTN market.



04 SEAPORTS OF THE NETHERLANDS

Relevant research into the seaports located in the Netherlands

KPN's focus on the Dutch market makes it relevant for the project to look at what kind of developments are taking place in the Dutch maritime sector. Dutch ports play a substantial role in Europe's trade with the rest of the world. This makes it interesting for KPN to get involved with the seaports in the Netherlands and investigate what business opportunities there are to capitalise on. This chapter is divided into four sections. First, the different sea harbours in the Netherlands are highlighted. Then the stakeholders needed for the operation with a harbour are discussed. The third section will go into the effect of the global developments on the harbours in the Netherlands. Lastly, the Port of Rotterdam will be discussed and what developments are taking place within the port.

4.1 Different ports

Located in the Netherlands

In the Netherlands, there are several seaports, all of different sizes. Rotterdam is by far the largest seaport, followed by Amsterdam, Vlissingen and Groningen. Especially Rotterdam and Amsterdam play a role on a global level, Rotterdam is the sixth seaport of the world and the largest of Europe and Amsterdam is the fourth seaport of Europe (CBS, 2019). From these ports, goods are imported and exported from all over Europe.

To strengthen the Dutch position at a global level, the various seaports in the Netherlands are working together under the Port Memorandum 2020-2030 (Ministry of Infrastructure and Water Management, 2020). This cooperation focuses on eight different themes: accessibility and logistics, safety, digitisation, economy and innovation, Europe and international, sustainability, the spatial environment and the labour market. Within this cooperation, there are several initiatives whose insights can help all parties to make improvements on a particular theme. By doing this together with the Dutch government, the companies hope to strengthen the competitive position of the Netherlands in the maritime sector.
A good example of this cooperation is Portbase. This is a company set up by the Port of Rotterdam and the Port of Amsterdam, which provides the Port Community System (PCS) for both ports (Portbase, n.d.). A PCS is used to digitalise various logistic movements, processes and information flows. By doing so, stakeholders and processes can be linked within the port, which ultimately makes it easier to share data and coordinate processes. By now, this PCS is used in all Dutch seaports to make it possible for all ports to benefit from it (interview Portbase, 2021). In the future, there are even plans to have inland ports work with this same system to increase the effect even further (Ministry of Infrastructure and the Environment, 2020).

For the most part, the same developments are taking place within the ports as in the rest of the maritime sector (see Chapter 3). Therefore this brings about changes in all ports or forces a port to deliver something. To do this as well as possible, cooperation is important for all parties involved. In this respect, the capacity and knowledge of the various ports are considered. Rotterdam is the largest and so therefore the place where most developments are taking place. In addition, Rotterdam has a large network of public and private collaboration partners called the Rotterdam Maritime Capital of Europe (Port of Rotterdam, n.d.-a). Within this network, a lot of innovation is taking place to improve the port. Because of the important role the Port of Rotterdam plays in the development of the Dutch seaports, the study largely focuses on the Port of Rotterdam. The various developments that are taking place in the field of ports are discussed in detail later on.

4.2 Stakeholders

Involved in the port process

There are a lot of companies within the port that jointly ensure that the processes run properly and smoothly. The port authority takes care of the infrastructure, like quay walls and waterways, which makes all this possible, but other parties take care of the interpretation of the processes (interview Port of Rotterdam, 2021). This allows companies to fully focus on their expertise. This can be compared to airports, where different companies also focus on their expertise. The companies need each other to continue to exist and to ensure that the port continues to function as it does.
This cooperation is also reflected in the developments taking place at the Port of Rotterdam. Figure 9 (Port of Rotterdam, n.d.-a) shows that the port authority has a large network of parties with whom it innovates, consisting of both fully-fledged companies and start-ups that are supported by the port. By using this approach, the Port of Rotterdam increases the possibilities to innovate, even if the knowledge is not directly available within the port authority itself.

Figure 9: Innovation partners of Port of Rotterdam (n.d-a)

4.3 Global developments

Influence on the seaports

Within the ports, the same developments as in the entire maritime sector can be seen (see Chapter 3). Naturally, ports play a serving role within the sector. This means that ports have to adapt to the developments within the rest of the maritime sector (interview Port of Rotterdam, 2021).

Automation, for example, also plays a major role within ports. For this, ports are looking at automating their own processes, but also what ships will need. Eventually, it will have to be possible to supply the right technologies and infrastructure to support the ships in automating their operations (interview Port of Rotterdam, 2021). To do so, the ports will have to implement the right technologies and adapt to the needs of the ships. This will result in changes to processes at the port authority itself and the implementation of certain technologies, such as data-driven decision making and the automation of processes.

The same applies to the development of sustainable shipping. Ports will have to consider their own operation, but also help the ships to improve. For this, operators will need certain fuels and fuelling infrastructure in a port, which will have to be facilitated by the port authority.

Ultimately, the same applies to the port and ships as to the companies involved within the port; they need each other to achieve results and they also depend on each other to make improvements. To go into a little more detail about how the Port of Rotterdam and the involved companies have innovated, the following section will discuss the developments that have taken place within the Port of Rotterdam.

4.4 Port of Rotterdam

Developments in the port

The Port of Rotterdam aims to ensure that the docking and mooring of ships take place as smoothly as possible in the shortest possible time. To achieve this, continuous improvements are made. In doing so, the port authority focuses on four different objectives for the port, all aimed at creating the best possible port. The four different goals are a smart port, a safe port, a sustainable port and an accessible port (Port of Rotterdam, n.d.-b). Below, the different objectives are discussed and the innovations that are applied to achieve the objective are highlighted. Of course, some innovations help achieve more than one goal.

To gain an even better insight into how things are going in the port and to see how far the developments have already come, interviews were held with KPN's account manager for the Port of Rotterdam (HbR), the Strategy &Innovation Manager at Portbase and the program manager of long-term digital transformation at the Port of Rotterdam (see Appendix E).

SMART PORT

The Port of Rotterdam aims to lead the way in developing the so-called smart port. Within this, processes are optimised and automated which offers the possibility for autonomous ships to visit the port. The Port of Rotterdam, therefore, hopes to receive the first autonomous ship in 2030 (Port of Rotterdam, n.d.-c). To realise a smart port, three components are considered: innovation, digitalisation and the energy transition.

Innovation

The first aspect the Port of Rotterdam has looked at to become a smart port is the development of innovations that can be deployed within the port. The port authority does this together with the partner network mentioned earlier. In addition, there are also companies located within the port that optimise their processes through innovations. This means that not all innovations come from the port authority itself, but sometimes from a company located in the port. The port authority then only ensures that the infrastructure required for this is present (interview Port of Rotterdam, 2021).

For this project, the most interesting one is the contract that Port of Rotterdam has with IBM, Cisco, Esri and Axians. This contract is to deliver the Internet of Things platform for the port authority (Visser, 2020). Within this platform, various sensors monitor water and weather conditions and keep this up to date. By combining these data points and analysing the data on the platform, it can serve to better predict and anticipate upcoming conditions (interview Port of Rotterdam, 2021). In turn, this can be used to better regulate the planning and management of ships. In addition, the platform offers the port authority the opportunity to implement technologies such as edge computing, real-time analysis, artificial intelligence, hyper-precise data and blockchain (Port of Rotterdam, 2019-a). In doing so, it provides the first component for autonomous sailing within the port for the future. As this provides the first component for autonomous sailing, this platform could play an important role in autonomous sailing in the Netherlands.

To explore the innovations to become a smart port a bit further, the remaining interesting for this project are in Appendix F.

Digitalisation

To become a smart port and the best in the world, digitising processes and forms is an important part to invest in for the Port of Rotterdam. There are therefore various projects and implementations of digitalisation that helps the port take steps towards becoming a digital port. Several of these digital components are also used in the innovations in the port and are linked to each other to be able to get even more out of the data. The most interesting digitalisation developments can be found in Appendix F.

Energy transition
Like many other sectors, the maritime sector will also have to become more sustainable. The Port of Rotterdam also plays an important role in this. To achieve this, an energy transition will have to take place both in the port itself and in the ships that dock there. For the port itself, the Port of Rotterdam has devised a strategy with three different phases to become completely CO_2 neutral and circular by 2050; Efficiency, new fuels, new materials and new fuel system (Port of Rotterdam, n.d.-h). The different phases for this transition and how the Port of Rotterdam wants to achieve these can be found in Appendix F.

SAFE PORT

Safety comes first at all times in the port of Rotterdam. If it is not safe, work cannot be done. To ensure that the port is as safe as possible, the port authority applies various technologies to monitor this closely. By using sensors and processing the data in a flood risk management study, the port authority continuously monitors the risk of flooding (Port of Rotterdam, n.d.-j). In addition, the port authority has installed E-noses throughout the port. These are sensors that can smell dangerous substances and raise the alarm when necessary (Port of Rotterdam, n.d.-i). The data from these sensors is read continuously and can be viewed by all parties involved in the port. This prevents dangerous situations and improves safety and health at work. Besides preventing dangerous situations, sensors can also be used to monitor environmental conditions. By measuring the air quality pollution can be detected from specific areas, which can help to target specific pollution sources in the port (Port of Rotterdam, n.d.-i). In this way, the network of these sensors also contributes to a sustainable port.

SUSTAINABLE PORT

The Port of Rotterdam sees a sustainable port not only in terms of climate but also in terms of safety and people. Within this objective, there are three directions, namely safe & health, climate & energy and people & employment (Port of Rotterdam, n.d.-j). Within all three of these directions, the port authority, in collaboration with other parties, undertakes projects to improve this aspect within the port. A variety of examples of these improvements can be found in Appendix F.

ACCESSIBLE PORT

Being accessible as a port is seen in several ways by the Port of Rotterdam (Port of Rotterdam, n.d.-k). Firstly, there is physical accessibility. To guarantee this, investments have been made, for instance, in a tunnel between the A20 and A15 motorways. This will ensure that trucks can reach the port more easily. In addition, the port authority is working on automating processes. This will optimise the processes and keep the throughput higher within the port. Which ensures that more trucks can enter the port. In addition to physical accessibility, the possibility of better planning through digital insights into activities has also been examined. By using PortXchange, shipping companies, agents, terminals and other service providers can monitor all activity in the port and use it to optimise their planning (Port of Rotterdam, n.d.-l). This in turn can ensure a higher throughput, which in turn benefits the accessibility of the port. Besides, it creates the possibility to cut out agents locating goods in the supply chain, saving on costs (interview Portbase, 2021).

FINANCIAL ASPECT

The Port of Rotterdam, and with it the port, wants to be at the forefront of innovations, and for this, it is perfectly fine to be the first user of a new service or technology (interview account manager HbR at KPN, 2021). However, one of the greatest challenges of innovations within the port authority is to close the business case. Ultimately, investments must be recouped and there must be a plan for doing this when an innovation is implemented (interview account manager HbR at KPN, 2021; interview Port of Rotterdam, 2021). This ensures that who will pay for an investment must be crystal clear before steps are taken to implement an innovation. In the past, this has meant that projects were stopped at the last minute because it was not clear enough how the money would be earned back.

4.5 Conclusion

Developments within the seaports in the Netherlands

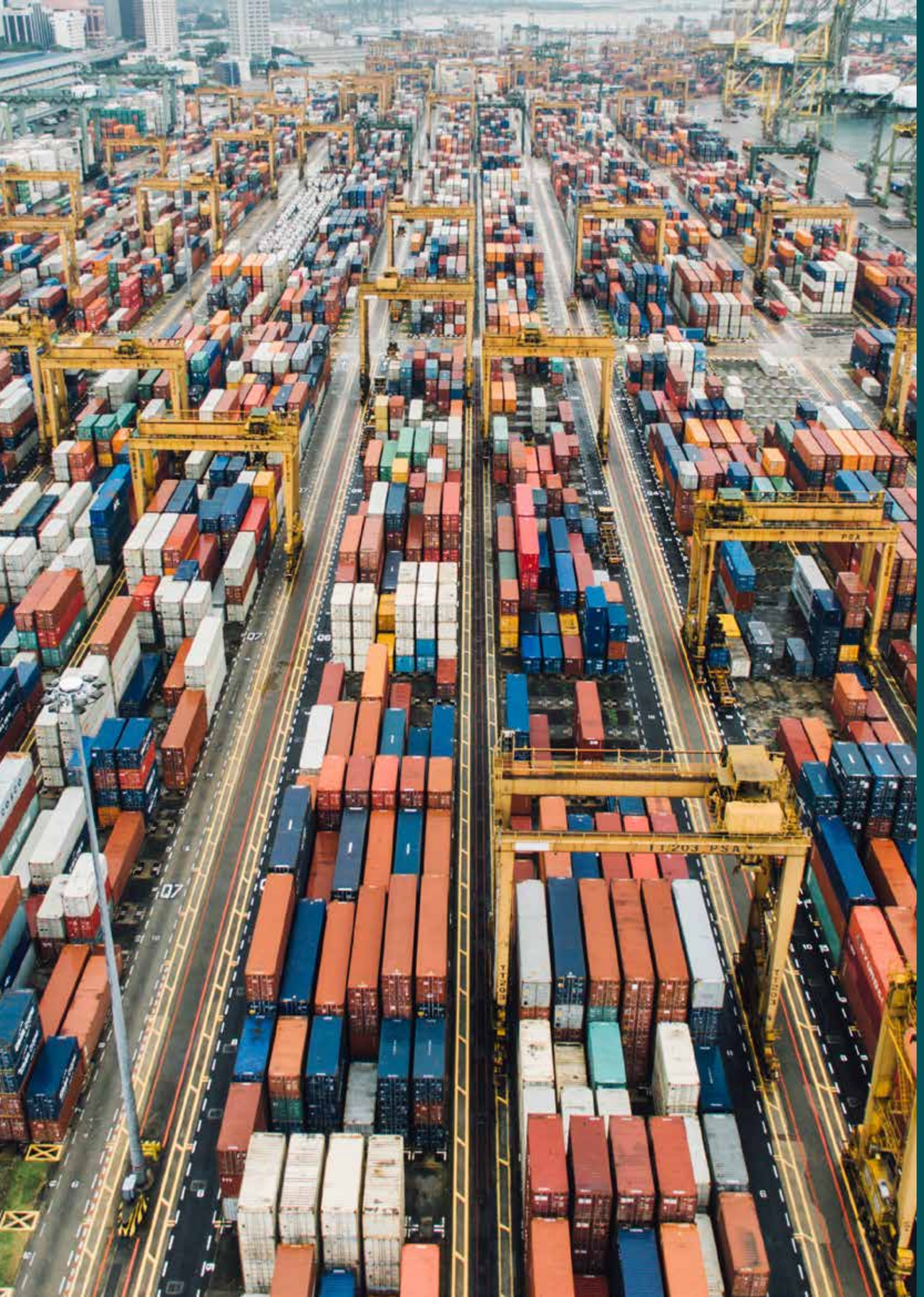
Within the Netherlands, there is a lot of cooperation between the different ports to strengthen the position of the Netherlands worldwide. Besides that this happens between the ports, this also happens within the ports. To make the entire port process run smoothly, various stakeholders are needed who are all concerned with their part of the process.

In addition, it can be seen that there are a lot of developments going on within the port that can also be seen in the rest of the maritime sector. Within the ports, for example, there is also a focus on automating processes.
To achieve this, more and more use is being made of data and sensors. By analysing this data, processes can be optimised and the port's efficiency increased. In addition, the entire supply chain is being made transparent to all parties involved. This will provide insight into where improvements can be made and parties can better prepare for deliveries in this supply chain. As a result, throughput in the port can be increased even further. By linking different ports, the effect of these innovations can be increased.
In addition, there are several developments to make conditions safer in the port by deploying robots and continuously monitoring the environment for possible dangers. This allows for better anticipation of what is to come. In addition, by using the generated data in models, it is possible to better simulate how a process can be optimally executed. As a result, any dangerous situations can be prevented.
Finally, the ports will also have to reduce their emissions to meet the environmental targets set within the maritime sector. Besides supporting the transition to new fuels, the ports are also innovating to reduce their own emissions. To this end, they are reducing energy consumption, investing in green energy and digitising the energy network to be able to tackle critical points effectively.
For now, the possibilities seem endless, but it should be noted that it can sometimes be difficult to find the party that is willing to pay for the innovation. The value usually arises for several stakeholders within the port, so there is not one stakeholder who has to pay for it. Therefore, for future innovations, it will be important that the question of who pays for the innovation is answered before the actual development takes place.

However, more innovations will be applied in the ports in the coming years. To do so, current and also new possibilities within the port will be used to improve the entire process. These innovations will be necessary for sea freight transport to be competitive in the coming years. Ultimately, the entire process will have to be carried out emission-free and at a low price to remain relevant in the future.

KPN itself also plays a role in the port of Rotterdam, supplying certain products and services. This can be divided into two parts, namely the network supply of radar stations in the port and the hosting of various applications. What exactly is included, will be discussed further in Chapter 5.2.
Furthermore, KPN is in discussion with the Port of Rotterdam to provide connectivity to future vessels (interview account manager HbR at KPN, 2021). For this, KPN must be able to guarantee that the required bandwidth will be available at all times. This is essential for the port if it is used to operate the port of the future. If this connection would be lost, the consequences would be huge. The Port of Rotterdam still has doubts whether this can be provided within a network that other parties also use, so they are also considering constructing their own network for the port alone (interview account manager HbR at KPN, 2021). No conclusion has been reached on this yet and it will be discussed further shortly. In any case, it would be an enormous opportunity for KPN to add more value to the Port of Rotterdam.

Besides, for KPN, the developments in the seaports can be interesting to keep an eye on. With the number of innovations that are taking place and the possibilities that are created, there is a big chance that in the future needs will arise that KPN can fulfil. To respond to this, KPN will need to stay in close contact with the various seaports within the Netherlands. At the moment, at least at the Port of Rotterdam, KPN has to take into account the contract concluded between the Port of Rotterdam and IBM, Cisco, Esri and Axians. This contract limits the possibilities for KPN to contribute to the Port of Rotterdam as these parties currently supply the majority of IoT applications. IoT applications are precisely a service that KPN can provide to generate value on top of their connectivity. This contract will expire and the contract may be concluded with other parties, perhaps even KPN (interview Port of Rotterdam, 2021).



05 CURRENT SITUATION

The way the sea freight transport sector operates currently

In order to get a better picture of KPN's position within the sea freight transport sector, but also of how the sector currently operates and where the opportunities lie, a 4C analysis was carried out. The aim was to be able to give KPN better advice, based on the current situation within the sector, on how to utilise the opportunities within the market. Within this analysis, four components were examined, namely context, company, customer and competition. The first section deals with the context, looking at how the current transport process looks like. The second section deals with the company, looking at KPN and its current position within the maritime sector. The third section is about the customer, within this project these are divided into four subsections: ship operators, software developers, hardware suppliers and facilitators. The final section deals with the competition, looking at what competitors within the maritime sector do and offer. To give this paragraph some extra depth, Porter's 5 forces model was used.

5.1 Context

Sea freight transport

As previously described in Chapter 1.3, the sea freight transport industry faces several challenges, such as sustainability and staffing issues within the industry. These are certainly challenges that should be considered when designing the business proposition at a later stage.

In order to get an idea of how the sector works, the journey of a container that is transported to another port is mapped. The visual representation is shown in Figure 10. The transport is divided into three phases, namely pre-sailing, during sailing and after sailing. One thing that quickly becomes apparent is that the process of sending goods by sea consists of a whole bunch of different steps, which adds to the complexity of the whole. In all the steps, different parties are involved to ensure that the step is handled correctly and that it does not cause problems later in the chain. This dependency creates more variables, which also increases the uncertainty of the whole process. Eliminating this uncertainty, even if only partially, ensures a more competitive position for the entire sector. The many steps that have to be taken make sure that there is a lot of room for improvement and optimisation, all of which ultimately affect the smooth running of the transport. The downside, of course, is that if the entire process is to be automated in the future, a lot needs to be taken into account, which complicates innovations. As can be seen in the Port of Rotterdam (see Chapter 4), innovation needs to happen with partners to succeed. Focusing on the benefits for an individual stakeholder could help to make innovation easier and more successful (interview account manager HbR at KPN, 2021). By doing so, the industry will be, step by step, automated.

In addition, sea freight transport is a relatively conservative sector, which can be difficult to innovate in. Not all parties involved are open to new ideas or technologies (interview Damen, 2021). This means that the steps taken should not be too big and the direct value to the user should be immediately clear. This increases the chance that companies are interested in innovations.

As described earlier, it can be seen that within this process the various parties work together in an ecosystem. As a result, it will be necessary to look from the ecosystem's perspective at how sustainability and innovation can be achieved.

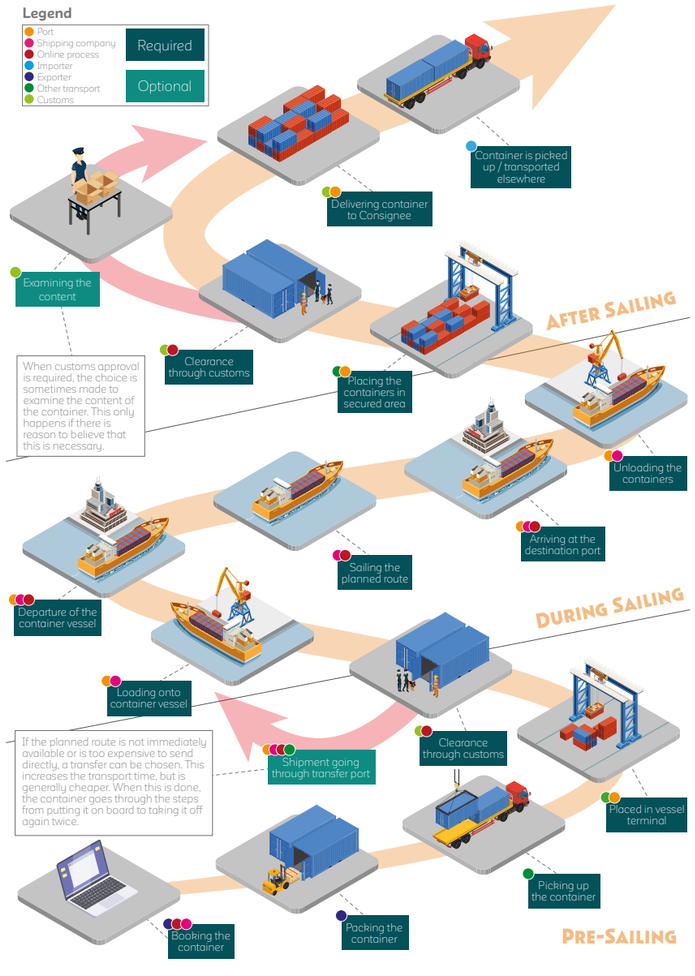


Figure 10: Container journey (own illustration)

5.2 Company

KPN's contribution to maritime sector

From the Resource-based view can be concluded that KPN has several resources and assets that can be used to fulfil business opportunities (see Appendix G). However, it must be concluded that many of these resources are not unique to KPN and therefore it is difficult to exploit them in relation to their competitors. To delve a little deeper into KPN's chosen scope of the project, namely the maritime sector, their activities within it will be discussed.

The contribution that KPN currently makes to the maritime world is limited, but they do see that there is potential for more business propositions. As a result, there are a few projects in which KPN is involved to investigate the possibilities within the sector, all with a slightly different angle. The current contribution is determined based on thirteen interviews with KPN employees complemented by desk research (Appendix E).

Captain AI

In the field of autonomous sailing, KPN is involved in a project within the watertaxi in Rotterdam via Captain AI. This is a company that is developing software for autonomous sailing. Through the water taxi data is collected that can be used to improve the software. At the moment, Captain AI is focusing on developing the software, so the data collection and therefore this project has a lower priority (interview Captain AI, 2021). KPN's position within this project is limited; they provide connectivity so that the data can be sent quickly and efficiently (interview director IoT Academy, 2021). KPN would like to play a greater role and make a contribution to this project, for example in the form of data handling (interview director IoT Academy, 2021). This is currently difficult to realise since the stakeholders involved already have partners who handle the data. The low priority of Captain AI means that KPN's current contribution is even more limited.

Figure 11: KPN & Captain AI water taxi

Drones

KPN is also involved in a project in collaboration with KNRM and TNO to apply drones in the North Sea. These drones are used to rescue people or ships when they get into trouble. The drone can provide a visual to the rescue services and therefore the chances of a successful rescue are increased (Jager, 2021). The challenge for KPN in this project is to ensure that connectivity can be guaranteed, even if the drone is further away from shore or above a busy beach. Loss of connectivity could have major consequences, as the drone would become uncontrollable. In addition to the connectivity, KPN delivers flight plan analysis on planned routes, to guarantee connectivity along the route (interview Commercial Product manager IoT, 2021).

Figure 12: Rescue drone KNRM & TNO

Seafar
KPN is also involved in a project looking at remotely controlled ships, aimed at inland shipping. This project focuses on the development and testing of systems. KPN does this in cooperation with Seafar, the company responsible for the systems. To remotely steer ships, a good, reliable connection is needed and KPN is responsible to realize this. Because of its focus on inland waterways, KPN can make a major contribution to the realization of this project. This project is therefore at an advanced stage and Seafar is already able to steer vessels safely at a distance. Regulations require that there is still a crew on board to intervene or support where necessary. For KPN, the challenge is to get the coverage so good that the connection across the Netherlands is good enough to support Seafar.

Mission-critical communication
Finally, KPN has an internal team that deals with mission-critical communication. This team takes care of the communication of a lot of parties that benefit from this communication without problems. This includes marine radio communications that are often used on ships or communications to bridges and locks in the Netherlands. The market for this is relatively small for KPN and is seen as a niche market (interview mission-critical team KPN, 2021). Within this market, KPN is mainly responsible for the connections and the appropriate technology to use them. Despite the small market and minimal turnover that this generates for KPN, they can be seen as the market leader in the Netherlands in the area of marine radio communications. Approximately 60% of the market is supplied by KPN (interview mission-critical team KPN, 2021). Both the hardware and the connectivity are needed for the marine radio. In addition, there are competitors of KPN that use the network of KPN (SAIT, n.d.). In this case, KPN does not supply the hardware, but only the connectivity. This makes the proportion of data that is transferred via the KPN network slightly larger. In some cases, KPN serves as a subcontractor to another company, especially when more is required than just a connection, with for instance the remote operation of locks. For such an operation more complicated technology is needed which can be supplied by another company.

Even though changes in this area are very slow and very much dependent on legislation, they do show a transition to more digital and centralisation of certain processes (interview mission-critical team KPN, 2021). This can save both time and money. Due to the large market share that KPN has, this can certainly be seen as a possible business opportunity. Therefore, KPN must keep a close eye on the developments because KPN will have to anticipate developments, although they will never be in the vanguard of these changes (interview mission-critical team KPN, 2021). The challenge for KPN will be not to be too late so that other parties will compete with them.

This mission-critical communication is also delivered to the Port of Rotterdam. The delivery to the Port of Rotterdam can be divided into two parts. The first is the supply of the network, the second is application hosting (interview account manager HbR at KPN, 2021).

For the network, KPN supplies the radar stations needed to monitor ships within the port area. KPN also provides the connections between these posts, the security of the network and manages it for the port authority. It also provides telephony and marine radio infrastructure to the port authority. In the future, KPN hopes to be able to expand this by also supplying the network required for autonomous sailing (interview account manager HbR at KPN, 2021).

The application hosting services KPN provides to the Port of Rotterdam are mainly concerned with the provision of certain applications used within the port processes. This does not involve the development of these applications, but only their hosting. This mainly concerns mission-critical applications.

5.3 Customer

Ship operators, technology development & facilitators

In order to get a better picture of companies that can play a role in the transition to an autonomous future, their current role and their view of the future were researched, both online and by semi-structured interviews. The semi-structured interviews were conducted with six people, all working in or researching the maritime sector (see Appendix E). By gaining insights into the current situation, a better understanding can be gained of how KPN can add value. To give a clear picture, the stakeholders are divided into four sub-sectors: Ship operators, software developers, hardware suppliers and facilitators.

Ship operators
The competitiveness of sea freight transport is coming under increasing pressure due to innovation within other forms of transport. As a result, ship operators have little choice but to take steps towards digitalisation. All the ship operators are busy trying to improve their processes (interview Autonomous Shipping Expert, 2021). They will be dependent on what technologies are developed and at what price. As a result, they are somewhat cautious about the steps they take. This is also because ships have a long lifespan, which means that renewing the fleet takes time. At the moment, the focus is on applying technologies that are already available and increasing the size of ships in order to be able to take steps (McLeman, n.d.). By making ships available, ship operators create the opportunity to further develop technologies, hoping that they will be able to reap the benefits of this in the future.

Software developers
The software developers focus on creating the software needed for autonomous sailing. To do this, they use data for deep and machine learning to train and optimise artificial intelligence.

Currently, there is a focus on ports and inland waterways, mainly since the regulations then have to be arranged within a country. Later on, the same software can be used to make the step to ocean-going (interview Captain AI, 2021). The regulations are currently one of the greatest challenges for autonomous sailing. Regulations often lag behind technology (interview Autonomous Shipping Expert, 2021). By focusing on one country, it is more likely that something will be possible sooner, compared to when different countries still have to work it out among themselves, as is the case with global shipping (interview Portbase, 2021). The first steps for the technology are already taken and therefore software developers are focussing on continually improving it. Besides the software, hardware is also needed, such as sensors, data storage and communication technologies. These communication technologies are mainly based on the communication standards that already apply within the maritime sector (interview Captain AI, 2021). This makes implementation within the current sector easier, but also results in the software being able to understand and anticipate human speech, widely used in today's communication (interview Damen, 2021). For now, this is still quite a challenge for software developers to match and incorporate this with the rules on water (interview Autonomous Shipping Expert, 2021). With the use of current communication standards, it does result in the fact that an internet connection provides little added value to the software. The internet connection can help to keep an eye on the ship and provide a helping hand to the software when needed, to send new commands (interview Captain AI, 2021; interview Damen, 2021). The bandwidth and latency are less relevant for this.

For the future, the goal is to make it possible to disembark everyone. The software developers expect that this will happen step by step and that the technology will be introduced step by step.

Hardware suppliers
In addition to the software, hardware will also be required to run the software. This includes shipbuilders, engine builders, and sensor suppliers.

Currently, a lot of attention is on the sustainability of shipping within the hardware providers. This includes the development of new engines with different fuels, but also how sensors can be integrated (interview Damen, 2021). There is a lot of collaboration with other parties, such as software developers, so that the hardware can be seamlessly integrated with the

software from the factory. Until these projects are fully operational, many non-sustainable ships will be delivered. It is important to think about how these can be made sustainable in the future (interview Damen, 2021; Lloyd's Register &UMAS, 2019). This is to ensure that the long service life of ships will not cause problems in making the sector more sustainable.

Besides the fuel used to propel ships, shipbuilders are also improving the design of the ship itself. They are looking at the shape of the hull to reduce resistance, but also at the size of the ship. The trend for ocean-going vessels is to become larger and larger (McLeman, n.d.). This is an attempt to reduce the price by transporting more containers on a ship. The growth of ships has been going on for a long time and is expected to continue for some time. In addition, almost all shipbuilders are currently working on a form of autonomous sailing, all in their own way (interview Autonomous Shipping Expert, 2021). There are also differences in how far companies have progressed, and therefore in how much they are communicating on this subject. Shipbuilders cannot afford not to look into autonomous sailing and then not be able to deliver when customers ask for it. On the other hand, there is currently increasing discussion about how much value it adds when a ship is fully autonomous. This discussion mainly focuses on if the crew should be removed entirely (Level 5) or should stay on board but be reduced (Level 3 / 4) (see Chapter 2.2) So, automation adds value to the ship because the crew can focus on other tasks. But making a fully autonomous ship is quite a challenge, so it should add enough value to be profitable. An optimum will be sought between fully autonomous and fully human-controlled (interview Damen, 2021).

In addition, many processes are automated using marine robots. These are robots that have been developed to carry out one or more tasks autonomously so that this no longer has to be done by people (Kumar, 2020). At the moment, these robots are still very much focused on a single task, but this can be further expanded in the future. By focusing on a single task, the design can be fully optimised for that single task. This makes it easier to ensure that the task is performed perfectly. Hardware suppliers work closely together with software developers to develop these projects. Hardware and software cannot exist without each other, which makes the cooperation between these parties important in the future.

Facilitators

Within the sea freight transport ecosystem, the facilitators focus on arranging the preconditions necessary for the transport to take place. These include the ports, data managers or network operators.

Currently, the focus is on keeping a close eye on developments in order to be able to prepare for the future (interview Port of Rotterdam, 2021). Ultimately, these companies are in the service of the transport companies and are therefore dependent on other companies for what they develop and want. They also create space to facilitate testing and developing technologies, also to be able to keep a close eye on developments (see Chapter 4).
In addition, they are working on digitalising various systems and components. This is to ensure that they can meet the expectations of customers. Digitalisation within the maritime world is moving very slowly, but it is starting to take off (interview Port of Rotterdam, 2021). It is expected that this will accelerate and that the need for data will increase as a result. By offering a platform on which this data can be exchanged more easily but safely with other parties, for example, the entire sector will be able to get even more out of the data. However, the facilitators remain dependent on other parties being willing to share data, which makes the neutral position they occupy within the ecosystem extremely important (interview Portbase, 2021). If the trust in them is lost, they very quickly lose the opportunity to add more value to the sector through these kinds of initiatives.

Because of the dependence on other stakeholders, the facilitators do not know immediately what technology will be used in the future. They do expect an autonomous future, where ships operate on their own. There is still some discussion about whether this will be totally autonomous (level 5) or whether people will remain on board (level 3/4). To facilitate this as much as possible, developments will be monitored with a close eye and helped to develop quicker.

5.4 Competition

Stakeholders involved in applying technology in the maritime sector

In order to get an idea of the competition within the market and how KPN might approach a possible entry into the maritime world, the Porter 5 forces model was used (Porter, 1979). By using this model, the competitive position of an organization is reviewed. This will help to support the decision to enter a market and at the same time, the best strategy to enter that market can be determined.

Porter 5 forces analyse five forces that play a role in a market: the threat of new entrants, bargaining power of suppliers, bargaining power of buyers, the threat of substitutes and competitive rivalry. The threat of new entrants is about how easy it is to enter a market, looking at whether, for example, knowledge, investments or capabilities are needed to enter the market. It assesses how likely it is that new companies will enter the market. The bargaining power of suppliers is about the extent to which suppliers can influence competitive dynamics, think for example about their prices. The bargaining power of buyers is comparable to that of suppliers, only they often exert influence to lower the price. The threat of substitutes is about the extent to which there are already products or services that fulfil the same basic need, this determines whether it is easier for consumers to switch to another product or service. Finally, there is competitive rivalry, which looks at the competition and its intensity within the market. The model is shown in Figure 13.

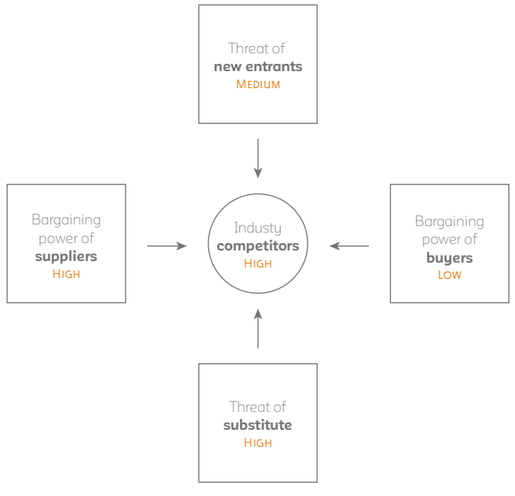


Figure 13: Porter 5 forces (1979)

The industry analysed with the Porter 5 forces is the sea freight transport industry. The suppliers are the technology companies who provide or develop the used technologies, the buyers are the ship operators who will be using the technologies and network providers have been considered for the competition. The competition was chosen in this way because of the position KPN could possibly occupy in the market.

Threat of new entrants

The threat of new entrants within the sea freight transport sector is medium. There are two sides to the analysis of new entrants. On the one hand, the companies that want to enter the market will have to develop a technology that can deliver added value to the sector. To make this happen, development is needed, which requires both money and knowledge. Therefore, the investments in money and knowledge are relatively high when a company wants to enter the market. On the other hand, when a technology is already developed, entering the market is relatively easy. At the moment, the sector is in such a transition phase that any new technology that can deliver even a small improvement is seized upon. Therefore, if the technology is offered at the right price, a company can easily enter into a partnership with a shipping company to implement the technology. Combined, these two points lead to a medium threat for new entrants.

For KPN, this offers both an opportunity and a risk when they want to enter the market. Firstly, it offers an opportunity, because when KPN applies a technology they have already developed, they can enter relatively easily. For this, they have to be able to demonstrate a clear added value and then the chance that companies will want to do business with them is relatively high. On the other hand, it also entails risk because they can easily be replaced by other companies that enter the market. This will be discussed in more detail later in the

section on the threat of substitution. For KPN, it will be important to focus on technologies they have already developed and with which they can enter the market. These technologies should add enough value to the sector to make KPN an interesting party to collaborate with. From here, KPN can develop new technologies and introduce them to the market later. In addition, KPN may seek to cooperate with potential new entrants. If standards are used that are easy to use for everyone, new technologies can easily be added to the service KPN provides. In this way, the uncertainty of a potential new competitor can be embraced as a strength, ensuring that KPN adds value through technology, but also offers flexibility to users. This makes users more inclined to cooperate with KPN and makes it easier for KPN to enter the market.

Bargaining power of suppliers

The bargaining power of suppliers is high within sea freight transport technologies. There are a lot of developments going on, and as a result, shipping companies have to choose what they want to go for. Once this choice has been made, it is difficult to switch to another technology or supplier. Besides the fact that it is difficult to recoup the investments that have already been made, not all technologies work together. When an initial investment in technology is made, a customer lock-in is created. When this lock-in occurs, it is really difficult for customers to switch to a different supplier without spending conversion costs. This is why, as a shipping company, you would prefer to implement the solution from one supplier, so you know for sure that the technologies are compatible and are aligned well. This allows the supplier to exert a great deal of influence on the choice of new technology. This only applies if a choice has been made for a certain technology because before that there is still a big competition going on between the technologies.

For KPN, this offers an opportunity to work together with different technology companies. The main focus should be on technologies that require a connection. KPN can be a good partner for this. If KPN does not offer the technologies itself but supports them more by, for example, providing connectivity or data handling methods, it is possible to do this for several parties. They are therefore not seen as a direct competitor and it also makes it easier to cooperate with technology providers. If a certain technology is then implemented by several transport companies, KPN can provide the support that is needed.
Besides, KPN can also look at the users. If a solution is offered that allows different technologies to be used, it becomes interesting for users to purchase this solution. This may in turn make suppliers want to work with KPN because it makes them more likely to be chosen as a solution. To ensure that KPN can do this, it will have to focus on using standards. This will make it easy to implement multiple technologies that use the same digital infrastructure.

Bargaining power of buyers

The bargaining power of buyers is low within sea freight transport technologies. The buyers within the industry are mainly the shipping companies, which operate the ships and need to become more sustainable in order to remain competitive with other forms of transport. The pressure to innovate is so high that this reduces their influence on, for example, the price. The only influence they can have is to switch to a different supplier, but because the technologies are still in development, there is not much choice yet. In addition, it can cause problems with the technologies that have already been purchased from the current supplier, as these do not always connect seamlessly with other solutions. For the shipping companies, it may help if they have a large position in the market, for example, due to the number of ships they own. This makes it more interesting for a technology supplier to work with a company, because the sales, and therefore the revenue, are much higher. How much influence this can ultimately have depends very much on how the technology develops and how many companies will eventually offer it.

For KPN, this can be a challenge because several competitors can provide connectivity. The strength of suppliers in the market makes it difficult to attract customers from companies that are already active in the sector. This becomes even more difficult because the difference between KPN and its competitors is not so big. Therefore, KPN will have to compete with them and gain a strategic advantage, but this is discussed in more detail in the section of industry competitors.
KPN, on the other hand, could offer a solution to users that would put them in a stronger position. As described earlier, customers with a large position in the market may demand more from their suppliers. By having different customers cooperate within a market, this large position can still be obtained. In this way, the customers can jointly enforce the requirements they want. KPN can respond to this need and ensure that customers can work together.

Threat of substitutes

The threat of substitution for technology suppliers within the sea freight industry is high. Shipping companies are looking for ways to innovate within the sector, as this will be necessary for the coming years to ensure competitiveness. The search for suitable technologies is very wide and technologies from other sectors are also considered. An example of this is the automotive industry. This industry is also working to automate processes. This makes it possible to quickly look at the methods that are applied there and whether they also work within sea freight transport. An example is the mooring of ships. Initially, the current methods for determining the location of ships, namely GPS, were examined to also apply them to determine where a ship is in relation to its surroundings. Now it appears that this is not precise enough for autonomous docking. The automotive industry is using cameras to determine the location of a car. By adopting this, a combination of GPS and the use of cameras can easily be made within the maritime world. The many developments taking place in other sectors, make the threat of substitutes high.

For KPN, this can be seen as a risk to enter the market. If a better technology is developed within another sector that better fulfils the need, there is a chance of substitution. On the other hand, this also creates an opportunity for KPN. They will have to keep innovating to keep adding enough value, but they can also apply their knowledge from other sectors. KPN is involved in a lot of sectors, they can apply this knowledge to strengthen their position within another market, for instance within the maritime industry. In addition, a transition to new technology will not happen abruptly, but as described by Geels (2002) a gradual transition will take place (see Chapter 2.3). This offers KPN the opportunity to respond in time to this type of change and to ensure that their position within the industry is maintained. For this, KPN will have to keep a close eye on developments. In addition, it must be ensured that knowledge gained within KPN in other sectors can also be applied to the maritime sector. This will enable KPN to use all the knowledge it acquires to ensure that they are not replaced. If all this knowledge is lost when switching to a competitor, it becomes difficult or less interesting for customers to switch to a competitor.

Industry competitors

The competition is focused on network suppliers within the maritime world. The focus was chosen based on the companies where KPN must compete with. For the mobile networks, the two other network providers within the Netherlands, namely VodafoneZiggo and T-Mobile, were taken into account. Because the sea freight transport mainly takes place on international waters, Non-Terrestrial Networks were also considered as competitors within this market. It is important to note that these competitors will have to add more to the sector than just connectivity. Connectivity is not seen as adding enough value to be an interesting partner to work with.

Within the market for network providers, there is a big competition going on to deliver connectivity to IoT solutions. Within the Netherlands, both VodafoneZiggo and T-Mobile offer solutions to provide IoT solutions with a network. Compared to both companies, KPN has the disadvantage that it only offers its own network within the Netherlands. Both VodafoneZiggo and T-Mobile are active in other countries, so they can use their own networks in these other countries to provide connectivity there as well. This gives customers the flexibility to have coverage in multiple countries through a single provider. KPN has to solve this by entering into roaming agreements with other companies, which makes them dependent on these other companies to provide the connectivity.
Besides, both providers use Narrowband-IoT (NB-IoT), which requires a licence to use. This could be considered as more secure. KPN itself uses the LoRa network, which does not require a licence. As a result, KPN's solution can be seen as less secure. Within the maritime world, KPN has the same

starting point as T-Mobile. Both providers do not currently offer specific solutions for the maritime sector but can offer connectivity in the North Sea through the Tampnet network (Tampnet, 2019; MediaMagazine, 2021). VodafoneZiggo, on the other hand, already offers solutions for the maritime sector. To do so, they have entered into a partnership with Inmarsat, a satellite network provider. By combining the networks of VodafoneZiggo and Inmarsat, VodafoneZiggo can guarantee global coverage for customers (Vodafone, n.d.). This gives them a competitive advantage over both KPN and T-Mobile. In addition, Inmarsat is already active within the maritime sector. VodafoneZiggo could therefore also use their partnership with Inmarsat to increase their position within the maritime sector. VodafoneZiggo could offer the services they already provide in other sectors, such as fleet management solutions, to maritime stakeholders.

Non-Terrestrial Networks (NTNs) are networks that use satellites to provide connectivity, making them independent of land-based networks and therefore also independent of the location where the connection needs to be provided (see Chapter 3.4). These networks are still being developed and still use geofencing. Geofencing make that it is currently not possible to provide mobile connectivity. When these networks are further developed, they will be able to offer this. Because they can guarantee worldwide coverage, even in difficult places such as at sea, they have a competitive advantage over KPN. KPN will always have to cooperate to be able to offer the same global coverage because investing in the creation of its own satellite network is not profitable. Besides, these networks are able to innovate quickly with their available financial and expert resources. This makes it difficult for KPN to compete with these parties.

The fact that several competitors have a competitive advantage over KPN makes it very difficult for KPN to be more attractive than its competitors. First, KPN is dependent on which technologies are designed and whether the technologies need connectivity. When this is not the case, KPN can then hardly deliver extra value to an ecosystem. If connectivity is needed, they will have to find ways to compete against companies that can guarantee global, or at least larger, coverage on their own. To enter into such a partnership, KPN will have to demonstrate that they can add value to a company or ecosystem, otherwise, it will be difficult to find a partner that is willing to do business with KPN. For this, KPN will have to focus on value-adding services that can be delivered on top of connectivity. The knowledge and capabilities they have acquired in other sectors can be used for this purpose, such as their data handling expertise. Overall, it can therefore be concluded that the threat from competitors within the market is very high.

Conclusion Porter 5 forces

To conclude, the sea freight transport industry is a highly competitive market. Many parties want to make their contribution and entering the market can be difficult for a new company. On the other hand, there are opportunities for companies because the sector has to meet increasingly price requirements.

This means that there are also opportunities for KPN in the market. KPN must build on the knowledge and skills it already has and deploy them in the market. KPN will have to accept certain limitations that make them dependent on other stakeholders for certain aspects of their business and find ways to deal with them. When this happens and KPN focuses on adding value other than connectivity, they can gain a position in the market. Within this market, KPN will have to position itself as a company with a neutral position. This will make them less seen as a competitor and it will make it easier for KPN to work together with companies. In addition, it offers KPN the possibility to mediate or assist in collaborations between other parties. In order to further rely on their own resources, it may help KPN to have a focus on the Dutch maritime sector. This will allow them to start providing services to the maritime sector and expand into a larger service area at a later stage. This ensures that KPN has the opportunity to first prove its value within its own network. Once that is done, KPN can look to involve third parties who can offer connectivity in a larger area.

5.5 Conclusion

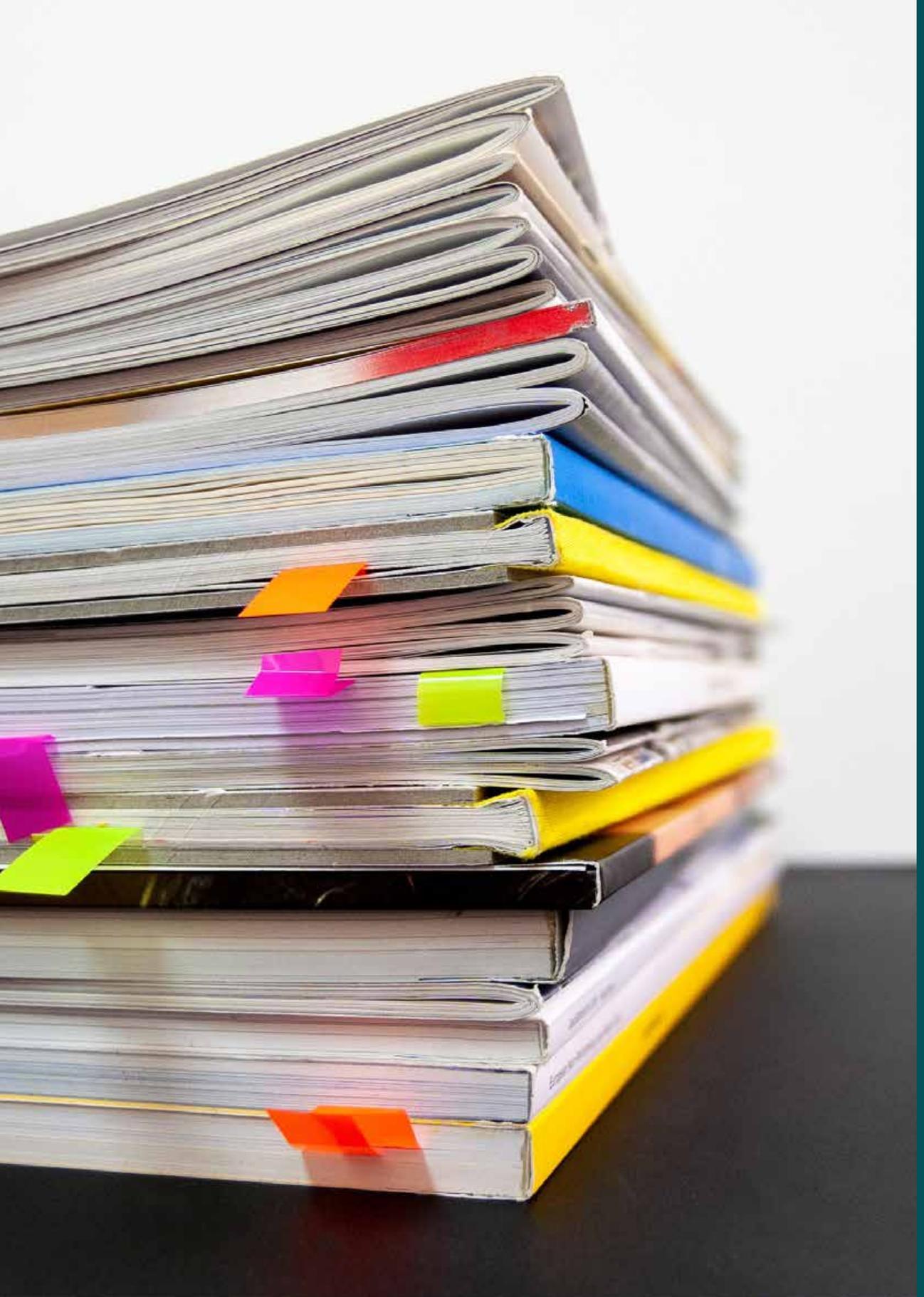
The current operation in the sea freight transport

In general, it can be seen that the maritime sector is an interesting sector where a lot of stakeholders are involved to make transport possible. Within this transport, a lot of steps are taken, executed by different stakeholders, all to make sure the transport runs as smoothly as possible.

KPN, on the other hand, only offers a limited number of services and is still minimally involved in the maritime sector. They are involved in a number of maritime projects through other companies, but the position they occupy is not always as large. Except for the marine radio, they have a large share in that market, which could be an interesting possibility to explore. For the other projects, investments have to be made to prove their value beyond the connectivity.

Furthermore, all stakeholders in the maritime sector are working on automating. To achieve this, all stakeholders depend on each other and will have to work together towards an autonomous future. It is still unclear what the final solution will be and which stakeholders will be involved. Besides, the value of being fully autonomous should still be proven in the coming years. With still too much uncertainty, investments will have to be made in various solutions.

In addition to KPN's limited involvement in the maritime sector, several network providers are already active in the sector. The experience these competitors have already gained and the global network coverage they can offer make that these competitors often have a better starting position than KPN considering the global scope. This will make it very difficult for KPN to add enough value within a possible ecosystem of autonomous sailing. Seen from the ecosystem's perspective, KPN would then only be an extra stakeholder that must be taken into account, without getting anything in return as an ecosystem. Therefore, KPN should focus on the Dutch maritime sector for the design phase.



06 CONCLUSION

Concluding the findings of the discover phase

In order to be able to use the findings of the discover phase in the following phases, they are summarised in this chapter. To complement the conclusion, the most interesting search fields from the SWOT analysis applied to KPN are highlighted.

6. Conclusion

Discover phase

From the analysis, it can be concluded that the maritime sector is busy with the transition to an autonomous future. It is shown that the sector needs to innovate if it wants to remain competitive. A lot of effort is put into automating processes. It is becoming increasingly clear within the sector that automation can add a lot of value, while jobs can be retained within the sector. In terms of jobs, the sector will also continue to make a transition. Connectivity will increase more and more, creating the possibility of relocating jobs and improving the working environment of the employees. By relocating jobs, people will always be involved in the process, but their tasks will change from performing to monitoring roles.

In addition to the various insights from the maritime sector, the strength, weaknesses, opportunities and threats (SWOT) of KPN, shown in Figure 14, revealed several interesting insights relating to KPN. In this chapter, the most interesting search fields are highlighted and discussed is how they affect the design process. The complete SWOT matrix and analysis, including the potential search fields generated by the SWOT, can be found in Appendix H. Here, the most interesting insights from the SWOT are also discussed. This SWOT analysis is based on the previously discussed research combined with an analysis of Deloitte researching KPN's capabilities (Deloitte, 2021).

Figure 14: SWOT KPN (own illustration)

Conclusion SWOT

In general, the SWOT analysis shows that there are a lot of search fields that KPN could respond to within the maritime sector. KPN will have to look for opportunities to add value beyond just providing connectivity. To see which search fields could be interesting for this project, a few will be highlighted. We will look at how these could be used in the design phase. The most important search fields are: facilitating safe data transfer, providing an all-in-one solution for data analysis, align partners to provide hassle-free service and run real-time data analysis.

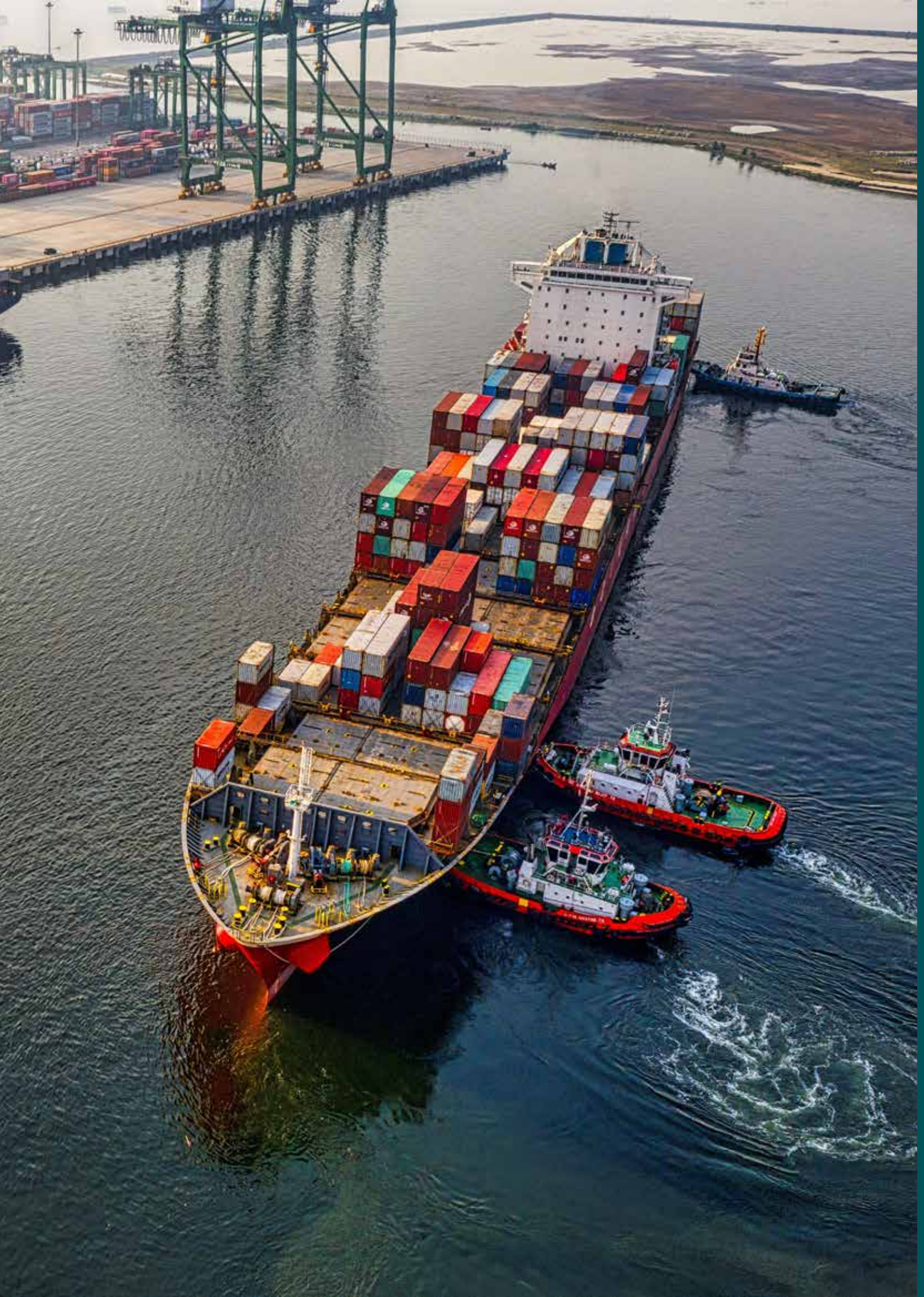
Facilitating safe data transfer
Combining the strength of data handling with the opportunity for companies to share more data results in the search field of facilitating secure data transfer. KPN will use its knowledge to ensure that the data can be shared safely, that competitors will not benefit from it and that it is stored in a proper and orderly way. With this, KPN offers companies the opportunity to take big steps in implementing data-driven choices. Data-driven choices are becoming increasingly important in the maritime sector and this search field also offers KPN the opportunity to add more value to the sector.

Providing an all-in-one solution for data analysis
The search field to deliver an all-in-one solution for data analysis comes from combining the strength of partner collaboration and the opportunity of hassle-free services. By delivering such a solution, KPN uses their network of partners to ensure that a customer gets what they pay for without any effort. Because of the large number of partners KPN has, it is possible to perform a variety of analyses. For a customer, it can be difficult to realise such analysis, especially with the ease with which it could be arranged at KPN. By offering an effortless service, customers can focus on the actual processes instead of being preoccupied with the data that supports the process.

Align partners to provide hassle-free service
The search field to align partners to provide hassle-free service largely corresponds to the previously discussed search field of providing an all-in-one solution. The major difference is that it arises from the weakness that KPN depends on partners to make an impact. This weakness is turned into a strength because this dependency also offers flexibility. KPN can work together with various partners, which means that the ultimate impact is much greater than if a company were to rely solely on its own strengths. This is certainly true for the maritime sector and KPN can make good use of their neutral position in the market. Because KPN's contribution to the maritime sector is still relatively small, they have little interest in which way a particular solution will go. This allows KPN to gain the confidence of companies that KPN will go for the best solution rather than the one that fits KPN best. When working together, KPN has to be aware of the risks that stakeholders will continue without them. To ensure they stay involved, KPN will always have to make sure that they deliver enough added value with their capabilities.

Run real-time data analysis
Combining the strength of real-time analysis with the opportunity that companies share more and more data results in the search field of real-time data analysis. Within this search field, KPN can make good use of the resources they already have and thus add value on top of their connectivity. By deploying these analyses in daily operations, companies can make great strides with data-driven choices. Which in return results in a business opportunity for KPN.

Based on the conclusion of the current situation described in the previous chapter, the target market is chosen to be focusing on the Netherlands. This will enable KPN to make better use of the resources they currently have at their disposal. With this focus, there are a lot of opportunities for KPN to add value. For the next phase, the define phase, it will be important to set and define this focus. This will ensure that a good business proposition can be designed for KPN.



07 DESIGN BRIEF

Guidance for the design phase

To give guidance during the develop phase, a design brief was drafted. This summarises what was concluded during the discover phase and what criteria will be used during the design phase. This chapter is divided into four sections. First, the future vision that was sketched from the analysis is highlighted. Then, the context challenges within this future vision that KPN may be able to respond to will be discussed. The chapter continues with the design goal for the develop phase. Lastly, design requirements are stated to make sure the added value is included in the design.

7.1 Future Vision

The future of sea freight transport

From the discover phase, several conclusions can be drawn. To give a clear overview and an idea of how the future will look like, a future vision has been created. In this vision, various developments are included that will be present in the future for the maritime sector. The future vision is shown in Figure 15.

Within this future vision, different ships are active for different purposes. This is currently true but will remain true in the future. Based on the distance to be covered, a mix of sustainable fuels will be used for the propulsion of the ships. All the used fuels are however sustainable. Besides, many processes have been automated; ships sail themselves to their destinations, processes within the port are automated and weather buoys are monitoring the weather to compensate for the loss of information from manned ships. People continue to be involved in the process, only in a different role than they currently do. The executive role they currently have is changing to a monitoring role to ensure quality. To perform this monitoring role, the connectivity within the shipping industry is also increased. This connectivity allows for the exchange of data so that processes can be monitored from a distance. The increased connectivity also ensures that the components within the ecosystem can communicate with each other, ensuring that everything remains up to date without humans involved. The automated processes generate a lot of data. This data can be used to improve the systems and optimise the process even further. To conclude the following future vision statement is made.

*In 2050 the sea transport sector will be a **data-driven supply chain** working together by **connecting digitally**, with an **eye for the environment**, and where the **machines are doing the hard work** with the **approval of people** involved.*

All these developments will also influence the ports and ship operators within the Netherlands. They will have to support this transition when these developments are implemented. The various distinguished elements will be briefly explained.

Data-driven supply chain

The entire supply chain will become increasingly reliant and dependent on data. With this data, processes will be optimised and coordinated. For the port, it will be needed to install sensors in the various steps that measure all kinds of data. Data that must be processed and acted upon. Not everyone involved in the process can do this on their own. A solution will have to be found to keep up with this transition.

Connecting digitally

Connecting the various components digitally ensures that this data-driven supply chain can be established. This makes this digital connection extremely important for the future. To make this connection possible, a reliable network is needed that can communicate with all connected components. The movement of data should always add value to prevent data from being moved without a purpose.

Eye for environment

To reduce the sector's emissions, the sector is looking at all components. When emissions have been eliminated, the sector will look in the future at how the environment can benefit from freight transport instead of suffering from it.

Machines doing hard work

By automating processes, more tasks are performed by machines. During the transition of automating, the stakeholders in the maritime sector are keeping an eye on how much automation will benefit the process; ultimately, it must be carried out as efficient and cheap as possible. Sometimes that will be by humans, in other cases by machines. Of course, this may not be at the expense of the quality in which it is carried out.

Approval of people

Within the sector, the role of people is changing. Automation ensures that tasks are carried out by machines without the intervention of people. This development is going to continue, and so people get a more monitoring role. This involves looking at whether the processes are being carried out correctly and whether the right results are being achieved. As a result, people will no longer do the heavy lifting, but they can intervene if things go wrong. For this changing role, personnel will have to be retrained, ensuring that they can carry out the monitoring task and maintain an overview of the entire process

7.2 Context challenges

Challenges for different stakeholders

With the analysis done in the discover phase and the resulting future vision, the challenges for two different stakeholders can be defined. In this section, both stakeholders are discussed and the possibilities for the future are explained.

On the one hand, one can look at the maritime sector. There are a lot of challenges that can be tackled by automating and implementing various technologies. To meet the environmental targets, among other things, it will be important that everyone within the maritime sector participates in these developments and utilises the available opportunities. Within the maritime sector, a difference in how far the involved companies have progressed with the implementation of certain developments can be seen. Larger organisations generally have more R&D budget and are therefore further along in the developments. As a result, smaller operators of ships, for example, are very dependent on the larger organisations when it comes to improving their operations. This can lead to larger stakeholders gaining a dominant position, such as customer lock-in, over the smaller operators, making it very difficult for these smaller operators to seize the opportunities. To ensure that all stakeholders in the sector are allowed to exploit opportunities created by technologies, a way to share experiences, knowledge and technologies without creating a monopoly must be found.

In addition, the problem that KPN has to deal with can be looked at. KPN focuses mainly on delivering connectivity and companies increasingly see this as a non-value-adding component, KPN will have to look at other ways to use their expertise. A solution must not be too far removed from their expertise, otherwise, the challenge of entry will be too great. On the other hand, it must add enough value to be interesting for other companies to cooperate with KPN. By looking for such a business opportunity, KPN will be able to remain relevant and find a way to recover investments made, for example in the 5G network. The focus will have to be on the Netherlands, simply because this is where KPN can make the best use of their expertise. In addition, KPN will have to make use of the resources, capabilities and services they already have in-house. This will make it easier to enter the market and give a very clear reason why KPN should pursue the business opportunity.

If these challenges are combined, an interesting opportunity arises for KPN to offer a service within the maritime sector. In the next section, this will be converted into a design goal that provides guidance for the next phase of the project.

Figure 15: Future vision (own illustration)

7.3 Design Goal

For the develop phase

As this graduation project is done in collaboration with KPN, the design goal will be oriented towards fulfilling a business opportunity for them within the maritime sector. As the analysis pointed out, the opportunities for KPN to facilitate the transition towards an autonomous future on a global scale are limited. Therefore the focus will be on the Dutch maritime sector. In order to use the acquired knowledge in the design of a business proposition for KPN and to tackle the challenges mentioned earlier, a design goal was formulated in consultation with KPN. The aim is to address the problem of small operators by using KPN's expertise. This led to the following design goal.

*Design an **ecosystem** which enables small operators to fully **utilise the offered possibilities** by new technologies and generated data, while **not limiting their choice** by the large maritime stakeholders*

Within this design goal, a few important components can be distinguished. Below will be briefly explained what is meant by these and why they are important for making a business proposition.

Ecosystem

For smaller players to be able to take advantage of the opportunities offered, more will be needed than just connectivity. This will require multiple stakeholders in an ecosystem to work together to achieve the stated goal. By allowing all stakeholders to focus on their own expertise, flexibility can be built in and ensure that the best solution is found for the right problem. Besides, goals can be achieved that would be impossible to do alone. Formulating it as an ecosystem makes clear that companies that use it also deliver back to other stakeholders. In this way, all stakeholders involved can strengthen each other to achieve their own goals. In the end, everyone should benefit.

Utilise the possibilities

For the design to be successful, it must create a value that companies cannot generate themselves. Because small operators can have a hard time using new technologies and analysing the data generated from these new technologies, it can be difficult to fully utilise the new technologies. Because in-house Research & Developments budgets are limited and sourcing the right knowledge can also be a challenge, enabling the use of the opportunities will create a lot of value for companies that they cannot achieve on their own.

Not limiting their choice

Smaller operators are so dependent on what other companies are developing that this can lead to these smaller operators having less choice in the technologies or analysis they apply to their operations. This can lead to limited possibilities and opportunities not being fully exploited. To ensure that these smaller operators find it interesting to use the ecosystem that KPN offers, it must be made clear that there is no limiting factor within the ecosystem. KPN can make good use of its neutral position in the maritime world to do so, as it can make clear that it has little interest in which technology or analysis is applied. This provides users with the freedom to implement the technologies or analysis they want to use, not necessarily the technologies or analysis demanded by the maritime stakeholders. Of course, KPN has an interest in that the ecosystem is used, but the ecosystem supports a variety of technologies. And by showing that it adds enough value to the users, companies can still be enticed to participate in the ecosystem.

7.4 Requirements

For the design

In order to make clear what the design must do, a few design requirements have been drawn up. This is looked at from the viewpoint of various stakeholders involved in an ecosystem, namely KPN, ship operators and technology partners. Requirements are based on the previously conducted research.

KPN

- Should work with marine radio communications
- Should involve connectivity
- Should transfer data
- Should add more than just the network
- Should be able to grow in the future
- Should provide easy access to the maritime sector
- Should be a big enough market
- Should respond to strengths of KPN

Ship operators

- Should increase the value of the technologies
- Should utilise full potential
- Should be usable without much knowledge
- Should not jeopardize operation
- Should be safe to use
- Should not make competitors too smart (competitive information protected)

Technology partners

- Should provide data to improve technology
- Should provide the opportunity to apply technology more broadly
- Should increase returns

08 IDEATION

Describing the ideation process of this master project

In the ideation phase, the design brief and the design requirements are converted into initial ideas that can be used to create the final design. First, the literature about this process will be described in this chapter, and then it will be briefly discussed how this influenced my thesis.

8. Ideation

Develop phase

The scope from the design brief and the insights gained in the discover phase provide the requirements for the final design. In the ideation phase, the focus is on developing usable ideas for a final concept. This ideation is interwoven throughout the project as the various conclusions were drawn by conducting additional research. In order to get a clearer picture of how the process was shaped within the project, the literature will be discussed first.

Co-evolution of problem-solution

Designing a solution can be done in different ways and a distinction can be made between different design methods. Design is often seen as having a Eureka moment, but often designers cannot refer to the point within the process where this Eureka moment exactly took place. The reason for this is that often within a design process the problem space develops together with the solution space. In this process both spaces come closer to each other, making it increasingly clear what the possibilities are within the assignment (Dorst & Cross, 2001). With this clarity, an idea can then be developed into a good design.

This process of developing both spaces simultaneously is well illustrated in the model by Maher, Poon, and Boulanger (1996) (see Figure 16). It shows that a designer starts with exploring the problem space (P(t)) and finds a partial structure in it (P(t+1)). This is used to form a partial structure (S(t+1)) from the initial solution space (S(t)). The S(t+1) is used to generate initial ideas and further structure them into S(t+2). Then the findings of the found solution space (S(t+2)) are translated into further structuring from P(t+1) to P(t+2). These steps are repeated in varying order until a matching problem-solution pair is found (Dorst & Cross, 2001). Through this method, the creative process takes place over a period of exploration in which the problem and solution space evolve until they are formed.

The following section discusses how this evolution of problem and solution space took place within my thesis.

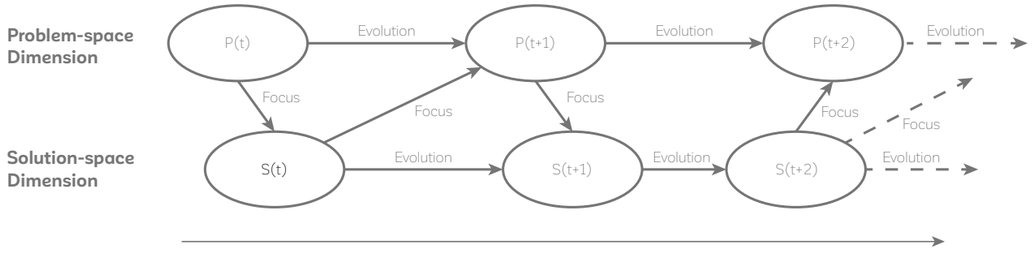


Figure 16: Co-evolution model (Maher, et al. 1996)

Thesis' process

To better represent the process of ideation in my thesis, Figure 17 shows how the problem and solution space evolved through the project. It shows that the two spaces come closer and closer together, making it increasingly clear what is needed to make a good design suitable for KPN. Finally, the idea of a maritime ecosystem emerged. The designed concept will be discussed in the following chapter.

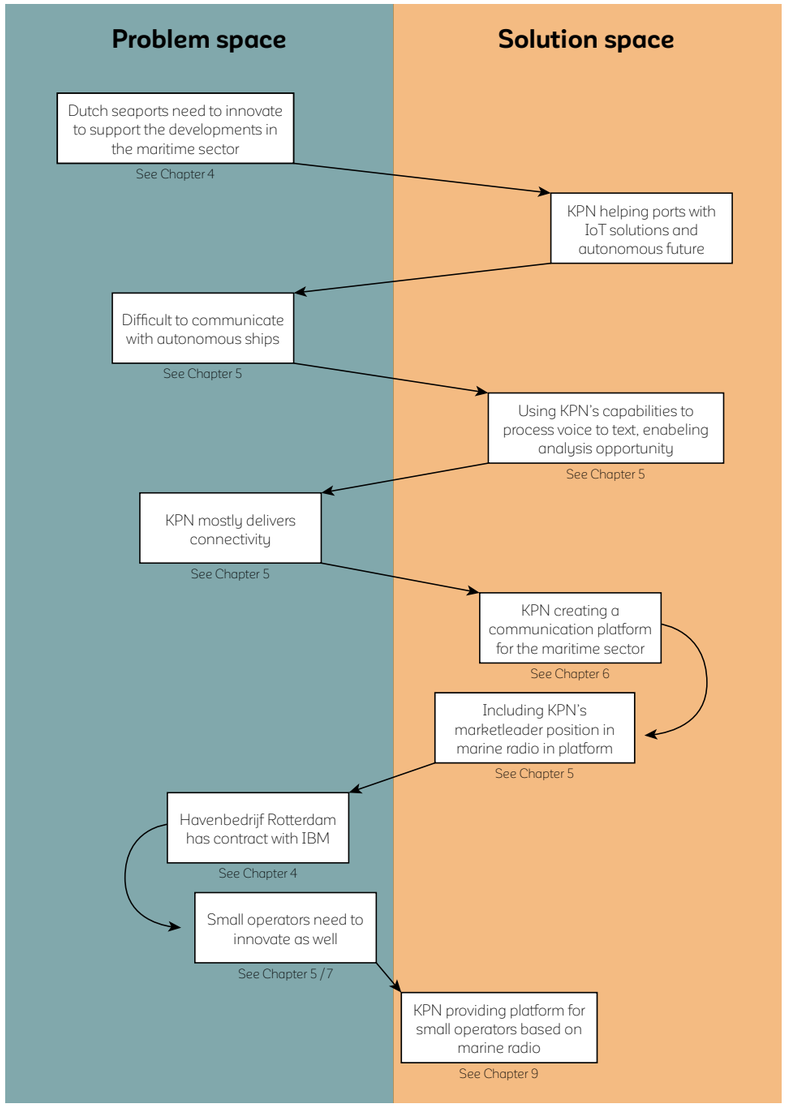


Figure 17: My thesis's process (own illustration)

09 CONCEPTUALIZATION

The designed business proposition for KPN to implement in the maritime sector

This chapter discusses the concept designed as a business proposition for KPN. To illustrate the effects of the future vision more clearly, an ideal future scenario has been drawn up in which the most important components are highlighted. After that, the concept will be discussed and how it fits into the future process of transport over water. The different elements of the concept will be explained in more detail.

9.1 Future Scenario

Process in the future ports

To clarify the process of the future, a future scenario is sketched.

The moment a transport is ordered, the carrier receives a message that products need transportation. Then there are two chains through which the transportation will pass on its journey, namely a physical chain and an online chain, connected to each other. The products are placed in a container, which is then registered online. The container is placed on a ship that then starts its journey towards the destination, all traceable online for all involved stakeholders. After having sailed the route over the sea, the ship with the container automatically enters the port after its arrival has been registered online. The online system is continuously up to date during the journey about the status of the ship and thus the container. The real-time updated arrival time enables the port to prepare for the mooring of the ship. When the ship arrives at the assigned quay, all necessities for unloading the ship are present. The container is unloaded and immediately placed on a truck to continue its journey to the company which ordered the transport. This way, minimal time is lost and the company gets the products as soon as possible. By automatically registering all these steps online, everyone in the supply chain can prepare far in advance for the handling of the products.

To clarify this scenario a bit further, and in particular, the maritime part of the supply chain, the visualisation on the right has been made (see Figure 18). The various elements will be explained in more detail.

Autonomous operation

By allowing ships to enter the port autonomously, a lot of time and effort is saved in getting the right people on board. As a result, marine pilots can more quickly shift their attention to another ship, making it possible to bring in more ships with the same number of pilots.

Up to date information

All the time, all parties involved have the correct updated information. This allows them to anticipate developments taking place earlier in the chain and minimise waiting time. It helps them to prepare the rest of the supply chain correctly and manage the expectations about the delivery time very well.

No registration

The cargo and the ship are registered during the voyage by the system. Registration at the port is not necessary, saving time and providing the correct information upfront. Therefore, preparations can be made and The ship can be unloaded immediately.

Aligned processes

By sharing all information with the parties involved, it is possible to coordinate all processes. This reduces non-value-adding processes and movements to a minimum and ensures that throughput time is optimised. This ensures the highest possible efficiency.

To achieve this future scenario, parties will have to cooperate and start sharing data. In the future, for maritime transport that is cost-efficient, good for people and the environment, has high delivery reliability, prevents crime and smuggling and is safe, data sharing will be important. Here, the party that makes it possible to share data in real-time plays an essential role in the collaboration.

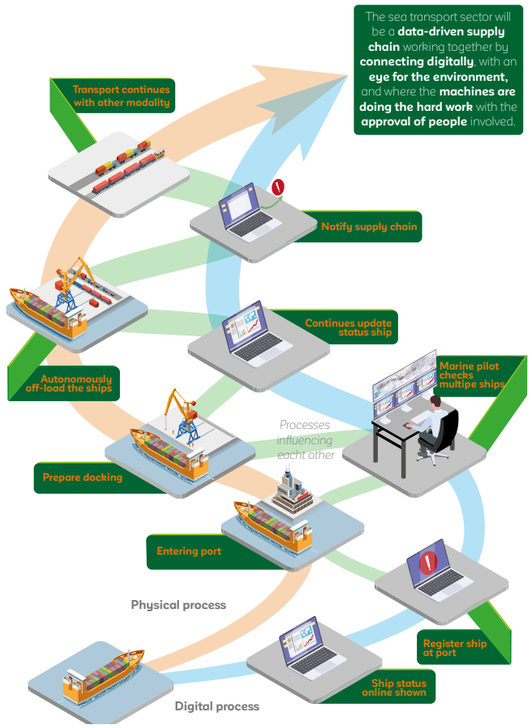


Figure 18: Future scenario (own illustration)

9.2 KPN Fleet

Business proposition to enter the maritime sector

Within the sector, data is playing an increasingly important role and companies are looking to optimise or even automate processes. To this end, a great deal of research is being done into new technologies and the application these technologies can fulfil, all striving for the future scenario in the maritime sector. Herein not every stakeholder in the sector has the same opportunities due to a lack of financial resources or limited size. To help these stakeholders, KPN, with all its experience in data sharing, can offer stakeholders the platform through which they can make use of the available opportunities. In addition, KPN can provide a platform for companies to deliver their products and services to the maritime sector.

Introducing KPN Fleet (Figure 20), the ecosystem that allows small operators to take advantage of all the new opportunities offered by technology and data. By combining its knowledge and its partners, KPN can create an ecosystem with all the necessities to implement new technologies and data in the daily operations of ship operators. In doing so, each stakeholder delivers their value within the system, ultimately benefiting all stakeholders.

To zoom in on the various components, KPN Fleet will be discussed based on five dimensions; Platform, data sharing, front-end, back-end and added value. In addition, more details will be discussed in Chapter 10 using the Business Model Canvas.

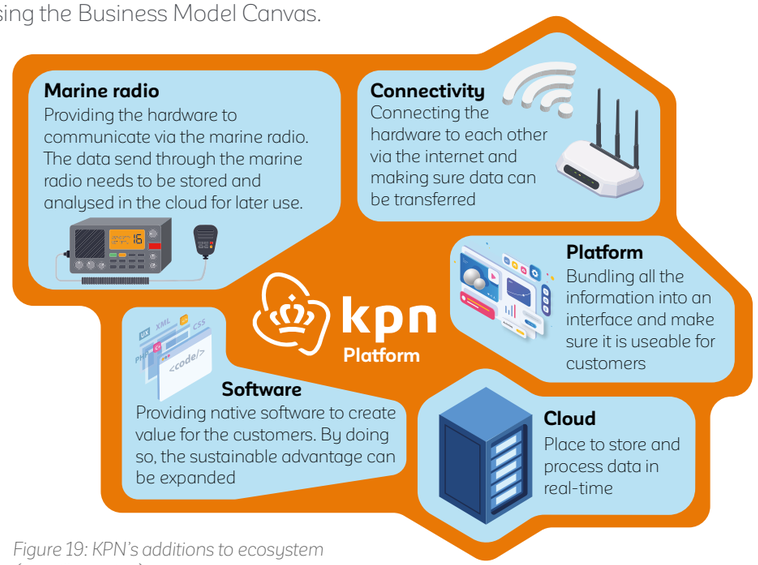


Figure 19: KPN's additions to ecosystem (own illustration)

Platform

The ecosystem will be initiated by KPN and they will also realise the corresponding platform. Within this platform, KPN will supply various components itself (see Figure 19). The first of these is connectivity, which is used to link all the different components together and to move the data across the ecosystem. Connectivity includes all components needed to connect devices, such as the network, the receivers, the transmitters and also the subscription. On this network, the marine radio delivered by KPN will also be connected. Hereby KPN delivers both the hardware and the software needed. By including these in the ecosystem, voice communication can be integrated. That can lead to new or extensive insights. To store all the data generated within the entire ecosystem, KPN will use cloud storage with the corresponding digital infrastructure. These are all components that KPN already delivers to other customers and can therefore be easily used for the platform in the ecosystem.

What does require some modification is the delivery of the platform. Although KPN has knowledge and experience in delivering and hosting platforms, the platform will have to be adapted to the specific needs of the ecosystem. This platform must be capable of processing all data in the right way and must be able to clearly show users what conclusions have been drawn based on the data.

To build on its strategic advantage, KPN will have to invest in developing software to perform data analyses. By developing native software, KPN can ensure that competitors will have difficulty developing the same business proposition. This will be discussed in more detail in Chapter 11.

Data security
With the capabilities of KPN around cyber security, the data will be secured as good as possible.

Maximizing effect
With the support of all the involved partners, the data can be used to it fullest to optimize the process as much as possible.

Save time / money
The analysis of the data provides the opportunity to optimize the process and therefore saving time or/and money.

Tested hardware
When purchasing hardware along with the platform, it is made sure the hardware works and is fully tested before distribution.

Network effect
By sharing the data with the ecosystem, all the involved stakeholders help each other to perform better. This effect grows as the platform grows.

Increased efficiency
By optimizing the processes, the efficiency can be optimized as well.

Transparent process
By being continuously up to date with the process, stakeholders can focus on more important things than what happens before or after their contribution.

Analysis speech data
By analysing the data sent over the KPN network by VHF radio, KPN can generate useful insights for both ship operators and port authorities.

Reducing fuel consumption
By plotting the fuel consumption of a ship against the conditions in which it sails, lessons can be learned about reducing fuel consumption. These can then be applied to the entire ecosystem.

Marine radio
Providing the hardware to communicate via the marine radio. The data send through the marine radio needs to be stored and analysed in the cloud for later use.

Connectivity
Connecting the hardware to each other via the internet and making sure data can be transferred

Improve weather information
By making use of radio link weather technology, KPN can enrich the weather data of KNMI. By installing the technology on KPN's transmission towers, the weather can be forecast very locally and accurately.

Platform
Bundling all the information into an interface and make sure it is useable for customers

Link different service
By aggregating the current status and information of a ship in a platform, this can be used to ensure that other services are coordinated accordingly. As a result, the right supplies are always available at the right time.

kpn Platform

Software
Providing native software to create value for the customers. By doing so, the sustainable advantage can be expanded

Cloud
Place to store and process data in real-time

FRONT-END

Data management

Maritime platform

Business analysis

Fleet management

Data into the ecosystem

BACK-END

Software developers

Weather conditions

Water conditions

Hardware providers

Figure 20: KPN Fleet (own illustration)

Data sharing

Sharing data is the heart of KPN fleet. We, therefore, pay extra attention to the way in which this takes place in an organized and digital manner. Figure 21 shows how data sharing takes place. This setup is based on the setup of KPN's Data Service Hub.

There is a general part and a company-specific part within the digital infrastructure. The general part contains all the different models and software that analyse the data into usable insights. The company-specific part contains all the data and insights of a company. These company-specific parts are separated from each other, to remain clear who the data source is and allow the company to retain control over its data.

When a company joins the ecosystem, permission is given to share data with stakeholders. This can be with another company, for example, the sharing of data between company A and company B, but also using the data in certain software or models. Without permission, an analysis cannot be made. When data sharing is approved, a link is established between the sender and receiver within the digital infrastructure. This means that the sending and receiving stakeholders remain responsible for the data that is shared. KPN then ensures that the entire ecosystem is secure.

To simplify data sharing for the companies, KPN offers tools to better determine what kind of data is involved and who should be able to view it. In addition to offering expertise in the area of data privacy, this should ensure that companies can easily but safely share data. KPN can support companies, but the responsibility remains with the companies.

There are three types of data flows: public, organizational and personal (interview Data Service Hub, 2021).
Public data contains information that can be viewed by anyone, such as weather conditions or fuel prices. This data is not harmful to any company or person. These data flows can be shared freely.
Organizational data contains information about specific companies or operations, such as fuel consumption or the cargo of a ship. Sharing this data can be harmful to the company. Explicit permission is required for sharing this data. It also determines what the data may be used for. However, when this data is analysed, the conclusions can be used to improve analyses. By doing that, the specific data is not shared with other parties, but only insights are used within a model or software to better perform.
Personal data contains information about people, for example, the name or contact details of a certain skipper. Sharing this data is prohibited in most places. KPN Fleet focuses on business processes. Sharing personal data is therefore not necessary. To help companies with this, KPN implements tools that give warnings when it looks like this kind of data will be shared through the ecosystem.

Although data sharing can help stakeholders get more out of the ecosystem, stakeholders should always be aware of the risks and regulations surrounding data sharing. KPN's capabilities provide the solid basis for secure data sharing.
When setting up the digital infrastructure, developments in data spaces resulting from European legislation must be taken into account (International Data Spaces Association, n.d.). This will enable KPN Fleet to develop into a maritime data space in the future.

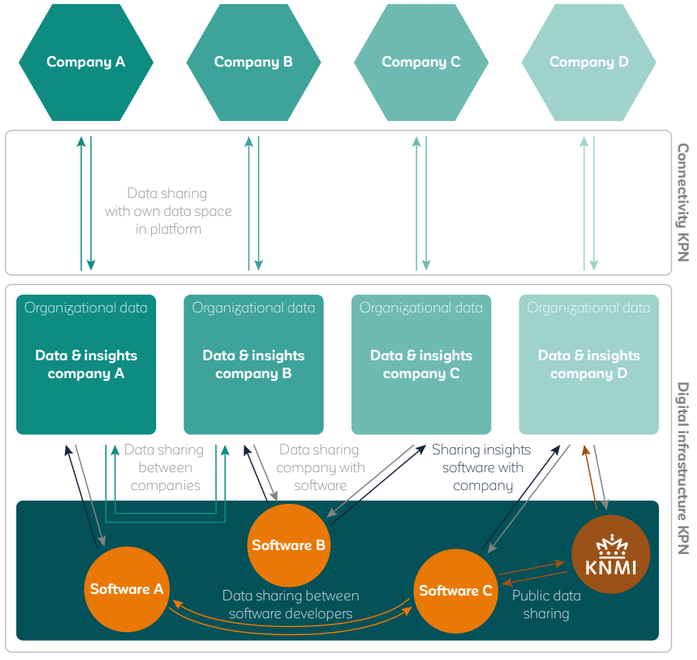


Figure 21: Data sharing KPN Fleet (own illustration)

Front-end

Looking at the front-end, different functionalities that users can use to optimise their operation can be distinguished (see Figure 22). KPN Fleet offers these functionalities.

Data analyses can be used to provide better insight into how certain choices affect the entire operation. For example, the conditions, such as weather and cargo, can be linked to the ship's fuel consumption. By analysing these data, it is possible to minimise fuel consumption, which in turn leads to a cheaper operation. Or the data analyses can be used to determine improvement possibilities in the operation.

In addition, the shared data can be managed transparently. The raw data that is sent does not in itself provide any added value for an operator. Only when it is filtered and categorised something can be done with it. By outsourcing this to the platform, a lot of time and effort can be saved. By transferring all the data to one platform a bundled way of displaying all data is created. External data, such as weather and water conditions, are also included. As a result, the operator have always access to all the necessary data.

Finally, it also offers the operator the possibility to manage multiple vessels from a distance. By adding multiple vessels, an overview of the ships is created and could be compared to each other. This makes it easy to adjust from a distance if necessary. In the future, this could even make it possible to manage autonomous ships. This would allow ships to receive new commands remotely, when necessary, and to make adjustments in the right way.

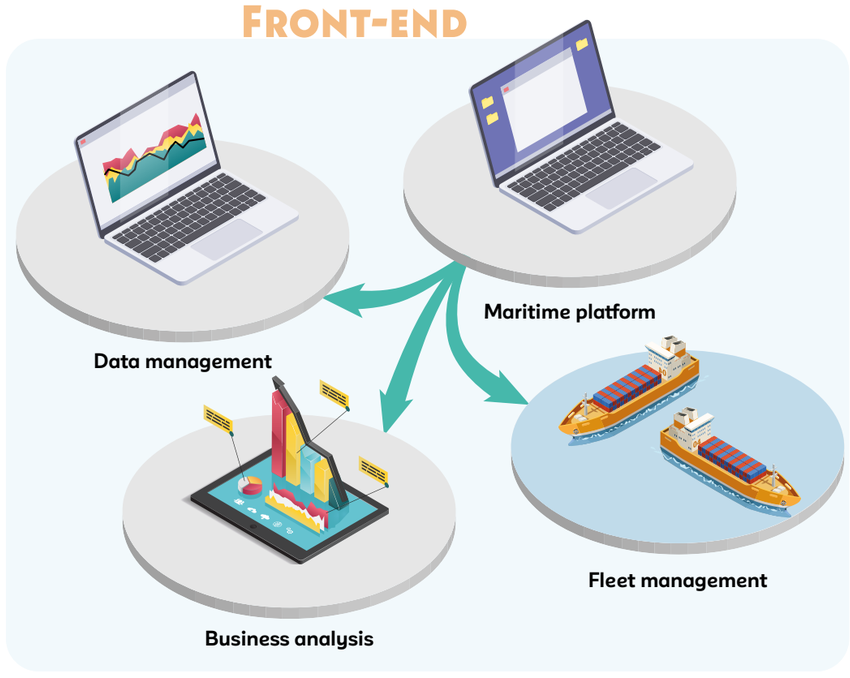


Figure 22: Front-end of KPN Fleet (own illustration)

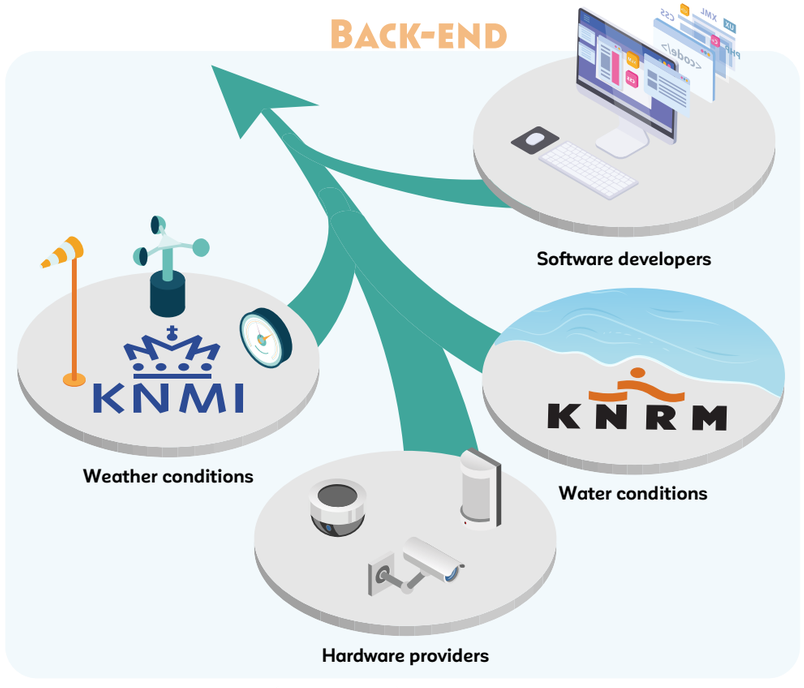
Back-end

To make KPN Fleet possible, several companies will be involved. The combination of companies in the back end will determine the value of the ecosystem (see Figure 23).

To properly reflect the situation on the water, stakeholders will have to be involved who provide data on weather and water conditions. The expertise of the KNMI and KNRM can be used for this. By supplying weather and water data from ships back to the ecosystem, these stakeholders can also further improve their services. Because these stakeholders already measure this data, it will be a small step for them to get involved in the ecosystem.

Furthermore, hardware will be needed to generate data for the customers, who will then be able to measure or optimise certain data. This could include sensors, trackers or robots, depending mainly on the services that will be added to the platform. For this cooperation, suitable companies will have to be found that either already provides this or are in the process of developing certain hardware. When these companies become involved in the ecosystem, they will earn extra income by selling more products, but also get a lot of user data. The user data they get through KPN Fleet allows them to further improve their products.

Besides the hardware, KPN will also have to look at the software within the ecosystem. The software will be needed to perform analyses on the data within the ecosystem. This can be done in cooperation with various software developers, all of whom can make a valuable and unique contribution to the ecosystem. Examples include speech-to-text, fuel analysis or logistics software. Again, it depends on which functions are added to the platform. For these software developers, the same applies to the hardware suppliers: using them generates more revenue, but at the same time it also generates more user data. This data can be of great value to the developers because it makes it possible to improve analyses. This results in an improvement of the software to all parties to whom the software is delivered, not just to the ecosystem.



To realise these collaborations, KPN as initiator will have to actively look for suitable companies that can add value. At the start, a lot of focus will be needed to get it off the ground, but later collaborations can easily be added.

Figure 23: Back-end of KPN Fleet (own illustration)

Added values

KPN Fleet adds different values for different stakeholders (see Figure 24). Here will be zoomed in on the value created for the users in the ecosystem; Chapter 10 will look more closely at the value proposition per stakeholder.

First, the purpose of an ecosystem is that all stakeholders help each other to improve and get more out of the available assets. When this is done well, all stakeholders benefit from the efforts of the individual companies. This allows the work that needs to be done to be divided and therefore more time and attention can be devoted to solving a problem. By sharing these assets, stakeholders need to make fewer large investments.

In addition, the creation of an ecosystem offers the possibility of linking different services. This allows multiple companies to use the same data. For example, the location of the ship can be used by a delivery service to coordinate the delivery. Or the energy or fuel supply can be matched to the current amount of energy or fuel in the ship. This increases the quality of service but also improves efficiency. This ultimately benefits all parties.
By combining all the sensors in an ecosystem and agreeing to share the data, all this data can also be combined. This ultimately gives all stakeholders a more comprehensive data set, with which they can achieve more or perform better.

Finally, creating an ecosystem and combining it into a platform makes it very transparent for all parties. This means that the stakeholders involved have one platform to go to in order to be able to view everything. This saves time and allows stakeholders to focus on important aspects.

Implementing KPN Fleet will ensure that all stakeholders can add their value to the maritime sector, bringing the sector one step closer to the future scenario presented in Chapter 9.1.

Figure 24: Added value by KPN Fleet (own illustration)

10 BUSINESS MODEL

The approach to convert the concept into revenue for the ecosystem

To ensure that a business case can be made around the idea presented, this chapter looks at the business model attached to this concept. First, the value exchanges between all parties within the ecosystem are considered. The Business Model Canvas (BMC) is then discussed. Finally, the different components in this canvas are zoomed in to and how they are interpreted within the designed ecosystem.

10.1 Value exchanges

Within the ecosystem

Within the ecosystem, different stakeholders are involved, all making their contribution to the ecosystem. To show this contribution, the value exchanges are schematically represented in Figure 25. As shown, KPN is seen as the central party in the ecosystem. KPN initiates the ecosystem and provides a platform that connects all the stakeholders. Then there are various companies, such as KNMI and KNRM, that supply data to the network and receive improved data in return. Then there are suppliers, of both software and hardware, who deliver products to the ecosystem and receive user data and money in return. Then there are two parties, namely KNRM (rescuing ships in distress) and the ports (fuel and docking services), that receive data from the ecosystem and can therefore better serve their customers. The ports get paid directly by the customer, not so much through the platform. Finally, of course, there is the customer, the ship operators, who pay to use the platform. In addition, the data from this customer is used to improve the platform and the ecosystem. Indirectly, all customers help each other to get more value out of the platform.

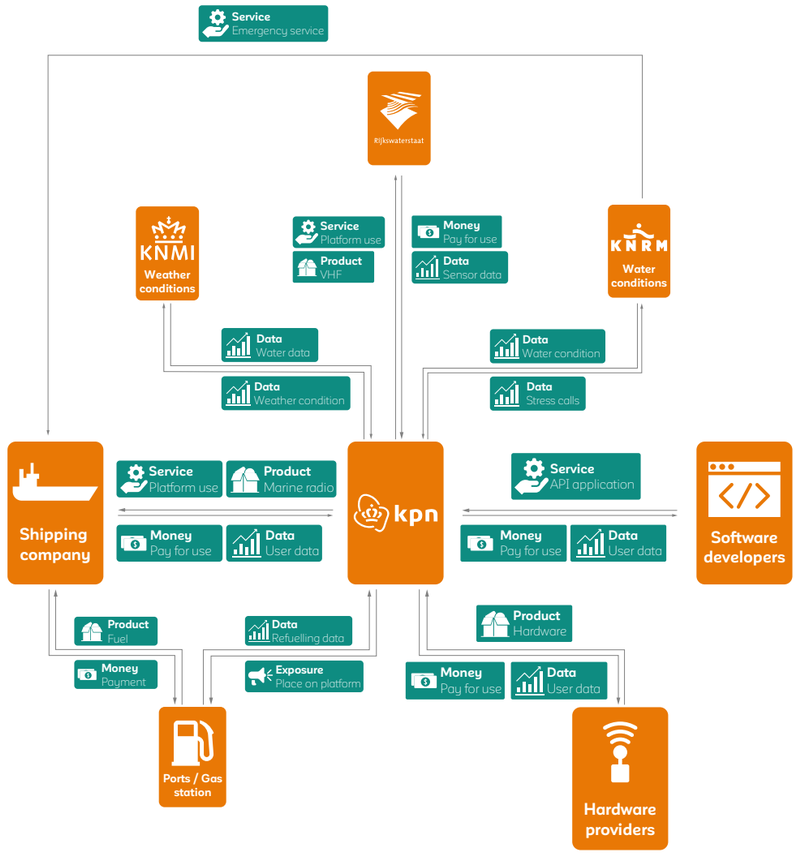


Figure 25: Value exchanges in the ecosystem (own illustration)

10.2 Business Model Canvas

Modelling the whole ecosystem

After looking at the value exchanges that take place within the ecosystem, an attempt was made to structure this further using the Business Model Canvas (BMC) (Osterwalder & Pigneur, 2010). This was done to better map out what would be needed to make an ecosystem as proposed work. The focus is on KPN, but for other partners, it is also looked at what they have to do or deliver for various components. The completed canvas can be found in Figure 26. To provide a little more explanation, all the individual components are discussed separately.

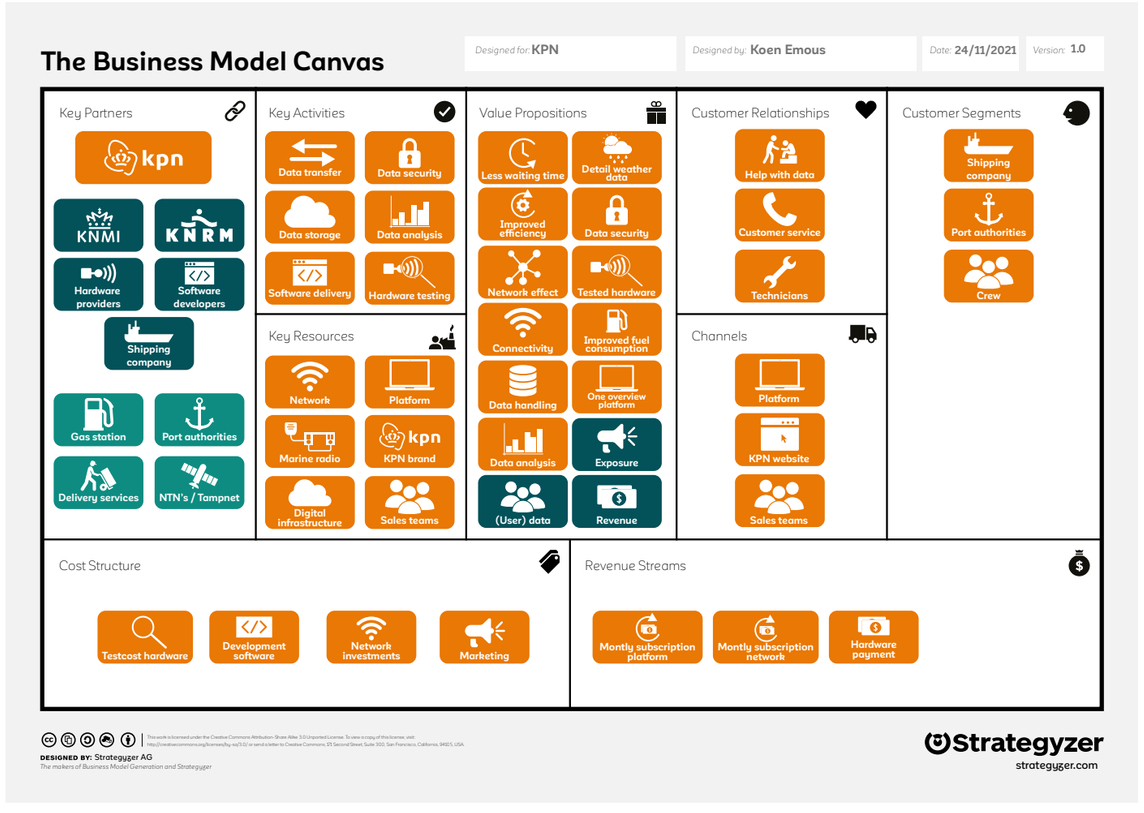


Figure 26: Business Model Canvas (Osterwalder & Pigneur, 2010)

KEY PARTNERS

KPN
As the initiator of the platform, KPN is of course a very important player in the whole. By using the capabilities they already have in-house, all parties involved in the ecosystem can be linked together. Appendix G discusses these capabilities in detail. To be able to link all parties, KPN will have to act as the trusted party for the various stakeholders. KPN also provides an important connection to the ships, namely the marine radio. As a result, more is known about the ships and more aspects can be included in the decision-making process.

KNMI (weather)
To give good advice on the water, weather is essential. To add data about the weather conditions to the platform, it will be necessary to collaborate with a party that has insight into this, for example, KNMI. This data can be taken as a basis and further supplemented with data from KPN's transmission towers (see Appendix G). In addition, KNMI's knowledge of weather forecasting can help to combine the data resulting in better forecasts.

KNRM (water)
In addition to weather, water conditions are essential for the correct analysis of the data. This will require cooperation with a party that has insight into the situation on the water, for example, the KNRM. In addition, KNRM can help to improve the analyses of the water conditions based on the data in the ecosystem because of their knowledge on this subject. Besides, KNRM can be included to provide help to ships in distress.

Hardware providers
To read the situation and convert it into data, sensors and hardware are needed that can be placed on-board of ships. It will be necessary to cooperate with hardware providers who can meet this need. The knowledge of these partners can be used to supply the right hardware, but this can also be supplemented with the testing capacities of KPN (see Appendix G). This ensures that the best possible hardware is made available to customers.

Software developers
In order to convert the raw data into valuable insights, software and models are needed. To be able to add as much functionality as possible to the ecosystem, various software developers will have to be involved. Depending on the data that is gathered, it can also be determined which analysis and models will be needed. Examples could be fuel consumption analysis or models to simulate and improve the planned route. This may also vary over time as more features are added. To strengthen its position, KPN will also have to start developing certain software that can create value within the ecosystem.

Ship operators
In addition to being the customers of the platform, the ship operators also largely provide the data that can be used to improve software and hardware. This makes them important partners in the ecosystem so that the value created by the ecosystem can be expanded further. Without the ship operators, there is no value from the ecosystem for all stakeholders involved. Including the ship operators from the start, they could help build and form the ecosystem and platform along the way. This could even be done as a pilot phase, so everything will be included when the ecosystem launches.

Optional partners
Apart from these key partners, some parties can be involved in the ecosystem to further enhance its value. This could include adding functionality or further improving the service that is offered. Below is a brief outline of what might be possible.

Energy providers
As the maritime sector moves towards sustainable fuels, the supply of energy will also change. This will result in, for example, a challenge on the electricity network to provide the needed energy in time. When energy suppliers are involved in the ecosystem, the possibility of matching the location and status of ships with where it would be possible to charge the batteries can be examined. This could reduce the price for the customer and distribute the pressure on the electricity network more evenly.

Delivery services
As the location and routes of the ships are known at all times, this information can be used to better coordinate ship deliveries. For example, delivery can be accurately timed with the refuelling of a ship, making it possible to continue their journey more quickly.

Port authorities
It may be interesting to involve port authorities in the ecosystem, especially for ports that cannot provide the various insights themselves. With this involvement of ports, new sensors can be added and therefore expanding the data. It also offers the ports the possibility of offering better services to ships entering the port. The data and analyses carried out within the ecosystem can be used to provide better advice to incoming vessels.

Tampnet / Non-Terrestrial Networks
For now, the focus of the ecosystem is on the Netherlands because of KPN's Dutch orientation, but this focus may change in the future. After all, the developments that can be seen in the Netherlands are taking place all over the world. To be able to realise this, KPN will have to look at expanding the network and thereby providing connectivity to a larger area. For this purpose, it may be interesting to involve Tampnet or Non-Terrestrial Networks in the ecosystem. In this way connectivity can be delivered on the North Sea (Tampnet) or even worldwide (Non-Terrestrial Networks) and the ecosystem can be expanded with customers from abroad.

KEY ACTIVITIES

KPN
A core capability of KPN is to provide connectivity and thereby move data. This capability will be important for KPN to make this ecosystem possible. Several aspects need to be arranged. These include moving the data, storing the data but also securing the data. This requires both software and hardware, both things that KPN already delivers and has a lot of knowledge about to take care of. To be able to continue to guarantee this, KPN will have to keep its network up to date and ensure that the national coverage is optimal.

In addition, KPN will have to be able to offer a place where real-time analyses can be performed. For this purpose, the ecosystem can make use of the digital infrastructure that the Data Service Hub (see Chapter 9.2) uses. To be able to perform analyses, KPN will have to develop software that can respond to the delivered data and convert it into valuable insights for customers. KPN will have to invest to realize this (see Cost structure). This will also make analysis one of the key activities KPN will have to perform.
Besides software for analysis, KPN also provides a platform that can be used to combine everything. KPN can fall back on previously developed software and adapt it to the specific standards of the maritime platform.

To improve weather forecasting locally, KPN will have to implement radio link weather forecasting (see Appendix G) in their network. This will allow them to generate very local weather data, which can be used to improve weather forecasting within the ecosystem.

Finally, KPN will ensure that the necessary hardware meets the requirements. All delivered hardware will have to undergo several tests to guarantee its compliance with the standards.

Hardware providers
It is important for hardware suppliers to develop hardware that is easy to install on ships. This can be done in consultation with KPN, making use of the knowledge that KPN has in the field of hardware. By making the hardware easy to install on ships, it is a minor step for ship operators to take part in the ecosystem. The hardware will also be extensively tested by KPN so that it meets all the requirements set within the ecosystem.

Software developers
The software developers will provide additional software that can perform analyses besides the software KPN provides. This will mainly be done by looking at companies that already have software for certain analyses and adapting those so that the software functions within the ecosystem. For this, it will have to comply with the standards of the ecosystem. In addition, these companies will be able to look at expanding or optimising their software, which in turn will create more value within the ecosystem.

Other stakeholders
The other stakeholders involved in the ecosystem do not specifically undertake other activities that they do not already do. Therefore, they have not been specifically addressed.

KEY RESOURCES

To realise the ecosystem, various resources are needed from KPN. Firstly, the KPN network is of great importance so that all the different components can be linked together, both concerning the physical part and the knowledge that KPN has in the field of networks. Also includes the marine radio that KPN supplies. The marine radio can be used to connect more data streams to the ecosystem, namely voice communication. In addition, the entire digital infrastructure that KPN has is needed to make the ecosystem work. The platform can be created and kept running on this infrastructure, but also the necessary analyses can be done on it.

To create such a platform, KPN's knowledge and people will have to focus on developing it. This will involve setting standards and processing all the different data flows. In addition, this must be combined in an orderly way, so that the platform can also be used by shipowners.

Furthermore, away will have to be found to sell the platform and to ensure that customers are interested. For this, the salespeople of KPN will need to start selling the platform. A team can be formed that talks to customers to convince them to use the platform.
In addition, the KPN brand can be used to promote the platform. The well-known name KPN has built up in the Netherlands and the results they have shown, give companies confidence in creating the ecosystem. This provides KPN with a solid basis that can be used to create this ecosystem as well.

COST STRUCTURE

To develop the ecosystem and make it operational, various investments will have to be made. A distinction can be made between a few different investments in parts of the ecosystem. For each investment, it is also considered which stakeholder or stakeholders should invest.

Network
First, the investments in the network will have to continue to keep it up to date and to ensure that it can process all the data. This is something that KPN already does, so it is not an investment that needs to be made specifically for this ecosystem. On the other hand, the ecosystem benefits from the improvement of the network by KPN. Another investment needed concerning the network is the radio link weather forecasting technology (see Appendix G). This will be done in collaboration with Tomorrow.io.

Software
As mentioned before, the software will also have to be developed to analyse the data. This must be done both by the companies involved through their contribution to software and by KPN. The size of the investment will depend on the functionality of the software and already available software.
In addition, the platform will have to be developed. KPN will have to invest in this as the central stakeholder in the ecosystem. Standards will have to be set to ensure that all other developers can align their software to these standards.

Hardware
Investments will also have to be made in the development and production of the right hardware. For this, it must be looked at what is needed and how this can be achieved. This investment will have to be made partly by the hardware providers and partly by KPN. KPN will have to invest mainly in testing the delivered hardware to make sure it complies with the standards.

Marketing
Finally, KPN will have to invest in promoting the ecosystem to attract customers. Of course, the channels of all stakeholders involved can be used, but KPN will have to make the largest investment in this area. As the initiator of the ecosystem and platform, KPN will be looked to when customers are needed to be found for the platform as well. Because of this, KPN will also have to invest in marketing.

REVENUE STREAMS

As already explained in Chapter 10.1, there are several stakeholders involved in the ecosystem who all exchange different values with each other. The revenue streams section of the BMC focuses on the payments that take place within the ecosystem, as does this section.

The most important payment is that from the user to KPN. Part of this is a one-off payment, part is a monthly recurring payment. Both payments contain several components that the user receives in return for the money. The one-off costs are mainly for buying the necessary hardware to be installed on the ships. There may also be a one-off cost for installing this hardware. The monthly costs are for the use of the platform, the function within the platform and the connectivity offered.

From the payment from the user, KPN will have to pay part of the money to other partners in the ecosystem. For example, the one-off payment for the hardware is largely for the hardware supplier. The other part will remain with KPN since KPN installs and tests the hardware itself. The monthly costs will be divided between the software developers and KPN itself. The software developers are paid monthly to offer their software on the platform and to ensure that users can make use of it.

Finally, some payments go beyond KPN but could be seen as payments within the ecosystem. These payments are between stakeholders in the ecosystem and are enabled by the platform This is the payment for refuelling of ships. This payment is done directly by the user to the fuel suppliers, so not through the platform.

VALUE PROPOSITION

Within the ecosystem, there are different value propositions for different stakeholders. A distinction is made between customers and partners.

Customers
For customers, the ship operators, the ecosystem provides the opportunity to make data-driven decisions without having to care about the data or its analysis. This gives the customer the advantages of the data, but not the difficulties like data security and data handling. By using the data to make choices, the efficiency of vessels can be increased, waiting times shortened and fuel consumption reduced. This allows the customer to reduce operational costs while reducing emissions and time. With multiple customers connected to the same ecosystem, the customer has access to a lot of analysed data that can be used to make even better decisions. So, a network effect is created, when more stakeholders are involved, the whole ecosystem benefits. Besides the comprehensive data set, the effect of innovation is increased by sharing it with the ecosystem. In addition, the customer gets the right hardware that has been tested, so there are no concerns about performance. Finally, this is also combined into a clear platform, making it very easy to use, creating a transparent process that allows more time to be spent on other things. This value proposition is also shown in Figure 27.

Partners
For partners, it provides different values. Obviously, it provides additional income by providing the expertise and products/services. In addition, it can also be seen as a way of gaining extra exposure to customers. This can give the company more exposure and thus promote other products or services of the company. Finally, the partners receive a lot of user data about their products or services. This user data can be used to improve the product or service or to improve analysis.

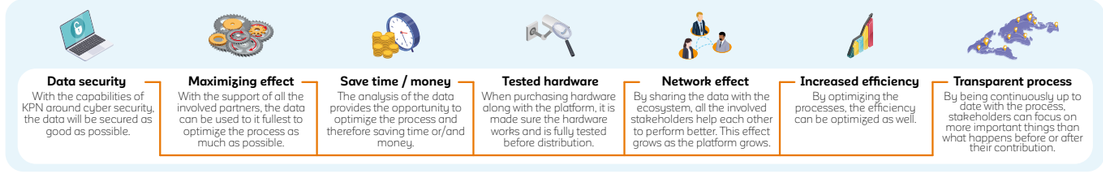


Figure 27: Value proposition for customers (own illustration)

CUSTOMER RELATIONSHIPS

It will be important for KPN to maintain good relationships with all the different stakeholders in the ecosystem. For the ecosystem as a whole to succeed, KPN depends heavily on all these stakeholders. Conversely, the stakeholders also depend on KPN to make it succeed. As the initiator, many stakeholders will build a relationship with KPN as a starting point. From here, relationships can be built with other stakeholders in the ecosystem.

To convince stakeholders to participate and remain interested when the platform is launched, KPN will have to offer more than just connectivity. The activities and services that KPN must offer for this purpose are described in the section 'Key activities' earlier in this chapter. By providing these activities, KPN can secure their strategic advantage within the ecosystem and make it more difficult for competitors to copy the concept.

In addition, KPN will have to maintain a good relationship with users of the platform. These ensure that the platform generates revenue and ensure that this ecosystem succeeds. In addition, the more users are involved, the more data is available and the better the analysis can be performed. To ensure that this relationship is and remains good, KPN will have to focus on making it as easy as possible for users. By providing good customer service by appointing regular contact persons, offering technical people when needed and providing data specialists to help with the handling of the data, KPN can focus on an intensive but good customer relationship with users. In this way, these customers can also be used for feedback and determining needs at a later stage to further develop the platform when, for example, new features are added.

The channels that can be used for the various communications with stakeholders are described in more detail in the "Channels" section later on.

CUSTOMER SEGMENTS

For the customer segments, a distinction can be made between three different customers, namely; small ship operators, crew and small ports.

Small ship operators

Small ship operators are companies that manage multiple ships and use them as efficiently as possible but are not able to implement major innovations such as automation and data analysis on their own. These operators want to work more efficiently, but also need to make their fleet more sustainable. Making them more sustainable is a challenge for these operators because sustainable solutions often cost money and therefore make it more expensive to use the ships. In addition, the current operation has been optimised for many years, so there is a chance that when a new or partly new operation is introduced, this efficiency will be lost. By working together in an ecosystem, the costs of these innovations can be shared and therefore these ship operators also have the opportunity to use the latest technologies.
When looking at the size of this segment, it can be seen that there are approximately 8,000 Dutch inland navigation vessels (Binnenvaart, 2020). These are distributed over approximately 5,000 companies, which means that it differs per company whether they have several ships or not. To make things easier for KPN, they can work together with the BLN-Schuttevaer, the Dutch interest group for inland navigation vessels (BLN-Schuttevaer, n.d.). Many of the inland navigation skippers are affiliated with this organisation, which makes it easier to make contact with potential customers.

Crew

Part of the benefits will be for the crew of the ships. Apart from having a good internet connection on board, other parties will also be better prepared for their arrival. This will reduce waiting time and leave more time for other things to do. In addition, the data from the ecosystem can be used to streamline deliveries to the ship, for example. In this way, the crew need to disembark less and have more time left over to do other things.

In addition, the crew is better supported in making decisions through the use of data. When automation is enabled through the ecosystem, even simple tasks can be taken over from the crew. This allows them to focus on other matters on board.

Small ports

The smaller ports in the Netherlands can be seen primarily as an opportunity to expand functionality, but also to improve the services that the ports can provide. The ports want to provide the best possible service to incoming ships and meet all their needs. In this respect, the data from the ecosystem can ensure that ports are better prepared for ships, but can also be flexible by keeping changes up to date in time.

CHANNELS

The platform will be used primarily for maintaining contact with customers of the ecosystem. Here, customers can view all data, make changes and post any questions or comments so that they can be communicated to the right party. Of course, this can be supplemented with KPN's customer services, so that all urgent questions can be solved immediately.

It will be necessary to look at attracting both customers and companies who want to be involved in creating the ecosystem.
To attract customers, KPN can look at their current sales channels, such as the website, social media and salespeople. These can be further expanded with maritime-specific channels to reach the right potential customers more quickly.
For collaborations with parties that want to be involved in the ecosystem, KPN can first look at the current network of partners that they already have, like Xdroid (speech analysis) or Prometheus Informatics (asset tracking). KPN can then see whether any companies among them can provide added value. In addition, new partners can be attracted in the same way as is currently the case.

11 IMPLEMENTATION

Guidance how to implement the designed business proposition

To ensure that the concept can be realised, this chapter looks at its implementation by designing a roadmap. To do so, the Design Roadmapping method (Simonse, 2017) was used. This roadmap is part of the total strategy that KPN can apply to enter the maritime sector. Within this chapter, the strategic roadmap is first discussed, which could be used to present the idea to shareholders. It then explains how the timing of the three horizons in the roadmap was determined. After that, the three different horizons are discussed in detail. To close the chapter, all the design aspects are concluded in the tactical roadmap. This provides more insight into which steps, collaborations, and technologies are needed to realise the entire roadmap, which could help project and program management with the implementation of the concept.

11.1 Strategic Roadmap

Implementing the concept

To realise KPN Fleet, several steps will have to be taken. To make this transparent, a roadmap has been drawn up, divided into three different horizons: building the platform, growing the platform and expanding the platform. The different focus for the horizons is based on Geels (2002) (see Chapter 2.3). In this, the first horizon focuses on creating a niche in which the platform can be built. Then the focus shifts to creating a regime within the Dutch maritime sector. Finally, in the third horizon, the regime is enlarged to a landscape that gives direction to several developments in the maritime sector. Figure 28 shows a clear representation of this roadmap. Each of these three horizons has a different purpose for the platform and will be briefly discussed below. This roadmap takes 2022 as the starting point for KPN to start implementing the concept. In Chapters 11.3 to 11.5, the three different horizons will be discussed in more detail.

Horizon 1: Building the platform

For the first horizon, the focus is on realising the actual platform. This horizon will be realised in 2024. In order to achieve this, all the requirements for the ecosystem will have to be brought together. The main focus will be on entering into the right collaborations and adapting the digital infrastructure so that the platform can be realised.

For the ship operators, the realisation of this horizon already offers various values. It offers them the possibility to make data-driven choices, which will result in better results. In addition, the platform offers them a clear overview of all added ships, so they will never again need to use different systems to keep track of the ships. Finally, the data-driven choices will improve the efficiency of the vessels. As a result, more can be achieved with the same amount of resources. To ensure the platform is built right, a collaboration with the ship operators can be crucial from the start. With their help and feedback, the platform can be launched with the right functions included.
The results of this horizon provide the basis for further expansion of the service and thus the next horizons in the roadmap.

Horizon 2: Growing the platform

For the second horizon, the focus is on growing the platform. This includes both growing the number of ship operators that use the service and growing the entire ecosystem. By growing the entire ecosystem, new functions can be added to the service, resulting in more value creation for the stakeholders involved. This builds on the developed platform of Horizon 1. The second horizon should be realised by 2029.

For users of the platform, more value is created by growing the platform. When more users are added, the analysis and models in the platform can be improved. Besides more functionality can be added when growing the platform. With more users, it gets more interesting for companies to add their service or product to the ecosystem and grow their revenue. In addition to the aforementioned values from Horizon 1, the addition of the port to the ecosystem can also be used to improve the port processes. There is an additional process that can be further optimised to increase the total efficiency of the ship. In addition, the platform will create a community of many involved parties, all of whom have expertise within the maritime world. Users can make use of this and it is easier to gain information on how to improve certain components. If this information is exchanged, ultimately all stakeholders can benefit.

Horizon 3: Expanding the platform

In the third horizon, the focus is on expanding the platform, looking at increasing the scope and adding the requirements for automating processes. By increasing the area where connectivity can be offered, the entire ecosystem can grow again. This makes more data available for use, but also allows new technologies to be implemented by serving a larger group. Both lead to more value creation for the users of the platform. The third horizon will have to be realised by 2036.

By adding connectivity outside KPN's network through Non-Terrestrial Networks, it offers users more freedom to move their operations outside the Netherlands. In addition, foreign companies will be able to use the service, which results in more revenue. As technologies to automate continue to develop, it is interesting for the ecosystem to add the requirements for this. This not only enables users to make data-driven choices but also to have entire processes carried out based on this data. This ensures that the entire process can be optimised even further and more can be achieved with the same amount of resources.

By allowing the concept to grow based on the strategic roadmap, KPN contributes to creating the future vision (see Chapter 7.1). In order to provide more insight into the given timeline in the roadmap, the timing of the various horizons will be discussed in more detail in the next chapter.

2036

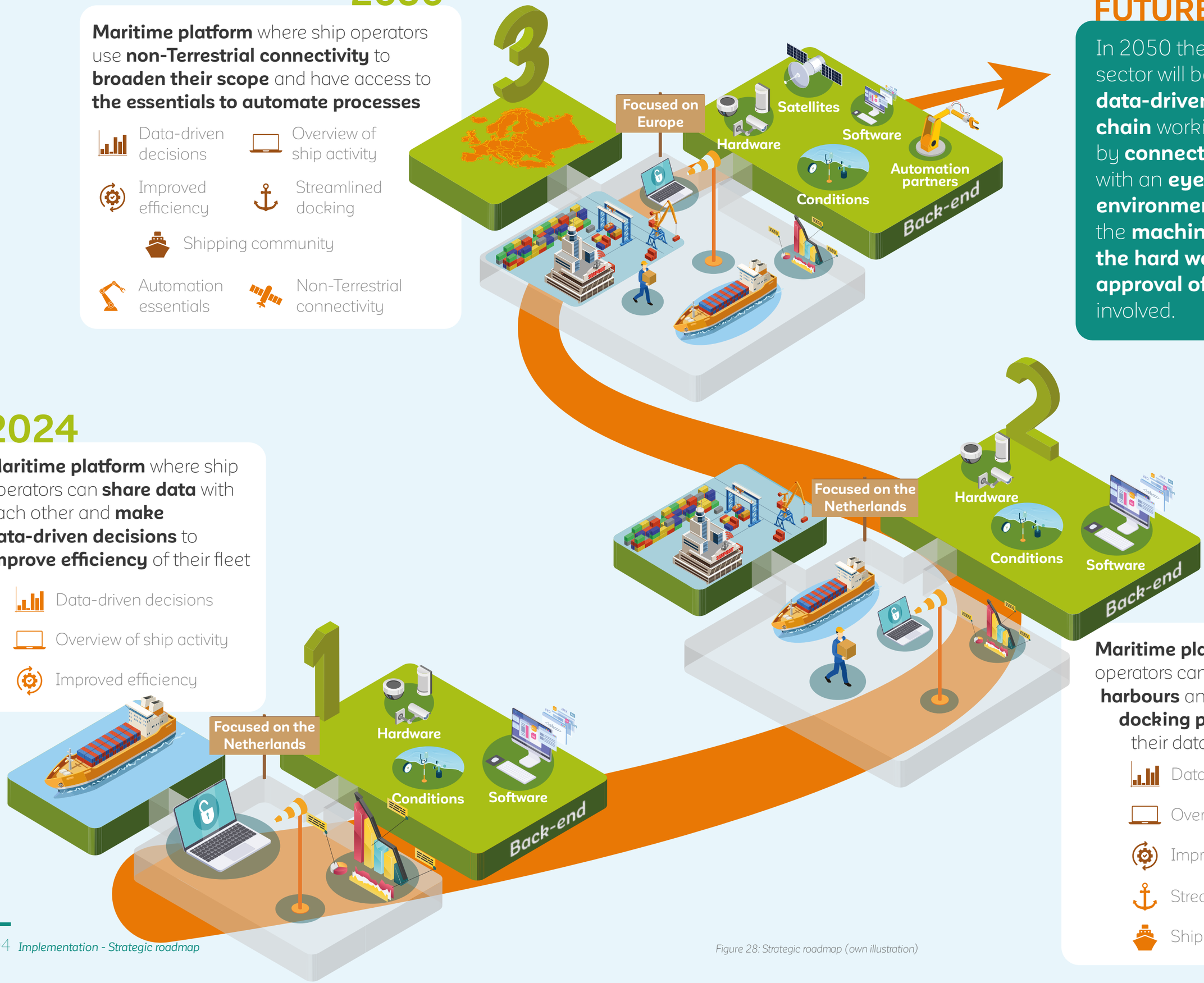
Maritime platform where ship operators use **non-Terrestrial connectivity** to **broaden their scope** and have access to **the essentials to automate processes**

- Data-driven decisions
- Overview of ship activity
- Improved efficiency
- Streamlined docking
- Shipping community
- Automation essentials
- Non-Terrestrial connectivity

2024

Maritime platform where ship operators can **share data** with each other and **make data-driven decisions** to **improve efficiency** of their fleet

- Data-driven decisions
- Overview of ship activity
- Improved efficiency



FUTURE VISION

In 2050 the sea transport sector will be a **data-driven supply chain** working together by **connecting digitally**, with an **eye for the environment,** and where the **machines are doing the hard work** with the **approval of people** involved.

2029

Maritime platform where ship operators can **share data with harbours** and **streamline the docking process** to expand their data-driven decisions

- Data-driven decisions
- Overview of ship activity
- Improved efficiency
- Streamlined docking
- Shipping community

Figure 28: Strategic roadmap (own illustration)

11.2 Timepacing

Timing the concept

To determine the timing of the steps in the strategic roadmap, a discussion with Jan-Rijk Vonk, Innovation Strategist at KPN, was combined with the findings of the discover phase. This led to three different developments that can be distinguished to the ecosystem: value proposition creation, user-centred value creation and design value enhancements (Simonse, 2017). The time pacing strategy is shown in Figure 29. Although 2021 is included as a starting point in the visualisation, no focus point is included for that year, mainly because 2021 is already almost over when my thesis is completed. To give a little more insight into the steps that need to be taken within this roadmap, the three different developments are highlighted. The most important developments of each level are discussed.

The choice of the different years for the steps in the roadmap is mainly based on how big the changes are that are needed to reach a step combined with the uncertainty that occurs in such a step. The further in the future something takes place, the more uncertain it becomes that certain technology or models will be developed.
For the first step in the roadmap in 2024, the changes are relatively small and the uncertainty is not so high. Many of the technologies used have already been developed and the challenge lies in coordinating them and making them work together in an ecosystem. To get started on the second step, it will be necessary to ensure that the first step is fully completed and operational.
The second horizon, in 2029, will require greater change and especially coordinating the entire ecosystem with outside companies such as the ports will be a challenge. For this, both the ecosystem and the outside companies will have to make changes to make this alignment flawless. Besides, the value for the ports can only be achieved when the platform has enough users.
For the final horizon in 2036, there is still much uncertainty and dependence on how technologies are developed. The implementation of Non-Terrestrial Networks depends primarily on how these networks and the connectivity they provide develop. In addition, the automation of processes requires a lot of equipment that needs to be well coordinated. These two major changes, therefore, cause great uncertainty.

Since the future is discussed here and it is not certain when all the needed technologies and partnerships will be established, the time pacing remains an educated guess.

Value proposition creation

Value proposition creations are the biggest changes to the ecosystem. Here, a new value proposition is added to the ecosystem that was not previously available. Due to the large number of adjustments required for these value propositions additions, they generally take more time than the other developments in the ecosystem.
Three value propositions are added to the roadmap. The first is linking different services by making use of the platform. This adds services that are not directly related to the maritime sector or the maritime process, but which ensure that even more value is created via the platform. Next is the expansion of the service area beyond the Netherlands. This will greatly increase the freedom in which ships can operate without loosing the functionality of the platform. Finally, automation services will be added to the platform. Users can use this to automate entire processes and thus focus on other, more important matters.

User-centred value creation

User-centred value creation refers to adding value for users of the platform. This makes additional functions available that create value and can be used within the platform. Within the outlined roadmap, it can be seen that five user-centred additions will be made until 2036. These can also all be found in the strategic roadmap in Figure 28. The first step is the launch of the platform itself, which is also the basis for the rest of the steps. Then the expansion of the service by adding the ports to the ecosystem is realised. This allows an additional part of the journey to be optimised via the platform. To broaden the scope of the entire platform, the connectivity of a Non-Terrestrial Network is added. With this, the service and the platform can also be offered outside the KPN network. Finally, there are two additions of automation, which starts with adding an automation partner. With this, the first processes can be automated by first focusing on the quick wins. This addition is then expanded by offering full automation services, this coincides with the addition of a value proposition as described above.

Design value enhancements

The design value enhancements mainly relate to improving certain designs within the platform or ecosystem. The value created does not change or hardly changes, but the result does improve compared to the previous version. These developments require less radical changes, which makes them faster and easier to implement.
The most important enhancements will be bundled and explained together, to keep it short and clear. In the beginning, the focus of the enhancements is mainly on building and growing the platform, this is where the foundation of the entire ecosystem is laid. After that, the focus will be on expanding the service that can be offered to the users. New functions are added and the available data is made better use of. Then the focus will be on expanding the service area in which the platform can operate. This way, users can expect the same service, only spread out over a larger area. In general, it can be seen that the design enhancements are fairly focused on the same points as the user-centred additions, only in smaller, less radical steps.

In order to delve a little deeper into the different horizons, the details of the choices made and goals set within the different horizons are discussed in Sections 11.3 to 11.5.

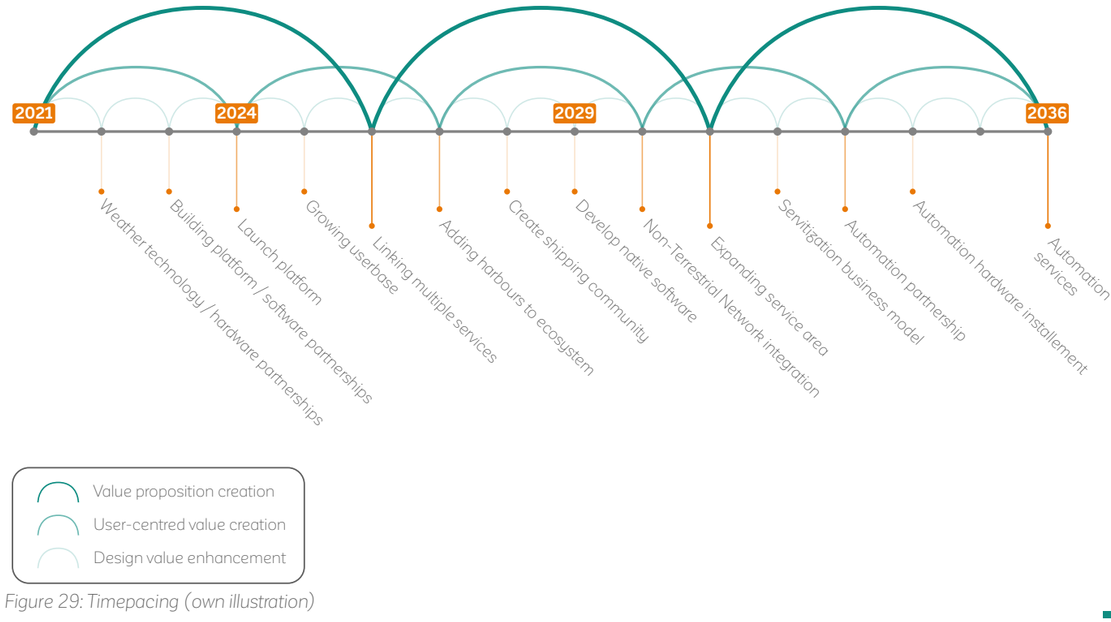


Figure 29: Timepacing (own illustration)

11.3 Horizon 1

Building the platform

The purpose of the first horizon is to realise the platform (see Figure 30). For this, the right partnerships must be established, the necessary digital infrastructure must be created and the right users must be targeted for the platform.

Vision

Maritime platform where ship operators can share data with each other and make data-driven decisions to improve the efficiency of their fleet.

Within the first horizon, ship operators are supported in generating, sharing and using data within their process. This will enable ship operators to make more data-driven choices and thus improve the entire process. As a result, they can get more out of their fleet with the same resources.

Market

Within Horizon 1, the focus will mainly be on the smaller ship operators within the Netherlands. These operators have several ships in their fleet and would like to benefit from new technologies and greater efficiency, but do not have the resources to do so on their own. By not becoming too dependent on a certain ship supplier and only using the technologies they offer, it can be interesting to use the platform KPN offers. This allows the ship operators to take advantage of different technologies, without being dependent on the innovation of a single company.

Product / Service

Since the focus for Horizon 1 is on realising the platform, the products and services required for the ecosystem and platform are delivered. The products mainly concern the hardware that is delivered, such as sensors, receivers and data storage. The services are more to be found in the software and models that can be used on the platform and the connectivity that is offered. The software can be divided into two parts, namely the software needed to make the platform usable and the software that converts the data into usable insights. The first category includes databases, interfaces and security. The second category ensures that value is created on the platform, and here one can think of mathematical models, analysis software and artificial intelligence. The connectivity simply ensures that all components can be linked together.

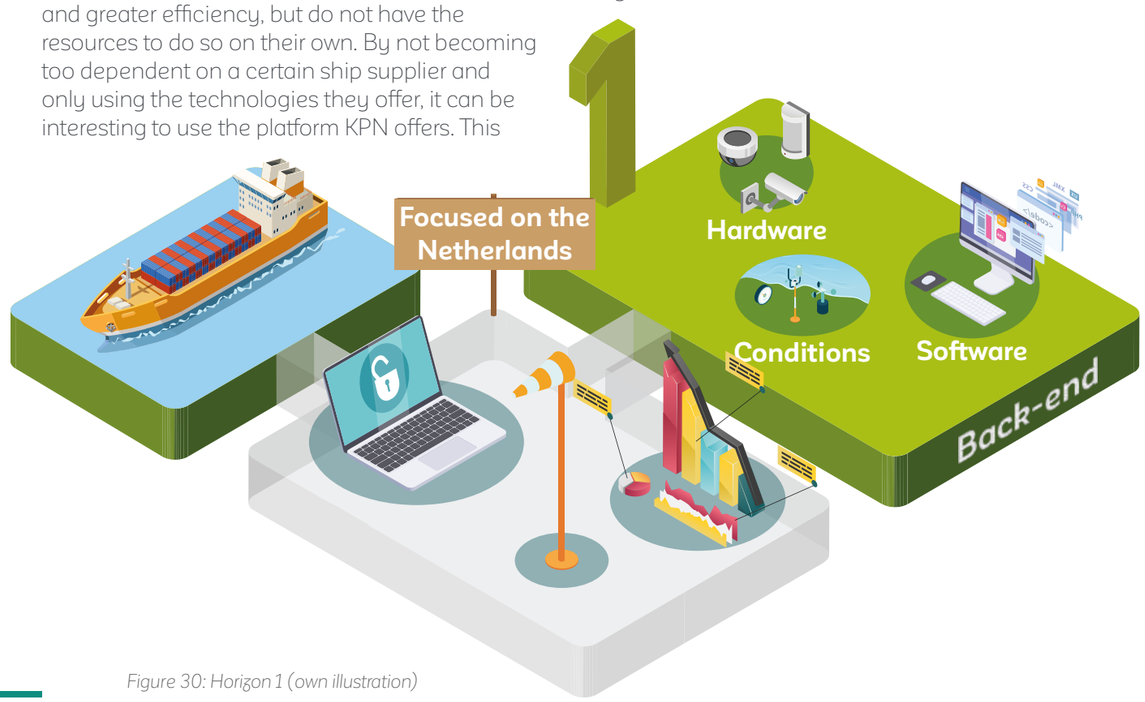


Figure 30: Horizon 1 (own illustration)

To ensure the value of the platform first, the hardware will be sold as a one-time purchase collectively with software as a service. This gives KPN some time to establish the ecosystem first, before making hard promises to their customers, which would be needed if sold as a completed service.

Technology

Most technologies used in Horizon 1 can be traced back to products or services provided in this horizon, described above. One can think of the connectivity and thereby create and optimise the network. KPN will provide this. In addition, KPN provides the technology for improving the local weather forecast.

In addition, software must be developed or supplied to perform analyses. These include data processing, machine learning, blockchain and artificial intelligence. Exactly which technologies are used on the platform depends on what is possible and what the needs of the users are, but examples could be fuel consumption analysis or shipping route improvement. To deliver the technologies needed for the analyses, KPN will have to collaborate with the relevant software developers within the ecosystem.

Partnerships

For Horizon 1, the different partners needed are already described in Chapter 10; key partners. By working together with these described partners, the platform can be created and ensure that it creates value for users.

To give some more clarity on what kind of partnerships these can be, possible hardware and software suppliers will be briefly highlighted. This will create starting points to work with when developing the platform and ecosystem. Hardware suppliers could include sensor providers, like Sensor Maritime or engine suppliers like Rolls Royce Marine. For the software developers KPN can think of Contexta360, to analyse voice communication, or Ocean infinity, to run analysis based on the maritime sector.
Besides suppliers, KPN can also collaborate with users to develop the ecosystem and platform. KPN can use their insights and expertise to be able to develop the ecosystem correctly.

Business model KPN

As described in Chapter 10, KPN will provide connectivity and data security within the ecosystem. This will be done based on a monthly subscription for both. In addition, KPN will select and test the appropriate hardware. For the testing of the hardware, part of the income for the hardware will be for KPN. This is a one-time transition. This may be supplemented by the cost of installing the hardware.

Strategic advantage KPN

Looking at why KPN should be the one to respond to the need outlined earlier, one can look at the strategic advantages of KPN within the concept. In the first horizon, the most important is the position KPN has within the market for marine radio in the Netherlands. As described earlier, this position is considerable and makes it difficult for competitors to copy the proposed ecosystem. When this is combined with the digital infrastructure KPN already has in place from the Data Service Hub (DSH) that enables real-time analytics, it gives KPN a good strategic advantage over competitors. In addition to the digital infrastructure, the service and expertise that are available due to the DSH can be used to support the customer as much as possible. This provides KPN with the right starting position to initiate the ecosystem.
In addition, KPN can use the knowledge gained in the Fieldlabs, such as automation and data analysis, to apply to the maritime sector. Through these Fieldlabs, KPN already has partnerships with several parties that can add value to the ecosystem. This makes it easier to involve companies in the ecosystem. This, combined with KPN's neutral position in the maritime sector, makes KPN a suitable company to set up this ecosystem.

11.4 Horizon 2

Growing the platform

The goal for the second horizon is to grow the platform and thereby the ecosystem (see Figure 31). This means looking for new users, both ship operators and ports, and growing the services on offer. This can be achieved both by collaborating with new and current partners and also by KPN developing its own software.

Vision

Maritime platform where ship operators can share data with ports and streamline the docking process to expand their data-driven decisions.

By adding the ports in the second horizon, ship operators can now also be supported in making data-driven choices within the ports. In addition, the ports can be helped to make optimal use of the data provided, so both ships and ports can benefit from it.

Market

Within the second horizon, Dutch ship operators remain an important market and must be involved in the ecosystem. In addition, in this horizon, efforts will have to be made to get ports within the Netherlands on board. Because of the ship operators already involved in the ecosystem, it is becoming increasingly interesting for ports to get involved as well. With this involvement, the ports can better prepare themselves for the arriving ships and thus reduce the docking time and increase the efficiency of the port. With this added value for the ports, it creates the potential to have a new set of customers as well.

Product / Service

For Horizon 2, the products and services provided are similar to those in Horizon 1, only some additions are made. By adding the ports, it will also be necessary to deliver software and hardware to these stakeholders. This is to ensure that the ports can be smoothly incorporated into the ecosystem. This also applies to any functions or analyses that are added to the platform. For example, to link multiple services to the platform, such as the delivery of goods to the ship. These delivery companies will need to be enabled to be properly included in the ecosystem and make use of the data that is generated.

Because the platform has already been set up in Horizon 1 and has proven its value, it may become interesting for KPN to start selling efficiency instead of using the platform, so-called servitization (see Chapter 3.2). This appeals more to ship operators because it is clear what they get for their money and offers the partners the opportunity to innovate to achieve the goal. This does require a change in ownership within the platform. As a result, the ecosystem provides all hardware and software as a service, and ownership remains with the original suppliers. With the addition of the ports, this efficiency is also achieved on multiple levels, which only makes it more attractive to ship operators.

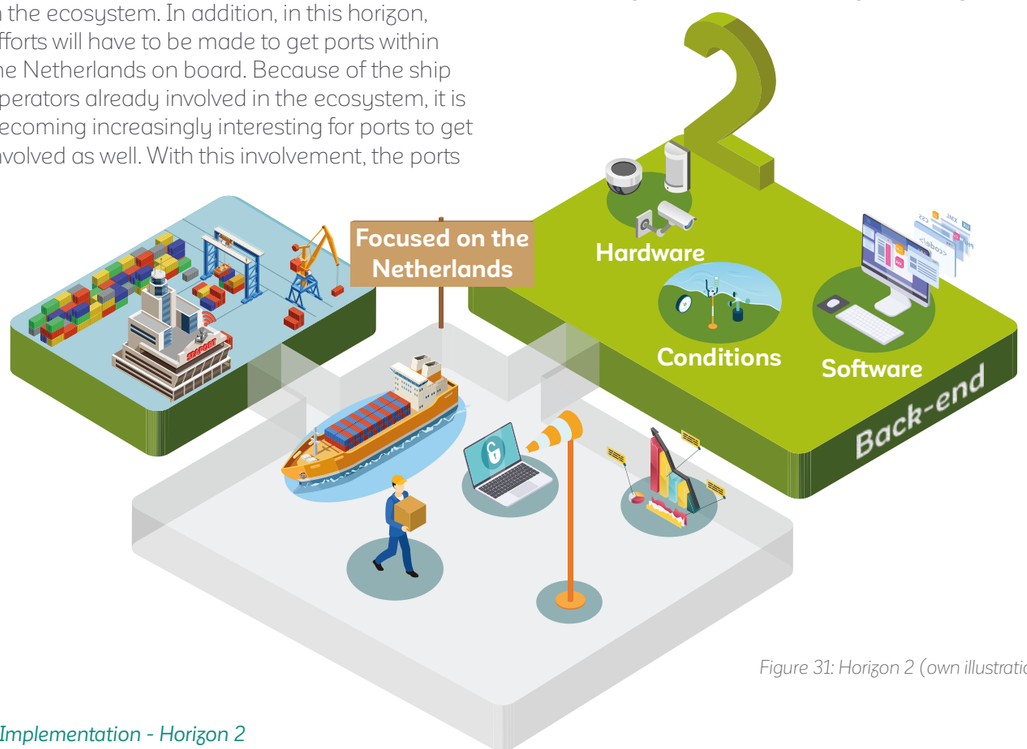


Figure 31: Horizon 2 (own illustration)

Technology

To make Horizon 2 possible, it will be necessary to invest primarily in technologies that ensure smooth communication with third parties. This will mainly be an addition to the technologies already used in Horizon 1. This will include ports, but also other companies such as delivery companies. For the ports, it will be especially important that there is good communication with the Port Community System (see Chapter 4.1). In this system, ports register and manage different aspects within the port and this will therefore need to work smoothly with the platform. This also creates the possibility of using the data from the port within the ecosystem. For example, by using data from sensors placed in the port to enrich the data in the platform, better analyses can be carried out. The port can then also enrich its data with the data from the platform, so everyone benefits if this data sharing goes smoothly. For other third parties, away will have to be found to share data safely, but in real-time. If this is done properly, it will enable the third parties to improve their service to the ships. Of course, data safety and privacy will have to come first.

To reinforce KPN's strategic advantage, it will be necessary to develop native software that can be used on the platform. For this purpose, KPN will have to investigate what needs are present on the platform and what KPN is capable of delivering. By developing this, KPN ensures that the share they have in the platform, and thus in the ecosystem, increases. This assures KPN that when the connectivity is provided by other partners, as in Horizon 3, they will remain a relevant stakeholder within the ecosystem

Partnerships

For Horizon 2, the partnerships already established in Horizon 1 must be built upon. The first collaboration for this horizon is with the ports within The Netherlands, even though the ports will be paying for the service. They will have to be involved in the ecosystem and close cooperation is very important. This ensures that the effect that can be achieved can be maximised. In addition, partnerships can be sought that add extra functions to the ecosystem, such as the delivery companies discussed earlier. To ensure that all the components fit together properly, input from both sides will be required. This way, all requirements can be met and the maximum result can be achieved for the user. This applies to all extra functions that are added to the platform. By entering into partnerships, the functionality can be expanded easily and quickly.

Business model KPN

As in Horizon 1, KPN will continue to provide connectivity and data security on a monthly basis. In addition, KPN will provide software to the ecosystem on a pay per use basis. With this, KPN generates an additional revenue stream for itself. The biggest change in the business model is through servitization. This means that the products are delivered as a service and the ownership remains with the original supplier of the product. This means customers pay for efficiency instead of getting the tools to improve efficiency. This gives the user more security and the suppliers more freedom to innovate. With this change, there will only be monthly charges for using the platform for the customer, all of which will have to be paid to KPN. KPN will then have to make a distribution of this revenue between the various suppliers within the ecosystem. Whether this is feasible and financially attractive will have to be investigated further in the future when there are fewer uncertainties.

Strategic advantage KPN

In the second horizon, KPN's strategic advantage is mainly based on the fact that the ecosystem has been operational for some time. This means that various stakeholders are already involved and a lot of data is already available within the platform. This makes it more tempting for new parties to join KPN Fleet rather than starting a new ecosystem. In addition, by providing the platform, KPN has gained more experience within the maritime sector, experience that can be used to fulfil new needs. This combined with the strategic advantage KPN already had in the first horizon enables KPN to maintain its strategic advantage over competitors. Besides, KPN can develop its own software, with which analyses can be performed, that can be implemented within the platform. This will allow KPN to further expand their strategic advantage.

11.5 Horizon 3

Expanding the platform

The goal for the third horizon is to expand the service area of the platform and to offer the possibility of automation (see Figure 32). This will require looking at the right way to expand connectivity, either by expanding the KPN network or by involving new partners. Besides, stakeholders who have the technology for automation will get involved.

Vision

Maritime platform where ship operators use non-Terrestrial connectivity to broaden their scope and have access to the essentials to automate processes.

By adding non-Terrestrial connectivity, ship operators can now also be supported outside the Dutch borders. In addition, automation services have been added, enabling ship operators to make progress with automation. All to ensure that they can operate more efficiently over a larger area.

Market

For the third horizon, the target market can be increased due to the larger service area that can be offered. This means that both foreign ship operators and ports located abroad can be targeted. Since the service has already been developed for the Dutch market, adding foreign parties should not pose major challenges.

Product / Service

The products and services provided in Horizon 3 can be seen as a further extension of Horizon 2. Expanding the service area means that new suppliers are also needed to provide the right connectivity. This will require new hardware as well as new software to ensure a smooth transition between the different networks.

By adding automation capabilities, the efficiency is sold as a service in Horizon 2 can be changed into automation. This will make ship operators pay for the end result, i.e. a process carried out, rather than a more efficient process. As in Horizon 2,

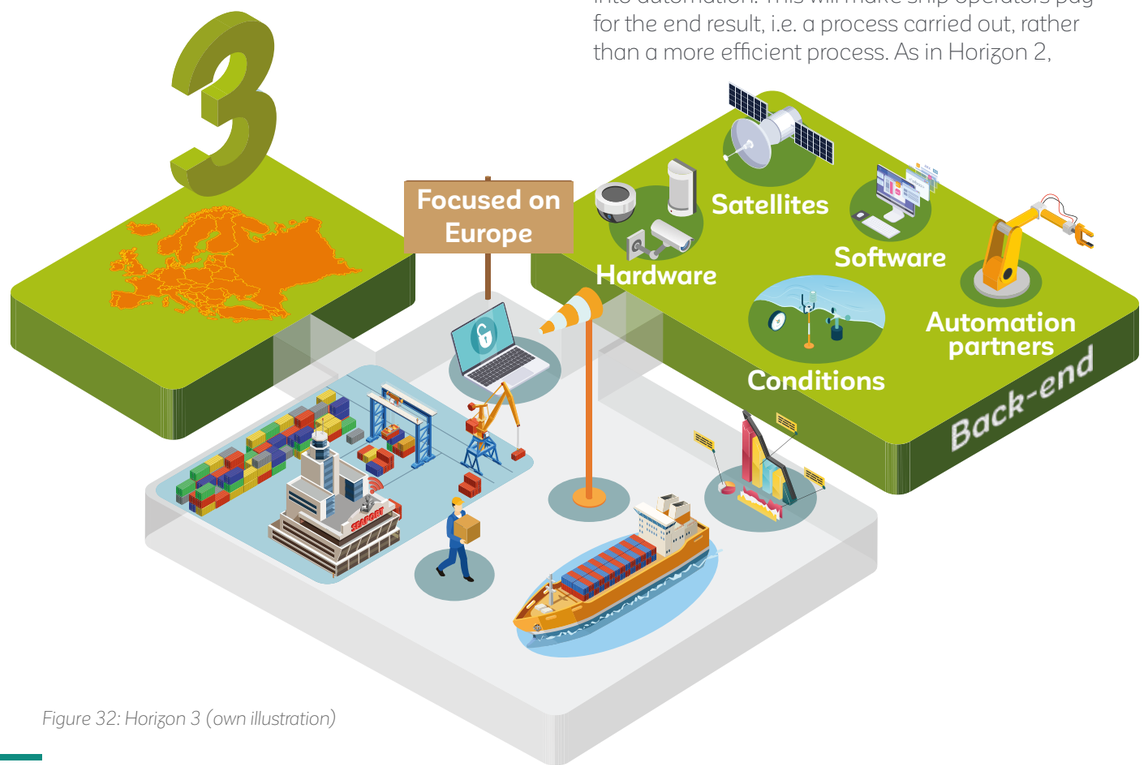


Figure 32: Horizon 3 (own illustration)

the delivered products remain the property of the original supplier. This is attractive for users because they no longer have to buy products themselves and know exactly what they are paying for. In addition, suppliers get more freedom to innovate and optimise and can better monitor the results of a particular innovation step. For this step to be realistic for KPN, they will need to be sure that they or the partners in the ecosystem are able to complete the set task.

Technology

To realise Horizon 3, a lot of innovation and technologies are needed, both in terms of connectivity and automation.

For connectivity, satellite technology should be the main focus. Satellites offer the great advantage of being able to provide connectivity everywhere, making switching between different networks unnecessary. At present, satellites do not yet meet the requirements set for the ecosystem (see Chapter 3.4 &5.4), but this is expected to change in the future. In addition, entering into a partnership with a company that can provide an NTN could be interesting for KPN itself, because it would allow KPN to fill any gaps in its network in the Netherlands.

Different technologies will be needed for automation, certainly, because different processes can be automated. It, therefore, depends on which processes are automated, which technologies and supplies are needed. This could involve robotisation, the use of robots to carry out certain tasks, but also, for example, systems that automatically register or place orders for the ship.

Partnerships

In addition to the partnerships that have already been established in Horizons 1 and 2, cooperation will have to be sought particularly to provide greater connectivity and achieve automation. For connectivity, KPN can look at other telecommunication providers that have networks abroad or at Non-Terrestrial Networks. The latter is preferred, as NTN's can also offer connectivity at sea. For automation, it is especially important to see which developments have potential and to enter into partnerships with the companies that develop them. For now, it is difficult to say which ones they are, because of the major uncertainties. This will have to be addressed at a later stage.

Business model KPN

For the third horizon, the business model of Horizon 2 will be built upon. Because automation becomes important within this horizon, KPN can also start selling automation instead of efficiency. As a result, customers pay for the end result of the process, instead of improving the process. Customers pay KPN a monthly fee that is then distributed by KPN among the stakeholders involved. The biggest change is that the cost of connectivity will have to be shared with the NTNs. This was not the case before because KPN was the only provider of connectivity. The data handling and security will be provided by KPN. For the other revenues of KPN, there will be no major changes compared to Horizon 2.

Again, the feasibility of selling fully automated processes needs to be examined. This is highly dependent on the development of the technology and which partners are involved in the ecosystem.

Strategic advantage KPN

In the third horizon, part of the strategic advantage that KPN has is lost as the connectivity is provided by other partners. With this, part of the digital infrastructure is also provided by these partners. On the other hand, the digital infrastructure provided by KPN to run real-time analysis will be used to process the generated data. Besides, KPN has been developing software from horizon one onwards to perform analyses on data. Ensuring that it is more difficult to copy the concept without KPN, giving KPN a strategic advantage over their competitors. In addition, the platform and therefore the ecosystem have been operational for some time. This means that there are already many stakeholders involved and a lot of data available within the platform. Such a network effect is difficult to imitate from the start. Therefore, new competitors will have to compete with an ecosystem that generates more value. In addition, by using AI for automation, the knowledge KPN has gained in the Responsible AI Lab can be put to good use. This can ensure that the AI that is deployed, is used responsibly. This can be further supplemented with the knowledge gained in automation from the Fieldlabs that KPN has, increasing the strategic advantage KPN has over their competitors.

11.6 Tactical Roadmap

Step-by-step towards the future vision

The three horizons described are summarised in the tactical roadmap shown in Figure 33. The tactical roadmap entails more detail to support the steps towards the implementation of the concept. Therefore, this tactical roadmap can be used for internal communication at KPN to ensure that project and program managers know what they need to work on.

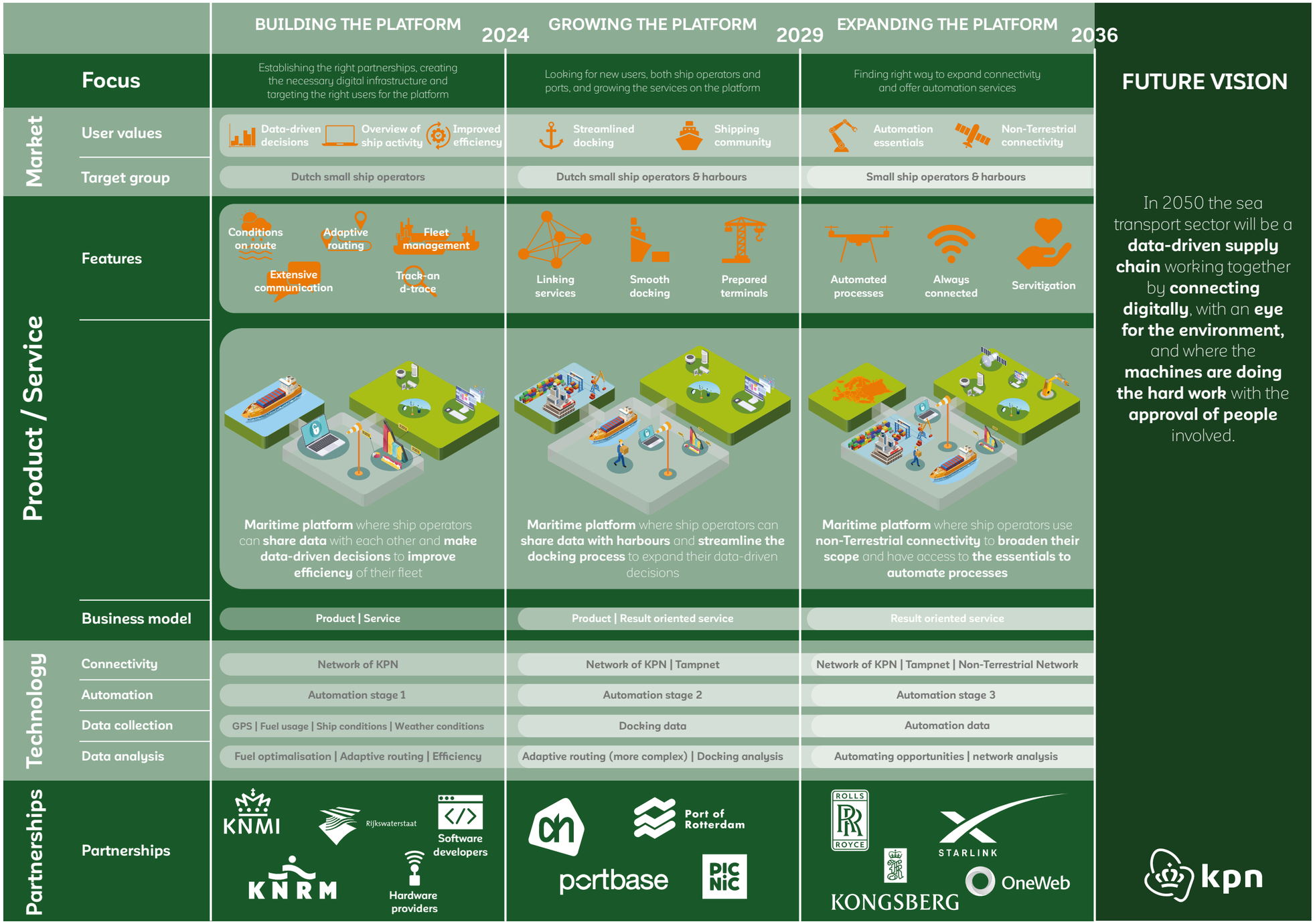


Figure 33: Tactical roadmap (own illustration)

12 EVALUATION

Evaluating the concept with multiple people within KPN

To reinforce the concept and investigate how the solution was viewed internally, several interviews were held with different employees of KPN. The feedback from these interviews has been incorporated into this chapter. This feedback provides KPN with leads to continue with the project at a later stage.

12.1 Employee evaluation

KPN's view on KPN Fleet

In order to receive feedback and get a good idea of how the KPN Fleet is viewed from different perspectives, various people working at KPN were interviewed. The focus was on people who in their daily jobs focus on the long-term strategy at KPN or who have a link to the maritime sector. The aim was to get a complete picture of what is good about the concept and which parts need more attention. To get a better idea of this, the complete concept was presented during the interviews, both the starting point (see Chapter 9.2) and the strategic roadmap (see Chapter 11). After presenting the concept, a variety of questions were asked and the concept was discussed further. The interview guide and presentation used for these interviews can be found in Appendix I.

The people that were interviewed about the concept are working as an Innovation Strategist, Executive Vice President (EVP) 5G, two Technology Leads for the Fieldlabs, two Commercial Product Managers for Internet of Things (IoT), and a Business Consultant Strategy &Finance. The feedback received from these people is discussed and how this may influence the further development of the concept. To provide an overview of the feedback, an attempt has been made to summarise it into various points that emerged from several interviews.

Deliver something extra

Something the interviewees all agreed on is that the idea fits very well with KPN's strategy of providing something extra on top of the connectivity they offer. It was acknowledged in the interviews that KPN needs to deliver more than connectivity to differentiate itself from other network providers. These additions should be based on the strengths that KPN already possesses and therefore connectivity should always be part of an idea. The connectivity should be a tool to help achieve a certain goal or help a certain business, not the end goal or end product.

"Then you just make sure that you are going to further exploit your installed base and that you are going to offer added value on that installed base."
Innovation Strategist

KPN as a connector

Secondly, it became clear from the interviews that KPN is seen as a connector within the Dutch society. This means that KPN can bring together many different companies to tackle a particular challenge together. To do this, KPN's neutral role as a company is seen as crucial. This is to prevent partners from getting the idea that KPN is biased or that they have to compete with KPN instead of working together. In addition, KPN can make good use of their strength in delivering generic and scalable solutions to get everyone working together. The concept presented fits this role of KPN very well.

"We are neutral and can use this neutrality to provide added value in terms of sustainability, i.e. to make data from other ships transparent for the entire platform."
Innovation Strategist

"I think you have correctly seen the role of KPN as an orchestrator, i.e. a party that can bind various parties together and that is independent. I think you use that strength very well."
Commercial Product Manager IoT

It was noted, however, that KPN finds it difficult to have the leading role in developing a new solution or collaboration. There are often certain needs and developments in a market, so it is necessary to respond to them. KPN is often too far removed from the sector to be able to sense or understand what these needs are, which makes it difficult to respond. As a result, KPN often looks for a specialist partner who is more involved in the sector, and KPN then helps that partner to innovate in the back end. This would also be something to consider when continuing the concept.

"In my opinion, KPN does not usually pull the cart, because there are always parties that have more understanding of a specific sector. They are actually the feelers, eyes and ears in the sector."
Commercial Product Manager IoT

Platform thinking

Thirdly, platform thinking was seen as a very interesting development for KPN that can be capitalised on in the near future. One of the interviewees said that this is a development that is taking shape in more and more sectors and that it is, therefore, important to respond to now. This is to prevent KPN from waiting too long and thus losing the opportunity to become involved in these types of ecosystems. During the interviews, the view on this platform way of working was mentioned by various interviewees.

"We see this kind of data platform coming back a lot, it is becoming more and more urgent."
Technology Lead Fieldlabs

"This is spot on, this is the way we want to go, platform thinking."
Innovation Strategist

"Eventually when you start sharing data with multiple parties, that's when you start winning."
EVP 5G

Another interviewee stated that KPN is already involved in an ecosystem in which the exchange of data ensures that all parties involved benefit. This ecosystem is working in the transport and logistics sector. Various parties are collaborating to develop a joint proposition to support different developments in for instance the Port of Rotterdam.

"I am talking to several parties in the market to think about a joint proposition with which we can support the Port of Rotterdam Authority in the field of, for example, autonomous sailing."
Commercial Product Manager IoT

Food for thought

It also emerged that the idea triggered a certain way of thinking, which fits well with the direction KPN should be heading. The way of thinking to look for a solution in a field in which little is available yet, based on the strength of KPN, but more than just connectivity, provides a good direction. A direction that is interesting for KPN and can ensure that they remain relevant in the future. Because of this, the idea also triggers new initiatives to investigate what would be possible when different parties are brought together.

"I like your idea of creating such a data platform in an area where not everyone is active yet. I see very few developments in this area yet, so we (KPN) do have an opportunity."
EVP 5G

"You've given me an idea, I think I can get a couple of parties together to find out."
EVP 5G

Specialist market

On the other hand, several interviewees noted that it is a very specialised, new market for KPN. A lot of knowledge is required to enter and the generic solutions that KPN currently offer might make it difficult to make such a solution a reality. For this, KPN would have to look for a partner that has more substantive knowledge of the sector. This would allow KPN to jointly market a certain solution.

"We (KPN) are good at the generic picture, but will never reach the level of expertise of a market expert."
Commercial Product Manager IoT

Small market

In addition, there were some doubts about the size of the market that could be served with this solution. For such an idea to be profitable for KPN, the market that can be served must be able to generate at least 50,000 customers. Otherwise, too much would have to be invested for a too-small source of income. However, KPN could investigate whether a solution can be applied to several small markets without additional investment so that the required market can still be served.

"I also have some doubts about the scalability. You have to cross borders quickly if you want to serve a large market, which is a challenge for KPN. How big is the potential that you have in the sector? 8,000 boats are peanuts for KPN."
Business Consultant Strategy & Finance

Maritime sector

Finally, there was some question from the interviewee as to how suitable the maritime sector was for KPN. Although it was recognised that it is a large and interesting market, it was also seen that it is very internationally oriented. So to make it profitable to realise such an ecosystem, a solution will have to be offered that can be deployed internationally. In addition, KPN currently has little knowledge about the sector, which makes it difficult to take the first steps. As a result, one of the interviewees indicated that the idea would be very interesting for KPN, but that KPN would rather look at another sector to apply the idea.

"Fits within the vision I have for KPN, but I would not initially apply it to shipping."
EVP 5G

Conclusion evaluation

To conclude, there was a predominantly positive response to the presented concept from the various sides. The way of thinking matched very well with the vision that KPN has for itself for the coming years. The concept is seen as a real opportunity for KPN to generate extra revenue. In addition, the concept is based on KPN's strengths and is in line with the developments observed in the market. On the other hand, there were some doubts about the specific market in which this is applied, about its size and the expertise required to enter the market. For any follow-up steps, these are two considerations that should be taken into account and investigated. This can ensure that in addition to the idea being a good fit for KPN, it is also profitable for KPN.

13 CONCLUSION

Concluding the project, determining future research and reflecting on personal experience

This chapter concludes the project and considers future steps to be taken. First, the project conclusion will be discussed. Then, the recommendations for possible future research needed to further develop this concept will be highlighted. Finally, the conclusion of my personal process and experience of the entire graduation project is drawn.

13.1 Project Conclusion

Overview of the project

There are a lot of changes going on in the maritime sector, due to the opportunities created by data collection and new technologies. These changes within the sector are to ensure that the sector remains competitive. Therefore, the sector is looking to implement new technologies and data-driven choices. Although everyone is working on these developments, not every company is at the same level. For some companies, this creates a high dependency on larger companies that are already further along. As a result, the larger companies within the maritime sector have more influence and can therefore also determine the speed of innovation.

To help these companies take advantage of the opportunities offered, KPN can use its data handling capabilities to help these companies to implement data-driven choices. Besides, this offers KPN the opportunity to add value to the maritime sector. KPN will have to focus on its strengths but will have to add more than just connectivity. The research has shown that simply providing connectivity is not enough, so additional products or services need to be delivered on top of connectivity. This will allow KPN to reduce the risk of being replaced by a competitor and ensure they are seen as a valuable addition to the sector. To deliver additional services, KPN must build on its strengths by focusing on automation within the maritime sector by enabling data-driven operations. To ensure that KPN can make the best use of its capabilities, the first business proposition should be focused on the Dutch maritime sector.

To take the first steps for KPN in enabling data-driven operations within the maritime sector, KPN Fleet was designed. KPN Fleet is the ecosystem that allows small operators to take advantage of all the new opportunities offered by data and technology. By combining its knowledge and its partners, KPN can create an ecosystem with all the necessities to implement new technologies and data in the daily operations of ship operators. By doing so, KPN can expand its position and capitalize on current developments in the maritime sector. By enabling data-driven choices for the stakeholders, KPN can help with automating various processes. This allows KPN to generate additional revenue to recoup investments in its network. Besides, it can generate valuable knowledge which KPN can use in other sectors. Additionally, the developments within the sector fit well with the vision KPN has for itself, namely to help other companies to operate better and more sustainably by making use of technologies.

The evaluations with KPN employees show that thinking in an ecosystem is becoming increasingly important and is seen as an opportunity for KPN to remain relevant in the future. In addition, it uses the capabilities KPN already has to create more value. In general, it triggers a certain mindset that is beneficial for KPN. Additional research is needed to ensure that KPN and the maritime sector are developing a good fit. The usefulness of the concept for other sectors can then also be investigated. This allows KPN to supplement the small market of Dutch ship operators with additional markets.

To conclude, KPN Fleet is an interesting concept for KPN to implement in the maritime sector. When the concept is developed further, KPN can grow its position within the maritime sector. Besides, it can help KPN with acquiring knowledge for other sectors they are involved in. When automation knowledge is gained throughout the maritime sector, KPN can use that knowledge in, for instance, the automotive industry to help that sector to automate. By devising a strategy to do so, KPN can increase the gains for themselves. This ensures that even if KPN would be replaced within the ecosystem, excluded from the ecosystem or copied by a competitor, the investment needed for the ecosystem would still be worth it.
Besides, implementing the concept gives KPN more experience in developing a data space, a development that is increasingly taking shape in the European Union legislation. A data space allows companies to share data more effectively and therefore work together. The presented ecosystem could even be further developed into the data space for the maritime sector. Something KPN should do more research on when continuing.

13.2 Future Research

Limitations & future steps

Due to the time restrictions for this project, not all aspects of the design could be worked out completely. Because of this, it will be necessary for KPN to work out certain parts when they want to continue with my proposed concept.

The first thing to look at is the specific analyses that can be included in the ecosystem at this moment. KPN must look at what data is available and what kind of analysis can be applied to this data. The first draft of this has been made in this report, but it should be extended further with specific companies. This will give KPN a complete overview of which partners need to be involved in creating the ecosystem. Besides, it allows KPN to select the right partner to work with, one who knows the sector better.

Secondly, KPN will have to look for suitable pilot customers with whom the ecosystem and platform can be further shaped. One example is Rederij Groen, a shipping company with which KPN already has contact. The selection of such a user will have to be based on the size of the company, but also on their willingness to think along with KPN and apply new technologies. By selecting a large enough company or companies, one can ensure that all aspects can be included in the design.

Thirdly, all of KPN's capabilities must be translated into the ecosystem. Even though I have tried to get a picture as complete as possible of what KPN can offer, there is always a chance that parts have been overlooked. Forming a team to work on the creation of the ecosystem will ensure that all necessary and useful strengths can be combined. This will allow KPN to get the most out of their capabilities and ensure that as much value as possible is added.

Fourthly, KPN's business model will have to be examined carefully. KPN will have to look at what is a feasible price for the service provided and how this can be matched with the investments that need to be made. To guarantee the market is big enough to pursue, additional market research is necessary. This could also result in a different market where the concept or the acquired knowledge could be used. To do so, KPN should research which sectors or industries would be fit to do so. By doing so, it would ensure that the investments needed to realise the ecosystem are worth it for KPN. In addition, KPN can examine whether it is financially attractive to deliver the platform as a complete service, as in horizons 2 and 3, instead of additional services.

Lastly, KPN could research the possibility to apply their knowledge and experience in data space to the ecosystem. By integrating standards and enabling the safe sharing of data, the ecosystem could be used to build or design the maritime data space. In the best-case scenario, the ecosystem could function as the maritime data space in the future. Creating such a data space would be a great opportunity to stay relevant. To determine whether this would indeed be possible and whether this is an interesting approach for KPN, more research will have to be done to clarify this.

13.3 Personal Conclusion

A 5 month journey

To conclude the project, I briefly look back on my personal experience during this project. There are things that went well and points that I learned from the project. These lessons can be taken into account in future projects.

First of all, I am very happy that I had the opportunity to go to the KPN office or to work at the faculty. This allowed me to speak with fellow interns, fellow students or colleagues from my department. Besides being nice to have social interaction, it also improved my work. A brief discussion can lead to a lot of new insights that can be applied to the project.

Additionally, the cooperation with KPN was very good during my graduation. I could easily approach people and they were often open to discuss my project; sending a message was often enough. I felt that I was taken seriously and that people were genuinely interested in my project. This made working on the project a lot more pleasant. The interviews I conducted with employees always gave me new insights and helped me take steps within my project. The pleasant cooperation also ensured that I was able to get a good picture of KPN and what they were capable of. This enabled me to match the design well with their current capabilities, but also to challenge them enough to innovate.

In comparison to the interviews with employees of KPN, interviews with external companies required a lot more effort to get people to talk to me. Although the interviews I had provided me with useful new insights, I mistook the time it takes to plan these interviews. If I would have anticipated this quicker, I think I could have had more interviews with companies and therefore gain more insights. In future projects, I will start making contact and approach suitable people sooner.

Speaking to more companies could have helped me with getting a grip on the maritime sector. It is a very large sector that was completely new to me. As a result, never everything can be explored, although, in future projects, it is good to set a good scope. This makes it clearer what belongs to the scope and time can be spent understanding it. This in turn can help to conclude earlier in the process.

Besides, the project gave me enough of a challenge because of its technological approach. I find technology very interesting and like to dive into a subject to find out more about it. This project certainly allowed me to do so and that made the subject fit in well with my personal interests. The fact that it fitted in so well made it easier and more interesting to work on the project.

For future projects, I will better apply time management to plan the project. The search for a suitable design space was a challenge in my project, resulting in little time left over for working out the details. In the future, I will be able to conclude more quickly, especially if it becomes clear that what the customer asks is not correct. By bringing this up more quickly, more can ultimately be achieved. This is also advantageous for the customer because a more complete project is delivered.

Overall, I can look back with satisfaction on the final result that I delivered. The concept fits in well with KPN and outlines an interesting direction for them to take. My project gives them various starting points to work with and to take steps in the maritime sector. Personally, a project always has its ups and downs, and this project was no different, but I enjoyed working on it and I have learned several things that I can use in future projects.

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15.1 Appendix A

Project brief

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

This document contains the agreements made between student and supervisory team about the student's IDE Master Graduation Project. This document can also include the involvement of an external organisation, however, it does not cover any legal employment relationship that the student and the client (might) agree upon. Next to that, this document facilitates the required procedural checks. In this document:

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME
Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name: Emous
initials: KF given name: Koen
student number: 4388380
street & no.:
zipcode & city:
country:
phone:
email:

Your master programme (only select the options that apply to you):
IDE master(s): ( ) IPD ( ) DfI (x) SPD
2nd non-IDE master:
individual programme: - - (give date of approval)
honours programme: ( ) Honours Programme Master
specialisation / annotation: ( ) Medisign ( ) Tech. in Sustainable Design ( ) Entrepeneurship

SUPERVISORY TEAM **
Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair: Erik-Jan Hultink dept. / section: MCR
** mentor: Niya Stoimenova dept. / section: MOD
2nd mentor: Jeroen Cox
organisation: KPN
city: Den Haag country: Netherlands
comments (optional)

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..
Second mentor only applies in case the assignment is hosted by an external organisation.
Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

APPROVAL PROJECT BRIEF
To be filled in by the chair of the supervisory team.

chair Erik-Jan Hultink date 24 - 06 - 2021 signature

CHECK STUDY PROGRESS
To be filled in by the SSC E&SA (Shared Service Center, Education & Student Affairs), after approval of the project brief by the Chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total: _____ EC
Of which, taking the conditional requirements into account, can be part of the exam programme _____ EC
List of electives obtained before the third semester without approval of the BoE

YES all 1st year master courses passed

NO missing 1st year master courses are:

name date - - signature

FORMAL APPROVAL GRADUATION PROJECT
To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: APPROVED NOT APPROVED

Procedure: APPROVED NOT APPROVED

comments

name date - - signature

Facilitating the transition to electric, autonomous sailing project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 23 - 06 - 2021 30 - 11 - 2021 end date

INTRODUCTION **
Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

Products nowadays are being connected to the internet more often and predicted is that Internet of Things (IoT) could generate up to $11.1 trillion a year in economic value by 2025 (Manyika, Chui, Bisson, Woetzel, Dobbs, Bughin & Aharon, 2015). Connecting objects through the internet creates the possibility to let them communicate. In the future, IoT could lead to everything in the physical world being connected via the digital world. With the addition of sensing abilities and computer power, this could lead to automation, improved planning and communication, and reduction of costs for companies (Brous, Janssen & Herder, 2020), therefore leading to improved efficiency, productivity, and sustainability. Currently, the possibilities of IoT solutions seems limitless and are applied in a variety of sectors to create, for example, smart homes, smart cities, and smart healthcare. During this project, I will focus on the freight transport sector and research the benefits of IoT for this sector.
In the freight transport the first IoT solutions are already being implemented. Ships are being equipped with more sensors whose data is being analysed for further improvements. Today's IoT solutions can already improve ship and cargo tracking, better control of the fuel consumption, and predict maintenance more precisely. This already led to improved efficiency, productivity, and safety in the sector (Plaza-Hernández, Gil-González, Rodríguez-González, Prieto-Tejedor & Corchado-Rodríguez, 2020). However, applying IoT in this sector could even lead to zero-emission, autonomous ships in the future (Daduna, 2020). Currently, tests are being done on a trial-and-error approach to see what is possible and needed in the future infrastructure to utilise this potential.
KPN, a Dutch telecommunication and IT provider, is experienced in creating connectivity and processing data. This could help the transport companies to exploit the full potential of these IoT solutions. In addition, KPN has the goal to be the most sustainable telecommunication company in the world, and to help and inspire their clients to become more sustainable. Currently, KPN is doing research in different sectors to map the potential of IoT.
To provide connectivity on deep sea, required for autonomous sailing, satellites will be needed. Non-Terrestrial Networks (NTN's) use satellites to create a network which provides connectivity anywhere in the world. To take advantage of both the cellular network of KPN and the NTN's, integration of both networks is preferred. To do so, hardware suppliers must provide both the hardware for the satellite connection and the sensors on the ships.
To accomplish the goal of autonomous, electric sailing, all stakeholders such as transport companies, KPN, NTN's, hardware suppliers, but also harbours and governments, need to work together in an ecosystem, all focussed on their own expertise. Achieving this can be difficult and should not be forgotten when designing such an ecosystem. Besides the complexity it brings, it also creates a network of bundled knowledge focussed on the maritime sector, that can be used to solve future problems.
For KPN, the research into the maritime sector would pursue the ultimate goal of making autonomous, electric sailing possible at a global level. For this project, I will focus on the current developments within the freight transport sector and KPN's ability to contribute to the sector. Within this project, the aim is to design a value proposition for KPN and determine how they can contribute to the transition towards the electric, autonomous freight transport.
[1] Brous, P., Janssen, M., Herder, P. (2020). The dual effect of the Internet of Things (IoT): A systematic review of the benefits and risks of IoT adoption by organizations. Int. J. of Info. Manag., 51, doi:10.1016/j.ijinfomgt.2019.05.008
[2] Daduna, J. (2020). Automated and Autonomous Driving in Freight Transport – Opportunities and Limitations. Computational Logistics, 457-475. doi:10.1007/978-3-030-59747-4_30
[3] Manyika, J., Chui, M., Bisson, P., Woetzel, J., Dobbs, R., Bughin, J. & Aharon, D. (2015). Unlocking the potential of the Internet of Things. McKinsey Global Institute.
[4] Plaza-Hernández M., Gil-González A.B., Rodríguez-González S., Prieto-Tejedor J., Corchado-Rodríguez J.M. (2020). Integration of IoT Technologies in the Maritime Industry. DCAI 2020, 1242(1), 107-115. doi:10.1007/978-3-030-53829-3

space available for images / figures on next page

introduction (continued): space for images

image / figure 1: KPN is also involved in testing autonomous sailing in the harbour of Rotterdam

image / figure 2: In NTN's individual objects communicate directly with the satellites

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

Currently, we see two problems arising in the freight transport sector. Firstly, the emission generated by this sector accounts for 2,5% of global greenhouse gas (European Commission, 2014) and therefore the call for more sustainable solutions becomes stronger. Secondly, it is becoming increasingly difficult to find personnel to work on the ships, due to the long periods of time they are away from home (Chartered Institute of Logistics and Transport, 2019). This triggers the development within the sector to research the potential of electric, autonomous sailing. For my graduation, the aim is to contribute to a more environmentally friendly and autonomous scenario in the freight transport sector.
At the same time, KPN is searching for ways to make better use of their expertise and with that create more value for their corporate clients. Simultaneously, KPN wants to ensure that both they and their clients become more environmentally friendly. The maritime sector has potential for both and therefore, KPN is interested in autonomous, electric sailing. However, KPN does not have the expertise or resources to operate ships. KPN wants to contribute to autonomous, electric sailing with their expertise in networks and data handling.

Combined, this leads to the two research questions: "What are the current developments within the freight transport industry in terms of electric, autonomous sailing?" and "How can KPN facilitate the transition towards electric, autonomous sailing within the global freight transport industry?". By answering these the biggest opportunities can be highlighted and a value proposition for KPN can be developed towards the freight transport industry.

[1] Chartered Institute of Logistics and Transport (2019). UK Logistics Monitor 2019. Retrieved 16 Jun 2021 from https://ciltuk.org.uk/News/Latest-News/ArtMID/6887/ArticleID/22813/Logistics-sector-facing-severe-skills-shortage-in-
[2] European Commission (2014). Reducing emission from the shipping sector. Retrieved 16 June 2021 from https://ec.europa.eu/clima/policies/transport/shipping_en#tab-0-0

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

Design a service concept for KPN to facilitate the freight transport sector in their transition to electric, autonomous sailing on global scale. To provide some guidance and clarity, I will create a roadmap illustrating the necessary steps leading to this concept.

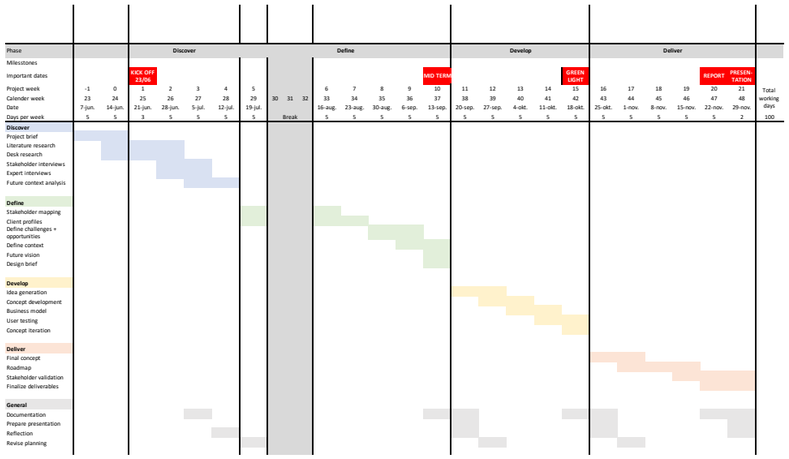
To design this ecosystem, I will start by investigating what are the current developments in terms of electric, autonomous sailing within the maritime and transport sector making use of a variety of learned methods, like for instance interviews, creative trends research and DEPEST. In addition, I will explore the possibilities for KPN to create value in this sector with their current expertise. Both literature and experts are consulted so that all contextual factors for the future context in which the design will be applied are clear.

With these context factors, I will create a future vision for an ecosystem to enable electric, autonomous sailing. Herein, I will determine the best opportunity for KPN to create value. Within this opportunity, I will design a service concept KPN could enroll the coming years. To make this future vision and service concept more tangible, I will design a roadmap that can help KPN to facilitate this ecosystem in achieving its goal of electric, autonomous sailing. With this future vision, roadmap and service concept, a strategy is illustrated for KPN to utilize the potential in the maritime sector.

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 23 - 6 - 2021 30 - 11 - 2021 end date



To plan my graduation, I will make use of the Double Diamond method of the British Design Council (2005). In the Discover phase, I will focus on the current situation and map what the possibilities are in the future. To get a complete overview, a desktop and literature research will be performed as well as conducting qualitative interviews. The findings of this research will be analysed in the Define phase and used to formulate the design brief. The design brief, including future vision, formulates what opportunities are present for KPN and should provides guidance during the Develop phase. These first two phases, Discover and Define, will be presented halfway the project during the midterm presentation.

In the Develop phase, the most promising opportunity will be selected and the first ideas will be created. These ideas can be validated with the different stakeholders and iterations can be made to improve design. In the last phase, the Deliver phase, the best ideas will be bundled in the final concept and the roadmap towards the final concept will be made.

A total planning of my graduation project is shown above in the Gantt Chart. As can be seen above, week 30 until 32 I planned my summer holidays, during these weeks I will not be working on my graduation project.

[1] British Design Council (2005). Double Diamond Design Process.

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

The demand for more sustainable solutions is growing and the time to comply is shrinking. I think technology could be a great tool to achieve a more sustainable world and at the same time enlighten people from certain tasks. Internet of Things is one of the possibilities which could do that. With my graduation project I would like to contribute to this possibility to see what is possible.
In addition, I want to gain experience in working at a company. During my studies in Delft, I did not do an internship and therefore have no experience in working at a company and work on a project for them. I think it could give me a better understanding for after my graduation.

For my graduation project, I will use various skills that I have gained in recent years. The skills that will come in handy during this project are:
1. Thorough research: In a project I like to know all the ins and outs of the subject
2. Commitment: When I start something, I want to finish it the best possible way
3. Working accurately: Creating overview and making sure everything can be found back

Besides, I have some competences I would like to develop or focus on during this project:
1. Go out and do
Sometimes I have the tendency to stick too much behind my computer, instead of going out and, for instance, interview stakeholders or try things in real situation. This sometimes results in a too theoretical design, instead of one that works well. To improve this, I want to go out more during my graduation.

2. Become more confident in own project / competences
In previous projects I sometimes was afraid to share my ideas because I thought people would not like them or thought they were not well worked out. Most of the time, those concerns arise from the lack of confidence I had in myself. During my graduation I want to try to share more and be confident in what I do. I think it can be useful to share my ideas, even if they are not finished yet, with people, so you can talk about it which results in a better design.
3. Ask for help

Due to the earlier point and the fact I sometimes feel I have to do things myself; I find it difficult to ask for help. Because I quickly think I am a burden to people I focus on myself and try to fix it myself. Even though asking for help may help me to deliver something better. To develop this skill, I will think before every meeting whether I need assistance with anything, both before a meeting with my committee and with my manager of KPN.

4. Argumentation for my ideas
During my studies I sometimes had trouble explaining to others what I meant exactly. So, in my head it was correct, but presenting it in a way people would understand and see it the same way, was sometimes difficult. Therefore, I would like to focus on my presentation skills and on my way of explaining during these presentations.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

15.2 Appendix B

Sustainable ecosystem innovation

To improve sea freight transport, sustainable innovations will be required from various parties involved. Based on Bossink (2013), sustainable innovation is the development of new initiatives at the firm "to sustain, improve and renew the environmental, social and societal quality of its business processes and the products and services these business processes produce". For most businesses sustainability issues are beyond their core activities and therefore it is a challenge for them to organize new managerial and organizational capabilities towards sustainability (Mousavi & Bossink, 2017). These managerial and organizational capabilities are often referred to as dynamic capabilities. And to innovate in a sustainable way, companies should not only focus on gaining a competitive advantage but also take responsibility for the sustainable aspect both internally and outside the organization (Iles & Martin, 2013). The dynamic capabilities include a variety of activities that can be clustered in three categories: sensing, seizing and reconfiguring (Teece, 2007). Sensing is the ability to identify and assess an opportunity, seizing is the ability to mobilize resources to address an opportunity and reconfiguring is the ability to continuously renew the resources. So, the ability of a company to innovate for sustainability depends on how well the company is able to adapt the complementary resources and competencies around an innovation opportunity, both individually and collectively (Mousavi & Bossink, 2017). Therefore, the dynamic capabilities help a company to not only invest in its own development but also in the business ecosystem to innovate towards sustainability.

To move cargo across the world, various parties operate in an ecosystem. As a result, companies depend on other parties to become more sustainable if the entire sector is to become zero-emission in the future. This makes it important to look at how a sustainable ecosystem can be achieved, for instance, a circular ecosystem. A circular economy maximizes the value of material resources and minimizes emissions, usage of resources, pollution and waste (Geissdoerfer, Savaget, Bocken & Hultink, 2017). For an ecosystem to become circular, a product, business model and ecosystem innovation will be needed. This can be done by pursuing five different strategies: narrow, slow, close, regenerate and inform (Konietzko, Bocken & Hultink, 2020-a). So, companies can use less material and energy (narrow), use products longer (slow), use materials again (close), use non-toxic material and renewable energy (regenerate) or inform about circularity (inform). In Figure 34 a schematic approach is shown how this leads to a circular ecosystem.

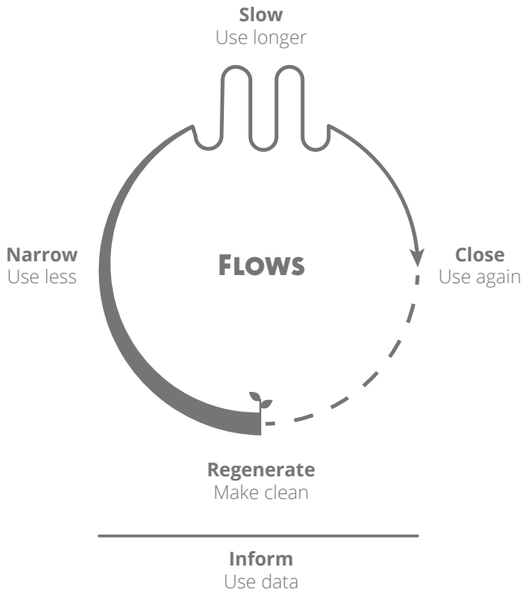


Figure 34: Circular strategies (Konietzko, Bocken & Hultink, 2020-b)

To successfully innovate towards such a circular ecosystem, three different principles can be used to implement circularity: collaboration, experimentation and platformization (Konietzko, Bocken & Hultink, 2020-b). These principles describe how firms can interact with other organizations in the ecosystem (collaboration), can organize a structured trial-and-error process (experimentation) and can organize social and economic interactions via online platforms (platformization). By implementing these principles companies can collectively innovate towards a circular and therefore more sustainable ecosystem.

When implementing sustainable solutions in an ecosystem, the innovating towards a circular ecosystem should be considered. This could increase the likelihood that the sustainable solution will be successful.

15.3 Appendix C

Trend analysis maritime sector

During the desk research different trends were found in the maritime sector. For finding these trends the DEPEST method was used. After finding the trends, they were clustered. These clusters were placed on the decision grid from the Design Roadmapping method (Simonse, 2017). The references for the trends, can be found in the references list.

Population is still growing

According to the projected population released by the UN the world population is growing, but at a slower pace than in the past. It is estimated to reach 8.1 to 9.0 billion by 2040. A higher population results in increasing demand for trade.

Source: UN

Increasing size of ships will continue

Bigger ships will have the opportunity to lower the transport costs and making use of the container space most efficient. This will help the sea freight transport sector to maintain a competitive position towards other forms of transportation.

By improving ship technology, structure and materials the shipping company can take advantage of the growth of these ships.

Source: Maersk c

Autonomous test are being done more

Unmanned vessels have also been top of mind for shippers. These game-changers could mean that ships can spend much more time at sea than human-controlled ones. Such innovation enables increased productivity, reduces reliance on human resources and is less prone to human error.

Source: Future NYC

Increased usage of big data and analytics

IT infrastructure will be upgraded to retrieve, store, and process data in real time.

Archived data can be stored either onboard a ship or onshore, thanks to the support of communication technologies. Furthermore, cognitive systems will act as data interpreters for humankind. These systems will combine machine learning and natural language processing to offer an intuitive interface between a person and a machine.

Source: Seatrade Maritime

Use of more advanced materials

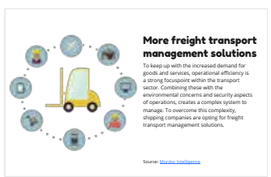
Developing advanced materials for ship applications will be a critical component of improving future ship performance. New features will be introduced, and multi-functional materials can be created.

Source: Seatrade Maritime

Increase of supporting systems

An increasingly connected ship will enable more data exchange and afford more shore-side support and vessel performance management. We will see more operational technology tools that unburden increasingly pressured seafarers onboard.

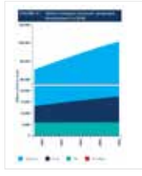
Source: Splash



More freight transport management solutions

To keep up with the increased demand for goods and services, operational efficiency is a strong focuspoint within the transport sector. Combining these with the environmental concerns and security aspects of operations, creates a complex system to manage. To overcome this complexity, shipping companies are opting for freight transport management solutions.

Source: Mordor Intelligence



Growing demand for world trade

The demand for transportation is primarily in response to the economic environment and population growth. Historically, there has been a close correlation between the growth in the gross domestic product (GDP) and the transport volume, which means that economic activities and trade are among the main drivers of the demand in transport

Source: World Maritime University

Workforce will need to be retrained

Given these projections, the importance of re-qualification and retraining of workers will be key in the successful transition of workers to this age of automation and technology

Source: World Maritime University

Uncertainty about trade negotiations

The maritime freight transport sector is highly dependable on the world trade and agreements made between countries. Currently, the US and China are negotiation these terms, but also the Brexit hasn't been completed yet. Both the agreements made within these conflicts, will influence the maritime freight transport.

Source: Research and Markets

Increase of solar and wind power solutions

To improve sustainability, the shipping industry is exploring renewable energies to power the ships in the future. To do so, solar and wind power is being implemented and tested with various solutions.

The most likely application for these technologies in commercial shipping will be systems to reduce fuel consumption by supplementing the existing power with wind and solar power.

Source: Maersk

Operations are being digitalised

The pandemic highlighted just how outdated the procedures and paperwork at ports really is. Measure to reduce cross-contamination led to the speedy adoption of digital forms – and in 2021, Brexit and new EU regulations will make digitization even more important. Digitization of maritime transport will help the industry respond to the increased demand with enhanced efficiency.

Source: shipChain & Xeneta

Implementation of robotics

There are three new types of robots that will be in use by 2030. The first will be a learning robot, the second will be a practical robot (one that can handle an asset), and the third type will be a mini-robot, useful for inspections in harsh, dangerous environments. These robotics will leverage: cognition, versatility, imitation, sense and adaptability.

Source: Seatrade Maritime

Workforce is ageing

In Europe an ageing workforce has created a mismatch between labour supply and demand. For the new created jobs are more young people needed, while the older employees are losing their jobs to new developments.

Source: World Maritime University

Skills needed for jobs will change

Highest potential for automation is in low-skilled jobs, which are intensive on predictable physical activities and data processing; therefore those jobs face a high risk of being impacted by automation. At the same time, the further introduction of automation will also create a demand for new types of jobs, such as remote operators, worldwide operating maintenance crews and mobility-as-a-service providers. As a result, the demand for labour will not completely disappear, but the requirements and skills needed for individual jobs will change.

Source: World Maritime University

Uncertainty about regulations for autonomous sailing

Regulations and legal aspects of autonomous maritime systems will present significant challenges. Autonomous systems will expose the constraints of current instruments and highlight potential future areas where additional, proactive regulation and governance will be beneficial.

Source: Lloyd's Register

Increased interest in LNG as fuel

It can help operators to meet the targets for reduced emissions, while also being competitive on price. CO2 emissions can be reduced by up to 25% when compared with diesel engines.

While conventional oil-based fuels will continue to dominate in the near future, there is likely to be increased adoption of LNG for specialist vessels, which gives an opportunity for the technology to be proved and developed on a larger scale.

Source: Maersk

Increasing demand for connectivity on board

Today, ships generate, collect and transmit an ever-increasing volume of data. To achieve efficient data transfer, wireless communications have been widely adopted for many years.

With the integration of 5G, WiFi and new generation satellites, as well as conventional marine radio communication networks, we will see transformation everywhere. Maritime 5G will play an important role for the remote control of autonomous ships in the future

Source: Seatrade Maritime & Future NYC

Increasing amount of automated processes

Automation that reduces reliance on mechanical and engineering crew and increases prediction and prescription capabilities of computer programs instead of human knowledge. This is not just the matter of having more sensors, but improving information technology analysis and decision making based on significantly richer data.

Source: Splash

Increased ship safety management

Safety on ships for both crew and cargo is been a focus point for the industry for multiple years now. To optimise this development, ship safety management solutions are more being implemented, which can be used to track the different things that are going on onboard.

Source: Maritime Logistics

Globalisation will continue

Many companies have already shelved pandemic-era reshoring plans, recognizing that concentrating production at home often raises costs without boosting resilience. Diversification across efficient domestic and/or foreign production locations, along with investments in technology and inventory, usually makes more sense, and surveys show more companies embracing these strategies.

Source: Harvard Business Review

Rise of more sustainable ships

To comply with the demand for more sustainable ships, ship builder and operators are constantly trying to decrease the emissions of their operations. By applying a variety of methods like low carbon fuels, more aerodynamic hulls, more efficient propeller design, improved voyage planning, better hull coatings and air cushions to reduce friction, the sector is minimizing their impact on the environment.

Source: Maersk & UNCTAD

Increasing amount of sensors on ships

To optimize operations and efficiency, ships will be monitored more closely on different aspects as fault detection, maintenance and overall performance.

To be able to monitor the ships, sensors are placed on multiple point at the ship. In the future ships will have a complete networks of sensors to measure all the important aspects of the operation.

Source: Maersk

Increasing focus on cybersecurity

While most major shipping organizations have a certain level of cybersecurity in place, the more technology is used, the more vulnerable their systems are. This is forcing them to invest further in more comprehensive security throughout 2021. With the addition of autonomous ships this will even drive the need for cybersecurity even further.

Source: Assenta USA & Stateoftheart

Finding different ways of data collection

Historically, ships have been an important source of data for marine weather forecasters. The vastness of the oceans means that forecasters must rely on a combination of visual observations made by ship crew and satellite-based proxy measurements.

By setting up distributed networks of low-cost nodes, marine forecasters can increase the density and redundancy of their data sources, thereby generating more data to feed into models for greater forecasting accuracy

Source: Xeltec

More intermodal transportation

As a consequence of globalization, companies are trading on international level which requires safer, more flexible and high capacity transportation options.

To achieve this, companies are choosing for intermodal transportation. By making use of different forms of transportation, the needed flexibility can be achieved without increasing the cost drastically.

Source: Monitor Intelligence

Increasing cost due to sustainability

With the demand of a more sustainable sea freight transport, the cost are rising for operators to comply with this demand.

Operators are investing large amount of money in converting vessels to alternative fuels or installing scrubbers to remove sulphur emissions. Operational expenses are also rising due to the costly low-sulphur fuels.

Source: Logistics Bureau

Increasing percentage of zero emission fuels

At least 5% of fuel used by ships around the world will need to be zero emission by 2030 if the shipping industry is to meet decarbonization goals set out in the Paris Agreement. With the goal of 5% it would serve as the tipping point to reach decarbonization by 2050.

Source: MRI Market

Reduce exposure to hazards with automation

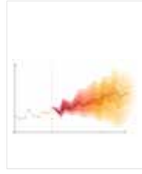
Autonomous or remotely controlled devices reduce the exposure of transport workers to hazardous environments.

Source: World Maritime University

Implementation of cloud-based solutions

Platforms in the cloud force a software-as-a-service (SaaS) model which opens unlimited opportunities for companies scalability and innovative digital resources usage. It allows reaching higher profitability and exceeding the common returns of on-premise systems' capabilities.

Source: shipChain



More precise forecasting by AI

Artificial Intelligence (AI) is growing as a major force in global shipping this year. Although it is a massive investment for carriers, it brings about tremendous benefits. AI-based technology allows logistics companies to manipulate data so they can forecast demand and make more informed decisions. AI can help shipping companies to provide more flexible and diverse price offerings, reduce man-made errors, and automate tedious manual processes.

Source: Assenta USA

Growth mainly in containerized, dry bulk and gas cargo

The global maritime freight transport is expected to grow with 4% until 2026. The biggest growth can be seen in the containerized and dry bulk, which are expected to annual grow with 4.5% and 3.9% respectively until 2026. Gas cargo is also an important driver of the growth realized in the global maritime freight transport.

Source: Research and Markets

Rise of protectionism

On the demand side, the uncertainty arising from wide-ranging geopolitical, economic, and trade policy risks as well as some structural shifts, constitutes a drag on maritime trade. An immediate concern are the inward-looking policies and rising protectionist sentiment that could undermine global economic growth, restrict flows and shift trade patterns.

Source: UNCTAD

Improving conditions for crew members

Hundreds of thousands faced and are still facing extended sea times, going months at sea without seeing families and loved ones. The crew change crisis in 2020 has highlighted seafarers'exceptional contribution as key and essential workers, on the front line of delivering world trade through a pandemic and in ordinary times.

Source: IMO

Increasing difficulty for finding crew

Internet access is becoming a mandatory way of life to all generations of people. Through this, people are always connected to their loved once. The limiting internet access for ships, makes that especially younger people are deterred from entering the industry. They don't want the isolated lifestyle presented on the ships. This makes finding new and enough crew to operate a ship more difficult.

Source: Lloyd's Register

Opportunity for smart contracts

A perspective use of blockchain in transportation is capacity monitoring. The cost of transportation depends on cargo volume. The use of Internet-of-things (IoT) sensors can help determine the amount of space a particular cargo occupies. This data can be used to calculate the shipment cost. Storing this information into a blockchain-based system signed with a smart contract will allow self-executing payments on a base of the amount of space taken by the freight.

Source: shipChain

Increasing use of drones

Drones can be used for inspection, repairs, deliveries and reduce exposure to hazardous environments. Drones are a way to collect data faster, cheaper and safer compared to other methods. Besides they can enter environments and conditions that would otherwise need to be totally shutdown, causing a costly delay.

Drones can offer huge potential to the maritime sector and the first developments are made by all the different stakeholders.

Source: Splash

Increasing demand for sustainability

Maritime shipping and logistics companies must prepare to take climate change policies seriously. These policies will increase costs for ocean transporters – costs of building cleaner ships, scrapping dirty ships, and fines for not meeting CO2 restrictions. Despite fewer emissions from less ocean transport in 2020, we still have a long way to go in the battle to slow climate change.

Source: SOAS

Increasing investments towards smart shipping

10% of the new buildings will be smart ships - arguably, smart ships are not a revolution but an evolution. The smart ship will integrate a variety of connected technologies to improve operational efficiency, ship management, regulatory compliance, decision making, environmental responsibilities and also improve safety and maintenance of vessel and crew through communication networks.

Source: Seatrade Maritime

Increased performance monitoring

Smart maintenance and condition monitoring using artificial intelligence and cloud-based big data analysis combined with sensors onboard. All to enable "right on time maintenance" allowing significant savings on vessel OPEX as well as optimal focus and action of both onshore and onboard staff on priorities.

Digitally-enabled remote monitoring and predictive maintenance services are focused on maximising operational availability.

Source: Splash

Working together to stay competitive

Liner shipping consolidation through mergers and alliances has been on the rise over recent years in response to lower demand levels and oversupplied shipping capacity dominated by mega container vessels. The way this affects competition, and the potential for market power abuse by large shipping lines as well as the related impact on smaller players, remains a concern.

Source: UNCTAD

15.4 Appendix D

Sustainable transport

There are many developments focussed on making the freight transport sector more sustainable. Various alternative fuels are being considered to increase the chances of success. At the moment there is too much uncertainty to decide on one solution that will make zero-emission shipping possible (Terwisga, 2020; Lloyd's Register & UMAS, 2019), so the most promising ones will be explained.

Electrification

Following the example of the car, much research is being done on the electrification of ships. Because of the many developments with the car, various insights can be adopted and attempted to ships (Lloyd's Register &UMAS, 2020). One of the greatest challenges for electrically powered ships is the distance they can cover, which is limited in comparison to diesel-powered ships (Lloyd's Register &UMAS, 2017). The fact that freight transport is often over long distances does not make electrically powered ships optimal.
To cover the long distances, more batteries will have to be used or bunkering needs to happen more frequently to compensate, which leads to an increase in weight or costs (Lloyd's Register & UMAS, 2017).
In addition to distance, the price is also a challenge. Compared to other alternatives, electrification is by far the most expensive option (Lloyd's Register &UMAS, 2019). Batteries play a major role in the higher price, seen in the storage costs (see Figure 35), since batteries are high in price and have a relatively low energy volumetric density.

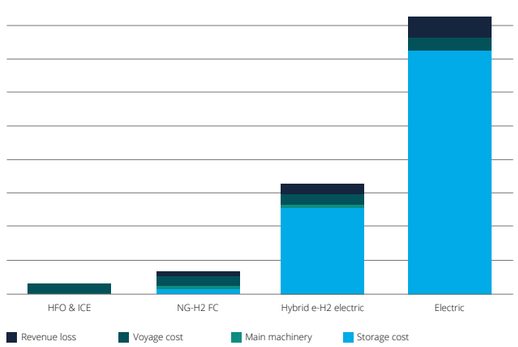


Figure 35: Additional cost for ship (Lloyd's Register & UMAS, 2019)

Therefore, to store the needed energy, a huge amount of batteries is needed, which results in expensive ships. This makes it difficult to get the electrification of ships price competitive, even when the prices of batteries will reduce significantly in the future.
One of the advantages of electric ships is that they can easily be combined with solar panels and wind turbines on the ships. These can charge the batteries while sailing, thereby increasing the range (McLeman, n.d.). However, the expectation is that the power from the solar panels and wind turbines will be insufficient to provide the power needed for international shipping. Therefore the improvements to the range will be minimal (Lloyd's Register &UMAS, 2019).

Liquefied Natural Gas (LNG)

Another fuel being considered within the maritime sector is liquefied natural gas (LNG). This is a gas that is cooled, making it liquid and greatly reducing its volume. As a result, the gas takes up less space and is easier to transport. At the moment, we cannot regard LNG as a zero-emission fuel, because its production and combustion still release greenhouse gases (Lloyd's Register &UMAS, 2019). However, these greenhouse gases are less than with fuels currently in use and this can be further reduced in the future by switching to Low Carbon LNG (Chrussakis, Pewe &Adams, 2021). The great advantage of LNG is that the technology is already mature. Already so much development has taken place that it is operational (Lloyd's Register &UMAS, 2020). With the presence of the right infrastructure and similarities to current diesel engines, LNG can replace diesel relatively easily and achieve a large reduction in greenhouse gases in the process (Lloyd's Register &UMAS, 2019; Chryssakis, 2021).

Biofuel

As a current replacement for heavy oils, the production of biofuel can be considered. These biofuels can replace diesel relatively easily, as current machinery and storage can be used (Lloyd's Register &UMAS, 2017). Biofuels are also currently available for use, yet in limited quantities. This scarcity is difficult to solve in the short term because biofuel production must not compete with food production for humans. In fact, growing food and obtaining raw materials for biofuels use the same agriculture. As a result, not all biomass can be used to produce biofuel. On the other hand, there are doubts about the sustainable aspect of these fuels. It is not clear yet to what extent emissions are actually reduced compared to the current situation. In order for biofuels to be used in the future, research will have to prove that these fuels are indeed environmentally sustainable enough to use (Lloyd's Register &UMAS, 2019). Due to the limited availability and challenges with the sustainable aspect, biofuels are uncompetitive in the long term compared to other solutions to make freight transport more sustainable (Lloyd's Register &UMAS, 2020). In the short term, however, biofuels can play a role in taking the first steps towards making the freight transport sector more sustainable.

Ammonia & Hydrogen

Ammonia and hydrogen are both synthetic fuels that may play a role in making freight transport more sustainable in the future. Both fuels have a lot in common; they are both relatively new and in the long term, both fuels could possibly replace LNG (Lloyd's Register &UMAS, 2020). Currently, the infrastructure for storage and bunkering of the fuel is still lacking (Lloyd's Register, 2020). To solve this challenge, regulatory actors and original equipment manufacturers will have to work together. Besides, it will be necessary to conduct research into the safety concerns of both fuels and to eliminate them by means of pilots (Lloyd's Register &UMAS, 2019). For example, the health risks associated with the toxicity of ammonia will need to be minimised with vessels designed with ventilated engine rooms. Furthermore, it will be necessary to reduce the price of the necessary components to ensure that they are price competitive (Lloyd's Register &UMAS, 2020). The price competitiveness is also linked to the final price of the fuel itself, which is currently still very dependent on the availability but will probably stabilise more in the future (Lloyd's Register &UMAS, 2017).

Methanol

Another fuel that can help with sustainability is methanol. Methanol has been used for a long time in various applications, so the technology is very mature and the infrastructure available (Lloyd's Register & UMAS, 2020). This makes its use an easy step to take. However, producing methanol in a sustainable way must be considered. Currently, producing methanol is very energy-intensive, which makes it difficult to ensure its sustainability. So its sustainability level partly depends on more renewable energy will need to be available. In addition, the way of operating will have to change to compensate for the low energy density of methanol (Lloyd's Register &UMAS, 2019). This because it is lower than other alternatives, so more fuel is needed on board to achieve the same distance. On the other hand, methanol storage is relatively simple, which simplifies the challenge of carrying more fuel (Lloyd's Register &UMAS, 2019). Overall, methanol can play an important role in the transition to a sustainable future.

Hybrid

Finally, hybrid solutions can be considered for the freight transport sector. In a hybrid solution one of the above technologies can be combined with an electric drive. The main disadvantage of a hybrid solution is that it requires batteries to store the electricity, which makes it difficult to be price competitive compared to the non-hybrid solutions (Lloyd's Register &UMAS, 2017). Due to this low price competitiveness, the likelihood of a hybrid manner is low. On the other hand, hybrid solutions can play an important role in the transition to a sustainable future. Currently, zero-emission fuels are still limited available, making it expensive and difficult to sail completely zero-emission. The use of hybrid solutions can help to reduce emissions until zero-emission fuels are more readily available (Lloyd's Register &UMAS, 2019). It is important to consider which combination can be chosen so that in the future it will be easy to switch to a ship powered by zero-emission fuels.

Overall, there are several alternative fuels that can contribute to a sustainable ocean freight transport sector. Here ammonia and hydrogen have the most potential, if these technologies develop well. LNG can play an important role in the transition to zero emission fuels. On a global level, electrification will make a minimal contribution; batteries will contribute more to ships for shorter distances. Finally, methanol can help to make sustainability possible, but it is very dependent on the production of green energy. In addition, the development of fuels and infrastructure has a great influence on the ultimate potential of a fuel. This also makes it difficult for companies to decide which fuel is the best choice for their application.
Sustainability in the sector is needed and different fuels is part of the solution. Besides different fuels, other developments to improve sustainability can be distinguished as well.

15.5 Appendix E

Interview guides

Adjusted to the different companies, the interview guide below was used to interview the various stakeholders. The people that were spoken to were working at Damen, two from the Port of Rotterdam, Portbase, and an autonomous sailing expert from the TU Delft.

Algemeen
- Waar houden jullie je precies mee bezig op het gebied van scheepvaart?
- Wat voor doelen hebben jullie in de komende jaren?
- Bij welke processen zijn jullie allemaal betrokken?
- In hoeverre is [naam bedrijf] betrokken bij de hele reis van een schip of is dit alleen gefocust op het begin / eind van de reis?
- Wie zijn jullie klanten?
- Wat is de meerwaarde die jullie leveren voor jullie klanten?
- Krijgen jullie vraag uit de markt of ontwikkelingen jullie vanuit jezelf nieuwe dingen?
- Wat zijn focus / speerpunten om op te verbeteren?

Uitdagingen
- Wat voor uitdagingen komen jullie tegen tijdens [activiteit]?
- Hoe gaan jullie om met deze uitdagingen?
- Wat voor uitdagingen zien jullie hier in de toekomst bij komen?

Technologie
- Wat voor technologieën gebruiken jullie momenteel?
- Zijn er momenteel technologieën waarmee jullie bezig zijn die te implementeren?
- Hoe grote rol speelt de connectiviteit hierin?
- Zijn er technologieën waarvan verwacht wordt dat die grote waarde gaan bieden?
- Komt er vanuit de markt vraag naar bepaalde technologieën?
- Met wat voor ontwikkelingen is [naam bedrijf] bezig om in de toekomst te kunnen gebruiken / bieden?

Toekomst

Algemeen
- Hoe ziet de toekomst van de scheepvaart er wat jullie betreft uit?
- Hoe gaat de haven veranderen in de toekomst?
- Hoe gaat het proces veranderen richting deze toekomst?
- Hoe bereiden jullie jezelf voor op die toekomst?
- Hoe zien jullie jullie eigen rol veranderen in die toekomst?
- Hoe bereiden jullie [naam bedrijf] voor op die toekomst?
- Wat is er nodig voor deze nieuwe toekomst?

Autonoom
- Zien jullie een autonome toekomst voor jullie in de haven?
- Hoe ziet deze autonome toekomst er precies uit (welk level)?
- Wat voor rol kan [naam bedrijf] spelen in autonoom varen?
- Hoe bereiden jullie je voor op deze toekomst?
- Hoe ziet de route naar de autonome toekomst eruit?

Elektrisch
- Zien jullie een elektrische zeevaart mogelijk in de toekomst?
- Zo ja, hoe zou dit de haven veranderen als dit zo is?
- Zo nee, hoe zien jullie de verduurzaamde toekomst voor jullie?
- Waarom op deze manier / met deze techniek?
- Hoe bereiden jullie je voor op de duurzame toekomst?
- Hoe gaat de duurzame toekomst de inzet van schepen veranderen?
- Hoe zijn jullie bezig met verduurzamen?

Adjusted to the roles within KPN, the interview guide below was used to interview the various employees of KPN about my project. Through these interviews, I wanted to get to know the KPN company better, but also discover how my project fitted in with KPN's strategy. Before I started with the questions, I always briefly told them about my project. I would go into how it started, where I was now and which direction I thought it was going in. This explanation changed throughout my project, as my project itself changed. The thirteen employees I spoke to where working as Innovation Strategist, Technology Lead for the Fieldlabs, Commercial Product Manager, Director IoT Academy, Visionary Advisor, Innovaton &Brand Consultant, Senior Architect and Financial Controller.

Rol binnen KPN
- Wat voor baan heb je bij KPN?
- Waar hou je je mee bezig tijdens je werk?
- Hoe ben je in deze baan terecht gekomen?
- Heeft dit een link met de maritieme sector?
- Wat doet [specifieke service] precies?

Project
- Hoe kijkt je tegen het gehele project aan?
- Hoe past dit project bij KPN?
- Wat vind je van het doel om autonoom te gaan varen?
- Denkt u dat dit haalbaar is?

KPN
- Zie je een rol voor KPN weggelegd in dit gehele ecosysteem?
- Past dit binnen de strategie van KPN?
- Is dit iets waarop KPN zich zou moeten onderscheiden?
- Is dit iets wat aansluit bij [specifiek project]?
- Hoe sluit dit aan bij [specifiek project]?
- Wat is KPN's bijdrage in [specifiek project]?
- Zou dit een business model zijn wat aansluit bij KPN?
- Zou KPN binnen dit ecosysteem meer bij kunnen dragen?
- Hoe wordt er nu voor gezorgd dat klanten in zee gaan met KPN?

Capabilities
- Wat onderscheid KPN van concurrenten?
- Waarbij focust KPN zich dan? (Prijs, experience, etc.)
- Wat zijn dingen die KPN kan die concurrenten niet kunnen?
- Hoe creëert KPN waarde naast de connectiviteit?
- Wat kan KPN op het gebied van IoT?
- Wat voor capabilities heeft KPN specifiek gericht op de maritieme sector?

Doorverwijzingen
- Zijn er stakeholders die ik nog niet benoemd hebt die wel belangrijk zijn?
- Zijn er andere problemen / challenges die nog niet benoemd zijn nog aan de orde?
- Zijn er mensen binnen KPN waarmee ik hierover zou moeten spreken?

15.6 Appendix F

Developments in the Port of Rotterdam

The different developments, based on desk research and held interviews, going on in the Port of Rotterdam, are discussed below.

SMART PORT

Innovation

A variety of innovations are implemented in the Port of Rotterdam to become a smart port.

Internet of Things platform
An important innovation is the Internet of Things platform that the port authority has developed together with IBM, Cisco, Esri and Axians (Visser, 2020). Within this platform, there are various sensors that monitor water and weather conditions and keep this up to date. By combining these data points and analysing the data on the platform, it can serve to better predict and anticipate on upcoming conditions (interview Port of Rotterdam, 2021). In turn, this can be used to better regulate the planning and management of ships. In addition, the platform offers the port authority the opportunity to implement technologies such as edge computing, real-time analysis, artificial intelligence, hyper-precise data and blockchain (Port of Rotterdam, 2019-a). In doing so, it provides the first component for autonomous sailing within the port for the future.

Digital twin
To make this autonomous sailing possible, the Port of Rotterdam is working with IBM to build a digital twin of the port. The entire port will be digitally reconstructed, using all the sensors, measurements and data from the port. There are various platforms within the port that contain data on specific aspects of the port. By combining these platforms, this digital twin can be realised (interview Port of Rotterdam, 2021). This will make it possible to carry out simulations that can subsequently help to improve the situation in the physical port (Port of Rotterdam, n.d.-f). This can, for example, reduce waiting times or optimise docking, loading and departure. In the future, such a digital twin can be used to carry out simulations for autonomous ships to ensure that they run smoothly.

Container 42
In order to collect more data on containers travelling around the world, the Container 42 project was launched. This project is a collaboration between various stakeholders in which a container is equipped with a whole bunch of sensors to travel around the world. While travelling, the container measures various parameters such as vibration, position, noise, air pollution and temperature (Tomás, 2019). With these measurements the stakeholders are provided with real-time data on the local infrastructure, water and air quality. By doing so, challenges in transport and logistics can be mapped out, which in turn improves the digital twin (Port of Rotterdam, 2019-b). These mapped out challenges should help the port authority to make the process within the port safer, more reliable and more efficient.

Unmanned container terminal
For the Port of Rotterdam Authority, the first steps have already been taken towards automating processes. For example, the port authority already has an unmanned container terminal. Here, cranes are largely automated and Electrical Automated Guided Vehicles (e-AVGs) drive around to move containers (Witschge, 2019). To carry out the steps that are not automated, for example, the cranes are controlled from a distance. The port authority had issued a tender for the construction of an unmanned transport route, the so-called Container Exchange Route (CER). By doing so, they wanted to further optimise the efficiency of transport between terminals. At the moment, the port authority has paused this tender because of safety risks that are too high and there is too much uncertainty (Bahtic, 2021). Instead, the port is now opting for a hybrid solution, whereby the transport is partly autonomous and partly human-operated.

Cargo tracking
Digitisation also offers the possibility of making sea transport process more transparent to all parties involved. In order to achieve this, the Port of Rotterdam Authority and Portbase have combined their knowledge and strengths in the area of Track & Trace, and the application Cargo Tracker has been developed. This application provides insight into the real-time location of a container, which makes it easier for all parties in the supply chain to adjust their planning accordingly (Portbase, 2020). In this way, parties are less dependent on the flow of information from parties earlier in the supply chain and are updated in time about delays or changes. Currently, the location only becomes available when a shipping company registers the ship and its cargo in the Port Community System (PCS). This limits the location to within the systems of the Port of Rotterdam, so the location information is not available for the steps before and after those of the Port of Rotterdam. The application does try to predict arrival times with the available data, to compensate for this loss of location (interview Portbase, 2021). In the future, the application will be expanded to include data from other ports (Halkes, 2020). In this way, the entire chain can be mapped out and it offers parties the opportunity to determine exactly where the bottlenecks are to tackle them. Because the ownership of the data in the PCS remains with the data supplier, Portbase and the Port of Rotterdam Authority depend on those parties regarding how quickly developments of this kind can be realised.

Port Insight
In addition to tracing goods and containers, the Port of Rotterdam Authority in cooperation with TWTG has set up a joint venture called Port Insight, which will focus on locating assets within the port. The first thing Port Insight will make possible is the online tracking of barges within the port area (Port of Rotterdam, 2019-e). These barges have to pay port fees, and determining where and how long a barge was lying somewhere is essential for this. Previously, this was all done by hand. By making the pushed barges traceable and displaying them on an online platform, it is easier to determine where pushed barges are, but also to arrange port fees. This saves a lot of time and effort.
For the future, they are looking at using the data from the platform for other applications as well, such as providing insight into available berths in the port. In addition, the possibility of expanding the platform to other ports in the Netherlands and even abroad is being considered (Port of Rotterdam, 2019-e). This could make it possible to work more efficiently for the entire sector.
Setting up its own joint venture that provides a platform within the port makes it more difficult for outside companies to compete with it. Because the joint venture can respond precisely to the needs of the port authority, this ensures that a solution will better meet the wishes of the port authority. This may result in the joint venture being chosen more readily when it comes to choosing a supplier. In addition, the choice will more likely be made for the company itself rather than a third party, simply to keep turnover within the company (interview account manager KPN, 2021).

Drones
Part of becoming a smart port is using drones for processes within the port. The Port of Rotterdam Authority sees many possibilities for using drones, for example, in incidents, water pollution, fire fighting, monitoring, surveillance and inspections (Port of Rotterdam, n.d.-e). The Dutch Drone Delta (DDD) was set up in collaboration with various parties to respond to these possibilities. One of these involved parties is KPN, who is responsible for the connectivity of the drones (Dutch Drone Delta, n.d.). This initiative studies how drones can be used safely, what added value they can offer and how they can operate autonomously in the future (Port of Rotterdam, 2019-f). The first steps have now been taken and the first drone delivery to a sailing ship has been successfully completed in the port area (Port of Rotterdam, 2020-b). This test flight is part of a series of test flights, all aimed at determining and improving the feasibility, safety and added value of drone flights. In addition, the DDD is promoting the use of drones for large-scale transport and logistics.

Blockchain
Another innovation in which the Port of Rotterdam Authority is taking steps is the use of blockchain. Blockchain is a technology where data is shared amongst various network nodes and every modification of the data is communicated to all these nodes. These modification are added to the previous saved data, resulting in a string of modifications. Since this string is shared with multiple network nodes, it makes it impossible to modify the saved data without the rest of the

network knowing about it (Conway, 2021). Jointly with the municipality of Rotterdam, the BlockLab has been established, a body that deals with what blockchain can mean for the port and how it can be deployed (Port of Rotterdam, 2019-c). Blockchain offers opportunities in cross-sector applications, where parties do not normally work together. For BlockLab, the focus is on two domains; logistics and energy.
Together with Samsung and ABN AMRO, BlockLab has been developing a blockchain platform that can be used to make containers traceable. This has resulted in DELIVER, a platform that ensures that containers can be transported paperless, directly financed and fully traceable (Port of Rotterdam, 2019-d). Physical, administrative and financial flows are now integrated into a platform, which can help automate processes. Storing the necessary data in the blockchain makes it more transparent, but also guarantees that the information is up to date. This allows parties to rely on this data and use it to better plan and organise their processes. Ultimately, DELIVER should result in an open, independent and global platform for the cargo shipping industry. This will improve transparency and efficiency, ultimately leading to cost savings in the long term (Port of Rotterdam, 2019-d).
In addition, the BlockLab focuses on the energy supply of the port area. The Distro platform has been developed in collaboration with S&P Global Platts. Within this platform, producers such as solar panels and wind turbines are linked to consumers of energy. By using artificial intelligence, consumption and production are predicted for each user and, based on this, the power is traded via the platform (Port of Rotterdam, 2020-a). As a result, when consumption is low and production high, resulting in a lower price, power can be stored in batteries. When the consumption rises again and with it the price, this stored power can be sold again for a higher price. All this leads to more consumption of locally generated energy, better use of the batteries, higher income from the solar panels and all this while the user pays a lower price (Port of Rotterdam, 2020-a). In addition, it can reduce the load on the power grid. By applying this platform on a large scale, it will help the Port of Rotterdam Authority to achieve its goal of becoming a climate-neutral port.

Digitalisation

To become a smart port, digitising processes and forms is an important part to invest in for the Port of Rotterdam.

Digital process
The digitisation of the port starts with the Port Management Information System, the so-called HaMIS. In this system, all activities in the port can be planned, monitored and registered. The system is used by both the Port of Rotterdam and the Port of Amsterdam, making it easier to exchange data between these two parties (Port of Rotterdam, n.d.-f). The data can be combined with the PortMaps, a digital version of the geographical representation of the port area. It shows depths, pipelines and power cables, but also assets and environmental zones. This allows stakeholders in the port to easily gain insight into the entire port area (Port of Rotterdam, n.d.-f). The data processed in this view is continuously updated by means of smart infrastructure. Sensors are incorporated in quays and bollards that register whether they are being used, for example, and for how long. This makes it possible to optimise the designs, but also their use. Which ensures that the available infrastructure can be used optimally (Port of Rotterdam, n.d.-f).

Transparent process
With all available data, the port authority makes the entire chain more transparent for outside parties (interview Portbase, 2021). For example, the PortXchange has been developed, which allows various parties to see the activities within the port (Port of Rotterdam, n.d.-l). PortXchange provides shipping companies, agents, terminals and other service providers a shared platform they can use to exchange information about their port calls. Beside, to make it easier for companies to plan and book the journey of a container, the Navigate application was developed. This application creates an overview of the most efficient routes to and from the port of Rotterdam (Port of Rotterdam, n.d.-g). This allows companies to further optimise their own supply chain.

Collaboration among ports
In order to use the PortXchange knowledge in an even broader application, the Port of Rotterdam Authority has entered into a cooperation with the twenty largest port authorities in the world. In addition to agreements on the environmental impact of the sector, these collaborations also focus on smart ports. The neutral platform Routescanner has been developed for this purpose. All member ports share information on shipping routes, train connections and road networks. Routescanner makes it possible to find the most optimal route for a container worldwide (Port of Rotterdam, 2021). This can save a lot of time and money while reducing emissions. Due to the dedication of the affiliated port companies, the knowledge gained by the Port of Rotterdam has a global impact.

Floating Lab
In addition, the port authority has converted one of their ships into a Floating Lab. The lab is equipped with cameras, measuring equipment and sensors to enable the development and testing of new applications. In the future, the Port of Rotterdam is also looking into the possibility of steering this ship from a distance (Port of Rotterdam, n.d.-f). With this, the port authority creates the possibility for other parties to test their application or design in an operational environment.

Digital infrastructure
Finally, the Port of Rotterdam Authority is looking at investing in the digital infrastructure of the port, especially in its own network (interview account manager HbR at KPN, 2021). Through this network, the port authority wants to offer the necessary infrastructure so that autonomous ships can enter the port in the near future. By investing in its own network and not using an existing network, the port authority hopes to be able to offer the guaranteed bandwidth to incoming ships. At the moment, it is not yet certain whether they will actually do this or whether they will opt for an existing network of a telecom company in the Netherlands. This mainly depends on whether the guaranteed bandwidth can be proven good enough by a telecom company (interview account manager HbR at KPN, 2021).

Energy transition

To become more sustainable, an energy transition will have to take place both in the port itself and in the ships that dock there.

For the port itself, the Port of Rotterdam has devised a strategy with three different phases in order to become completely CO_2 neutral and circular by 2050 (Port of Rotterdam, n.d.-h). The first phase focuses on efficiency and infrastructure by using the heat from the port and storing the CO_2 produced in the port under the North Sea. The second phase consists of switching to new fuels such as hydrogen, electricity and LNG. Here, the produced emissions will still be stored under the North Sea. In the third and final phase, the focus will be on new materials and a new fuel system. Fossil raw materials will be replaced by sustainable alternatives and only sustainable fuels will be used to complete the transition. All the different phases are further explained in animations which can be viewed by scanning the QR codes in Figure 36.

To ensure that the energy within the port is distributed and disseminated in the right way, the energy network will also have to be digitalized. Here, the Port of Rotterdam must look at where energy is needed, how much energy is needed and also when energy is needed (interview Port of Rotterdam, 2021). In order to achieve this, all the various components will have to start sharing this data with the digital platforms. This will make it transparent for all parties involved and will allow them to anticipate on the required energy supplies. Such a system can be compared to how shared scooters, like Felyx or Check, now share with the corresponding application where they are, how much energy they have left and how far they can still drive, so that the rider can decide which scooter to choose. This kind of data sharing should also take place for the Port of Rotterdam, with all the stakeholders sharing their data with the ecosystem (interview Port of Rotterdam, 2021).

Phase 1: Climate goals

The industry takes efficiency measures. Residual warmth is used to heat homes, commercial buildings and greenhouses. CO_2 is captured and stored under the North Sea.

Phase 2: A new energy system

In the long term, electricity and hydrogen will play a major role in making the port sustainable. This requires affordable electricity from sustainable sources such as sun and wind.

Phase 3: Circular Port of Rotterdam

New raw materials and fuels system. Fossil resources are being replaced through the use of biomass, recycled materials and green hydrogen.

Figure 36: Energy transition animations Port of Rotterdam (Port of Rotterdam, n.d.-h)

SUSTAINABLE PORT

Within all three of the directions of a sustainable port, the port authority, in collaboration with other parties, undertakes projects to improve this aspect within the port. A view examples for these project are discussed below.

Within safe &health, for example, the Port of Rotterdam is conducting studies in flood risk management to predict risks, impact and find possible solutions. In addition, ships that emit fewer emissions get a discount on their berthing fees. This reduces emissions in the port, which in turn ensures a healthier working environment for everyone (Port of Rotterdam, n.d.-j).

For climate &energy, the port authority has set itself the target of being emission-free by 2050. This applies to both their own activities and the ships that come in. As discussed earlier, the port authority has devised a strategy to become climate neutral and circular in three different phases. To realise all this, the port is investing heavily in wind and solar energy. In addition, improvements are also being made by, for example, replacing all lamps with LED lighting, which will reduce the port's energy consumption (Port of Rotterdam, n.d.-j).

Besides the fact that the processes within the port cause a lot of emissions, the port authority rents out several large pieces of land to fossil fuel companies. This way, the port authority indirectly earns money from the transport, storage and sale of fossil fuels. With the increase in sustainability, the question is what will happen with the lease of these pieces of land (interview account manager HbR at KPN, 2021). Because of this, the port authority is also looking at what possibilities they have when fossil fuels are increasingly replaced by sustainable alternatives.

In order to become a sustainable port in terms of people &employment, the port authority is committed to improving conditions. They have done this by signing a social agreement for improved working conditions. In addition, they have the "Startbaan" project, which creates opportunities for people who have no education to still obtain a diploma. With this project, they try to give these people a chance for job opportunities (Port of Rotterdam, n.d.-j).

15.7 Appendix G

General overview of KPN

To gain a better understanding of what KPN can contribute within the maritime sector, it is important to first have a good picture of KPN the company. To explore this, interviews were held with thirteen different people all working within KPN (see Appendix E). The products and services that KPN offers were also considered by using their own website. The results of both analyses were classified according to the Resource-Based View of the Firm (Wernerfelt, 1984).

RESOURCE-BASED VIEW

The Resource-based view (Wernerfelt, 1984) is a way of analysing a company based on its resources. It looks beyond capital, labour and assets to include customer loyalty and technical skills. By creating a resource profile of a company, the optimal product-market activities can be determined. Within this analysis, a distinction is made between five different resources: customer loyalty, technological leads, production experience, machine capacity and domestic contracts. In addition, KPN's current assets were examined in order to include them in the analysis. In this chapter, the various resources of KPN are discussed in order to determine whether they can be of added value within the maritime sector.

Customer loyalty

With customer loyalty, the main focus is on the customer base of a company. Customer loyalty makes it more difficult to take the place of a company that already has customers for a certain product or service than it is for a company to hold on to its position (Ries and Trout, 1981). This results in companies that enter later having to pay a higher price for their customers than companies that have entered earlier (Wernerfelt, 1984). When looking at KPN's customers, two different types of customers can be distinguished, namely business customers and consumer customers.

A tool to measure customer loyalty is the Net Promoter Score (NPS). From the NPS, a score is calculated on how likely customers are to recommend a company to other people. This results in a score of between -100 and +100, whereby a score above zero is considered good (Reichheld, 2003). KPN also uses this method to see how satisfied customers are with their services. For the consumer market, the NPS is +11, for the business market KPN has a score of -2 (KPN, 2021). It can be concluded that KPN does better on the consumer market than on the business market.

Because the focus of this project is on the business market, we will zoom in a little more on the NPS for that market. If this is compare with KPN's two main competitors, it can be seen that both Vodafone (+8) (VodafoneZiggo, 2020) and T-Mobile (+21) (Comparably, 2020) score higher on the business market. For KPN, this can be seen as a sign that there is work to be done in the business market, as currently, customers are more loyal to their competitors. On the other hand, if looking at the market share, KPN is larger (39,5%) than both VodafoneZiggo (30.5%) and T-Mobile (30%) (Meijer, 2019). Combining the NPS score and the market share of KPN, it can be concluded that the customer loyalty can be seen as a valuable resource for KPN. One that could be used for developing product or service propositions in the future.

Technological leads

As technological leads suggest, these resources are about a technological advantage that a company has over its competitors. This makes it more difficult for competing companies to provide the same products or services because of the missing technology (Wernerfelt, 1984).

At KPN, it is therefore particularly interesting to look at the previously mentioned Fieldlabs (see Chapter 1.2). In these, KPN works with various stakeholders from a specific sector to develop technology that can be used within a particular sector. KPN is currently involved in five different Fieldlabs: mobility, rural, urban area, industry and care (KPN, n.d.-b). By working together with technology partners, customers and suppliers, KPN tries to achieve certain goals within the specific Fieldlabs, such as autonomous driving, precision agriculture, virtual reality in the industry and smart antennas in cities. KPN focuses mainly on providing the connection and storing and moving the needed data. For now, the knowledge gained in these Fieldlabs is still mainly in the Research & Development phase, where the main focus is on researching what is possible. As a result, these technologies are not yet generating much new revenue for KPN and it is, therefore, difficult to label them as technological leads. However, the Fieldlabs are the ideal place for developing a technological lead for the future. It ensures that KPN remains involved in the development of new technologies and increases the chance that it will be able to participate at an early stage when such technologies emerge. The Fieldlabs can therefore be seen as a valuable addition to KPN at the moment.

In addition to the Fieldlabs, KPN is in the process of installing technology that can forecast the weather on the transmission towers that provide radio links. Radio links are connections that link masts within a network by sending radio waves in a specific direction. The radio links are a good alternative for laying cables between masts. In the Netherlands, these radio links require a licence for use, which KPN possesses. The technology used comes from the company Tomorrow.io, which can determine the density of the air through the delay in the connection. With this density, very local and real-time weather forecasts can be made (Wroblewski, 2021). Normally, because the technology does not come from KPN itself, this would be a technological lead for Tomorrow.io, but here they are using resources from KPN to make this happen. Through this technology, KPN uses the connections they already have and deploys them for other purposes. These accurate weather forecasts can be very valuable to different parties and because KPN already has the radio links, it makes it difficult to just copy this resource. This makes it a valuable addition to KPN's resources.

Production experience

When a company correctly applies the experience they have gained in earlier stages of production, this gives them the advantage of lower costs defined as production experience (Wernerfelt, 1984). Therefore, new entrants have to gain the same experience, only at the same time they have to compete with a company that has lower production costs. This makes it very difficult for these new entrants, as they have to pay more for the experience while receiving less revenue in return (Boston Consulting Group, 1972). This effect can be reduced if experience flows from the early movers to the later movers. This may be the case if ideas or innovations are not patented.

Looking at what KPN currently delivers in terms of products and services, it is particularly interesting for this project to look at products and services that go beyond the provision of connectivity. This could include the creation of a network (KPN, n.d.-c), the Internet of Things (IoT) solutions that KPN already offers (KPN, n.d.-f) and the data handling services offered by KPN (KPN, n.d.-g).

The knowledge to create a network can be seen as a resource of KPN, however, it should be taken into consideration that they are by no means the only ones who can do this. This makes it difficult for KPN to use this resource to compete with its competitors because these competitors also have this knowledge themselves. So it is certainly a resource that KPN should have and develop, but it is not a resource that KPN can use to be more attractive than their competitors.

The IoT solutions that KPN currently offers focus on tackling a few different problems, such as track & tracing, detecting and monitoring certain things. In cooperation with hardware and software suppliers, KPN delivers a plug &play platform that is easy to use for customers, KPN Things. KPN has a lot of experience and knowledge in the hardware to be used. They know exactly what is needed and test the hardware extensively before it goes to the customer (interview strategic manager IoT KPN, 2021). Compared to competitors, these production experiences are unique to KPN. This can be seen as a resource that can be valuable to KPN.

Also, the services to help customers deal with data, how it can be stored and how it can be processed, the Data Service Hub (see Current assets), can be seen as a unique resource that KPN offers

compared to direct competitors. KPN will continue to invest in their business in the coming years to ensure that their customers are satisfied with their services. Their competitors also offer connectivity, which is about moving data, so they probably already have most of the knowledge in house. They could therefore easily convert this into a service that could compete well with that of KPN.

Machine capacity

Machine capacity mainly involves the resources needed to compete with other parties in the market. Because companies have entered the market earlier, they have been able to take advantage of economies of scale, which means that they have lower costs and therefore need a lower selling price to be profitable. As a result, it will be irrational for new entrants to invest in the necessary resources when expected revenues will be low (Wernerfelt, 1984).

KPN does not produce any of their own products, so the services that KPN provides are looked at, especially the infrastructure that is needed. The network is the most important resource that KPN has at its disposal, both wired and wireless networks. The wired network is mainly used to connect buildings and houses, besides providing the connection between the towers of the wireless network. The wireless network is the 3G, 4G and 5G network that is used to provide connectivity to all mobile solutions such as phones, cars and sensors. The value of both networks is enhanced by KPN's knowledge and experience of network creation discussed earlier in 'Production experience'. To provide a network like KPN's, a lot of resources need to be invested before money can be made from it. This makes it more difficult for new entrants to enter the market. In addition, a licence is required for the use of certain frequencies (Velzen, 2019). These frequencies are used to send the signal of the wireless network, so without this licence, a competitor cannot make an operational network.

Although the network is an important asset of KPN, it does not make them unique. T-Mobile and VodafoneZiggo have similar networks and satellite networks can be considered as well to provide connectivity. This makes it very difficult for KPN to distinguish itself based on its network alone. In addition, other companies do not see connectivity as value creation (external analysis with multiple companies, 2021). They need the connectivity for their solutions, but they do not care who delivers that connectivity. Value creation only happens when the data sent over the connection is also processed and analysed. In order to add value through their network, KPN can look at analysing the data. Currently, this is done mainly by contracting with third parties who can already do this. This is discussed further in the section 'Domestic contracts'.

Domestic contracts

By contracting with other parties, companies can gain their initial production skills through a joint venture. This allows costs to be shared but allows the same experiences to be gained (Wernerfelt, 1984). Therefore, the domestic contract can also be seen as a resource of a company. However, it is important to consider how such a cooperation can lead to increased production skills or contribute to increasing another resource.

KPN works with a lot of partners to deliver different services and products. For the sake of brevity, the focus will be on the most relevant ones for this project.

First, the previously discussed Fieldlabs (see Technological leads) can certainly be seen as a domestic contract that can lead to the expansion of other resources. Within the Fieldlabs, knowledge and experience is shared between the stakeholders, which means that KPN can also benefit from this.

Collaborations within the IoT platform of KPN (see Production experience) can also be seen as a valuable contract that could lead to the expansion of resources. However, it is difficult to determine to what extent this contributes to the expansion of the resources of KPN itself. Most of the collaborations that fall under this heading are only about supplying their own part, which means that little knowledge and experience is gained from other stakeholders (interview director IoT Academy at KPN, 2021). If this is the case, these contracts lose their value at a certain point because it is easy for competitors to imitate them.

Then there is the contract with Tampnet (Tampnet, 2019). Here KPN uses Tampnet's network, which is constructed in the North Sea. This allows KPN to provide greater coverage to customers under the same contract. For this cooperation, the same applies as for the cooperation with the IoT partners: it is a cooperation to use it, not so much to expand resources. If we look at competitors, we can see that T-Mobile, for example, has signed a similar agreement with Tampnet as KPN (MediaMagazine, 2021). Therefore, this contract cannot be seen as a unique resource of KPN. This also applies to other roaming agreements that KPN has concluded with foreign providers (KPN, n.d.-h). In these agreements, the use of the network is the only issue at stake, not the extension of resources.

The last domestic contract that is interesting to look at is the cooperation with Innovation Center for AI (ICAI) and Jheronimus Academy of Data Science (JADS) whereby the Responsible AI Lab is run jointly (KPN, 2020-c). This research institute looks at how AI can be used responsibly and how problems with bias, discrimination or loss of privacy can be prevented. The approach of this lab can be seen as a valuable collaboration for KPN because the goal is to gain more knowledge and experience with AI. This knowledge and experience can then contribute to increasing other resources and can subsequently be used for business opportunities.

Current assets

The resource-based view does not look directly at a company's assets, mainly to shine a different light on companies (Wernerfelt, 1984). However, this does not exclude that assets that a company already has can be of great value in the pursuit of business opportunities. Therefore, this analysis also looks at KPN's current assets, some already briefly discussed before.

As previously discussed under 'Machine capacity', the most important asset KPN currently has is its network. Although this is of great value and helps KPN to fulfil business opportunities, it does not differentiate KPN from its competitors.

Then there is the Data Service Hub (DSH), a cloud service in which data can be stored and processed in real-time to produce insightful conclusions (KPN, n.d.-g). It also helps customers manage and secure the data. Providing a place to analyse data is valuable to companies, but the real value is created by the model or application that performs the analysis. With DSH, these are provided by third parties and not by KPN itself (interview DSH manager, 2021). As a result, the DSH has the potential to be a valuable asset that can be used for business opportunities, but due to the absence of native KPN software that can perform analysis, this is not fully reflected (interview Innovation Strategist KPN, 2021). Cloud services are already abundant, making this asset not unique to KPN. As a result, the DSH can be categorized together with the network, valuable but not value-creating.

In addition, the financial resources available to KPN could be considered. From the Annual Report 2020 (KPN, 2021) it can be concluded that KPN is a healthy company. A profit has been achieved and the free cash flow has increased. Although this is a good result, it cannot be seen as an asset with which KPN can compete with other parties. To be able to compete, money is obviously needed, but money in itself has no added value. What happens to it, however, can lead to an asset of resources with which a better competitive position can be achieved.

Finally, there are the assets KPN has in the form of, for example, offices, cars and computers. These are all needed to operate as a company, but in no way can these assets be used in isolation to exploit business opportunities.

Conclusion Resource-based view

In general, it can be concluded that KPN has several resources and assets that can be used to fulfil business opportunities. However, it must be concluded that many of these resources are not unique to KPN and therefore it is difficult to exploit them in relation to their competitors.

15.8 Appendix H

KPN's SWOT analysis

Based on the research on KPN and by mapping what resources they already possess as a company, the various strengths and weaknesses were identified. From the research into the context and the related developments, the various opportunities and threats were drawn up. By setting these against each other in the matrix shown earlier, various search fields emerge that could be interesting for KPN to respond to.

These different search fields were then used to design a business proposition for KPN. From the matrix, the various possibilities presented were combined to create the final design of the KPN Fleet presented in Chapter 9. In doing so, we primarily used the strengths that KPN already possesses to create a starting point from which the entire ecosystem can be built around the platform.

Scope: Network providers

Strengths
1. Helping companies with data handling
2. Test facilities and knowledge from Fieldlabs
3. Real-time analysis with DSH
4. Being green and knowledge about sustainability
5. Partner collaborations, so many possibilities

Weaknesses
1. Having a hard time to innovate
2. Connectivity adds not so much extra value
3. Lack of worldwide coverage
4. Dependable on partners to make an impact
5. Money available for exploring new opportunities is limited

Opportunities
1. The internet of senses, making use of visual, audio, haptic and other technologies to allow humans to have remote sensory experiences
2. Rise of data sharing between companies
3. People want hassle-free services and experience
4. Blockchain implementation to guarantee more transparency into the sector
5. Everything moving to the cloud

Threats
1. The developments of Non-Terrestrial Networks
2. People want to be connected all the time and be able to do everything online, independent of their location
3. Big technology companies expanding their focus to other sectors

		Strengths					Weaknesses				
		1	2	3	4	5	1	2	3	4	5
Opportunities	1	Processing the data of senses	Make a Fieldlab for senses	Instal algoritme on DSH to analyse senses		Create plug-and-play solutions for internet of sense			Make internet of sense offline	Find reliable partners to implement senses	
	2	Facilitating safe data sharing		Real-time data sharing	Green data sharing			Make value extra clear to companies	Create hubs to ensure data sharing is possible worldwide		
	3	Use data to help companies with hassle-free service	Test new services before implementing them	Provide service on DSH automatically	Become green service consultant	Provide all in one solution to companies / people		Create hassle-free solutions by making use of current network		Aligning partners to create hassle-free	
	4	Using blockchain to make data collection transparent	Invest in blockchain knowledge (become expert)	Using blockchain to make DSH transparent	Use blockchain to make green goals transparent	Intensive collaboration with blockchain		Implementing blockchain to add value to network		Create a blockchain lab	
	5	Providing cloud service		The DSH as cloud	Providing a green cloud	Create an all-around cloud, all API's available			Make the DSH downloadable		
Threats	1	Combine data handling with connectivity for NTN	Exploring the possibilities of a NTN	Instal the DSH on NTN to provide worldwide coverage	Helping NTN's to become greener	Collaborate with NTN and provide extra service			Work together		
	2	Make hotspots where people use the connection		Provide DSH worldwide		Create worldwide coverage with partners			x		
	3		Determine an expert field	x		Work together with big companies	Use their knowledge to innovate			Use their knowledge to innovate	

Helping companies with data handling | Strength
As a large telecom company, KPN has a lot of experience in handling and moving different data streams. Within KPN, everything is aimed at doing this as quickly and safely as possible.

As data becomes more and more important for businesses and processes, it also creates challenges for these companies to deal with it. Because KPN has been active in moving and storing data for years, KPN can help these companies overcome these challenges. In addition, by supporting these companies, KPN can also respond to society's growing demand for privacy. With the expertise KPN has, the data generated by companies can be saved securely. This relieves these companies of the worries of acquiring data but enables them to make use of it. The use of these resources by KPN offers many interesting possibilities for the further course of this project. This is certainly something that should be included in the develop phase.

Real-time analysis | Strength
KPN has the digital infrastructure to analyse data in real-time and thus enable companies to use these analyses in their daily operations. This is something KPN currently offers and can be well used in many different sectors.

As data will play an increasingly important role in the maritime sector, this strength can be used to develop a business proposition. The potential of data in the maritime sector can be exploited even more and KPN can support the stakeholders in the maritime sector in this transition.

Partner collaboration | Strength
KPN is already working with a lot of different partners to be able to offer their current portfolio to customers. This means that KPN knows very well how to set up and maintain such cooperation. In addition, working with partners can provide flexibility, because many things can be achieved in a short time by dividing the work between different companies.

This strength is something that can be put to good use when designing a business proposition for KPN. By using it, a lot can be achieved and more value can be generated for the customer, even if the need cannot necessarily be fulfilled by KPN.

Hard time to innovate | Weakness
A challenge for KPN is to continue to innovate in offering new products and services so that they remain a relevant company in society. This challenge has two causes. The first is that the networks and thus the mobile coverage are very good in the Netherlands. As a result, customers do not see connectivity as a value-added element of the supply chain, but rather as a necessity (see Chapter 1.2). This makes it difficult to get customers to pay more for the improvements, for example, 5G, that are made to the network. Because of the limited increase in revenues, it is difficult to make a business case for new innovations. It is then cheaper to offer already developed, old solutions. The second cause is related to this attitude of customers because customers do expect these improvements to be carried out. These improvements cost a lot of money, which means there is not so much money left for KPN to invest in innovation. With limited financial resources, progress is also limited. As a result, we are more likely to look at what is already available and redeploy it.

This weakness makes it important for the rest of the project to make good use of the resources that KPN already has. This gives them a good starting point for a business proposition and they can strengthen their position from there. As a result, an interesting business proposition can be designed with limited resources. Combining their current capabilities with their ability to collaborate with partners, makes KPN still able to have an impact.

Dependable on partners to make an impact | Weakness
A limitation that KPN will have to deal with is that they are very dependent on other parties to get things done, such as increasing sustainability. This can make it difficult to achieve certain goals, and KPN will have to be active in securing partners to achieve the same. Although KPN has to get these partners to work towards a common goal, the partners can also be seen as a strength. Because of the many partners KPN has, such a goal can also flow more easily outside KPN's supply chain. When this happens, the effect of KPN's efforts is felt in larger parts of society. So for designing a business proposition, it should be made sure that these partners are focused on a common goal and should all benefit from achieving that goal.

Rise of data sharing | Opportunity
More and more companies are starting to realise that by working together, more can ultimately be achieved for everyone. As a result, there has been a surge in collaborations and joint ventures working on particular challenges or solutions. Combined with the rise of data, which makes it possible to determine more precisely where things go wrong, this can ensure that supply chains are optimised more and more. All to serve the end customer as well as possible.

The knowledge and experience KPN already has about collaborating with partners, as discussed earlier, makes this a very interesting opportunity for KPN. By deploying their resources in the right way, KPN can offer a good business proposition to companies, making them stronger together. For the develop phase, this is, therefore, an interesting search field to consider.

Hassle-free service | Opportunity
Because more and more things are connected via the Internet and people are constantly up to date on everything, people and companies want to be served faster and with less effort. As a result, customer experience and relationships are becoming increasingly important for companies to focus on. To improve this, companies are working to remove all non-value adding processes or movements from the chain, such as waiting time. By doing this, customers can be served better and faster, which in turn leads to more satisfied customers.

The fact that the services KPN currently provide are mainly focused on real-time data exchange and partly already anticipate the simplifying of procedures, makes this opportunity an interesting one to capitalise on. This will allow KPN to distinguish itself from its competitors and become an essential partner for its customers. This conclusion will also have to be taken into account in the further course of this project to ensure that value can be created beyond just offering connectivity.

15.9 Appendix I

Interview guide feedback interviews

To guide the interview and followed discussion for gaining feedback on the presented concept, the interview guide below was used. The questions gave guidance in asking the right and interesting questions, but were not used as a script. Adjustments and additional questions came up during the conversation to deepen or broaden the feedback. All the interviews were held in Dutch, so the questions are also in Dutch.

Voorstellen

[*Mezelf even voorstellen en daarna andere mensen laten voorstellen*]

Idee presenteren

Het idee wat ik bedacht heb voor KPN is een maritiem ecosysteem waarin data gedeelte kan worden om uiteindelijk samen de processen te verbeteren. [*Idee uitleggen aan de hand van presentatie*]

Het idee

- Wat vinden jullie van het idee?
- Zien jullie dit soort vraag ook vanuit klanten uit andere sectoren komen?
- Wat vinden jullie positief aan het idee?
- Wat vinden jullie negatief aan het idee?
- Zien jullie punten die anders moeten?
- Zijn er onderdelen die nog wat aandacht nodig hebben?
- Hoe zou zo'n idee werkelijkheid worden?
- Vinden jullie het een realistische tijdlijn geschets binnen de roadmap?

Passend bij KPN

- Sluit dit idee aan bij de visie van KPN?
- Zou KPN dit idee kunnen realiseren?
- Sluit dit aan bij de krachten van KPN?
- Bij welke afdeling zou zo'n idee passen?
- Doet KPN al vergelijkbare dingen?
- Hoe pakt KPN dit soort samenwerkingen nu aan?
- Hoe zou dit passen bij [bepaald project]?
- Zijn er andere onderdelen die KPN nog zou kunnen bijdrage?
- Hoe zien jullie de strategische houdbaarheid?
- Zou de maritieme sector een goede fit zijn voor KPN?

Business model

- Vinden jullie het een realistisch business model?
- Past zo'n business model bij KPN?
- Wat zou er eventueel anders moeten aan het business model?
- Is het schaalbaar genoeg?
- Is de markt groot genoeg?
- Zou er genoeg geld aan te verdienen zijn voor KPN?

PRESENTATION CONCEPT FEEDBACK INTERVIEWS