University of South-Eastern Norway

The digital platforms in the maritime industry

An exploratory case study of two multisided digital platforms

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ABSTRACT

The purpose of this study is to provide and insight and deep understanding regarding the merging phenomena of digital platforms in the maritime industry for both manager from the industry and academic researchers. The aim is to comprehend the characteristics of the platforms, their key applications and the challenges that they are facing or presents to the maritime industry. For this reason, a qualitative exploratory study of two digital platforms were conducted. The data have been gathered through semi-structured interviews and analyse of publicly released documents. Then, it was analysed and processed using Yin guidance for case studies.

Some of the findings were supporting the theory while others were not. The key results highlighted the importance of the platform framing and its impact on enabling more cost-efficient transactions and attracts more users. The study highpoint also the area of applications where those platforms are contributing and last but not least, the key challenges that they face and present for decision makers regarding the security of their data and most of it the security of the information resulting from the process of those data.

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Dhia Tebni

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1 Introduction

1.1 Background

As the digitalization of businesses and society is increasing exponentially thanks to the growing computing capacities. Digital platforms become major players in both business to consumers and business to business relationships. They have spread and revolutionized almost every industry today.

The concept of platforms is a very old notion, a market place is also considered a platform. It is an environment that enable connections and interactions between buyers and sellers of different goods and services. Therefore, there are a many research that study them from an economical point of view. What is considerably new is the digitalization of such physical environment and its shift to a virtual place. Hence, the studies of digital platforms are not numerous comparing to other subjects and lack of comparability exist between them (De Reuver *et al*., 2017).

Digital platforms have grown into huge digital infrastructure and have been developed into corporations and even conglomerates such Alphabet Inc (parent of Google). This rapid growing scale and increasing complexity of their business models have made digital platforms a complex research subject (Evans & Basole, 2016). Besides the complexity that prevent from a holistic understanding of the phenomena, studies are usually performed as a snapshot in time while digital platforms are dynamic and have long time horizon. This method will not provide understanding of causalities (De Reuver *et al*., 2017).

Several other challenges orbit this research subject have been identified by Mark *et al.* (2017) regarding the concepts, scoping and methodology. So, they have provided recommendations for each issue they have recognised. In order to reduce conceptual ambiguity, they recommend researchers to provide clear description of what is a digital platform and to highlight the importance of digitality. The analysis also outlines the importance of widening the scoping of digital platforms research and to conduct longitudinal studies to avoid the risks from snapshot method.

The success stories of the world most famous social media digital platforms such Facebook, operating systems like Microsoft or E-commerce like Amazon and Alibaba have taken the spotlights for most of the research studies. The literature is lacking studies on how

some platforms succeed while others fails in the wide spectrum of different industries domains and especially regarding the business to business relationship. No single research has been found regarding the thrive of digital platforms within the maritime domain, this may be explained by the fact that digital platforms are based on big data exchange while the maritime industry have been suffering from serious lag regarding digitalization.

1.2 Motivation

Digital platforms are not only creating new businesses opportunities thanks to the network that they offer to the different market players, but they became majors' economic players in today's markets. Digital platforms such Amazon, Facebook or Google have taken the podium by being the three most valuable brands in the world (Brand Finance, 2018). They are influencing business models and shaping entire economies. Users' relations with organizations are changing as digital platforms simplify online interactions, and the rise of peer-to-peer relation have created a shared economy (Geoffrey *et al*., 2016).

Their bigger asset is a very low transaction cost between the stakeholders thanks to a standardised and automated handling of interactions, a revolutionary change in the existing relationship between suppliers and customers and in the development of new business models. This new business model of digital platforms has one thing shared, i.e. they exploit the potential of digital technologies to decrease business charges and they allow further market connections.

Being a low profit margin business, the maritime industry could have taken advantage of such opportunities, but the uptake of this technology has been very slow. Even though in terms of volume, seaborne trade represents over 80 percent of world trade (UNCTAD, 2017), only recently a few numbers of maritime businesses have started to leverage the use of digital platforms.

So, there is a risk that some organizations miss the tendency toward a more digitalized interactions within the maritime industry. Important strategic plans should be made by decision makers inside those companies in order to secure a sustainable competitive position in the market. Such decisions would only be successful when there is a clear understanding of the merging digital platforms in the industry.

This is the starting point of this master thesis, it will offer an overview of the features of such platforms and of the applications that are implemented under them. It will also provide a deeper knowledge about the aspect of openness and its relation to the issue of possible access

control. Are the inputs, the development, the usage and the commercialization limited or not, or if those limitations are realistic and similarly applied to all contributors.

The monopolisation trends in concurrence with the world most famous digital platforms' issues regarding the ownership of data and information are nowadays debate. The study will explore the types of data sets that have been used under these platforms, in particular the ownership of data and information. It will explore the challenges in sharing and utilization of such data by the different side players of a platform, and the impact they may cause on the development of this technology.

The research will also outline the opportunities that this technology represents for the maritime industry and will try to provide critical discussion and recommendations.

In order to reach this objective, the following research question is proposed:

- What are the digital platforms available for the maritime industry and their role in supporting the industry?

The study also involves the four following sub-questions:

- What are their characteristic and structures?
- What popular applications have been implemented by the maritime industry?
- What challenges and issues are encountered regarding data safety, analysing and sharing?

1.3 Thesis organization

This master thesis is organized in six chapters, each with their respective sub-chapters. Chapter one is an introduction that start by presenting a background of the subject followed by an outline of the current situation and the importance of the proposed research among the research questions. Chapter two reviews the academic literature on the topic regarding digital platforms and digitalization in the maritime industry. Chapter three explains the methodology used in order to accomplish this study. Chapter four presents the processed data collected about the studied digital platforms. Chapter five deals with the analysis of the data and the discussion. Finally, chapter six draws on the conclusion of the thesis as well as recommendations for further research.

2 Literature Review

This chapter is a review of scholarly articles and books relevant to the area of the research. It will provide descriptions and summaries regarding the topic of digital platforms and digitalization within maritime industry, while identifying new ways to interpret and trying to outline any gaps in prior studies.

2.1 Digital Platforms

Platforms are intermediaries who enables more efficient connections between different market players, as digitalization is spreading through industries and impacting most aspects of our daily life, platforms have been also digitalized and were able to realize even more efficient connections as they get rid of their physical limitation and become able to reach any market player around the globe and therefor build enormous networks.

De Reuve *et al.* (2017) outlined the fact that various definitions of digital platforms already exist in the literatures and this may lead to conceptual ambiguity and to the incomparability between studies. Therefore, they recommend researchers to specify whether the perspective on platforms is purely technical or socio-technical. However, this highlight over the technical side of digital platform may indeed create the ambiguity as there are numerous diverse technologies supporting different digital platforms.

Von Engelhardt *et al.* (2017) have made a more holistic definition: "*A digital platform connects two or more player groups in the market while the groups benefit from the size of the other group(s) and would not be able to interact as efficiently without the platform. This kind of platform market is also referred to as a two-sided or multi-sided market."* Building on this definition, I propose that a digital platform is a digital environment, in which a software can be executed in order to enable connection between two or more groups of users.

The size of the users of a digital platform is important since it will form the so-called network effect that determine the efficiency of this technology and furthermore, it increases its market value. For example, no one would use or invest in a social media or any e-commerce digital platform if just a tiny number of users are connecting to it, and in the other way round, the usefulness and the value of such platforms will increase as more users are connecting to it.

This correlation in the network and how a number of distinct group of players attract another group and vice versa is similar to the chicken-egg dilemma, and present a challenge to

the emerging new digital platforms. Interesting research studies could be realised regarding the best strategies to overcome this challenge especially for young start-ups.

2.2 Characteristic of digital platforms

A remarkable thing about the world biggest platforms is that they do not uphold any production systems to create physical goods or services, they bring together different sides of users and enable interactions between them. This why I am going to avoid presenting the one-side platforms, also called product platform, as they are not able to prove their efficiency and interest when competing with multi-sided platforms (MSP). Airbnb as an example are threating the hotel business around the world and competing with the world biggest hotel chain companies even the platform itself do not own a single hotel. Their valuable asset is the network they provide to the market players. MSPs are characterised by their ability to enable direct interaction between two or more group of users associated to the platform (Hagiu, 2014).

In the case of MSP, the network has two kinds of effects resulting from interactions (see figure 1). A direct network effects or same-side network effect is when the value of a platform for a group of users in the same side increase as similar users join the same side, a typical example is a social media, users will value the platform better as more of their friends or family join the network. Indirect network effects or Cross-side network effects is when the number of users in a side of a platform will attract more users in another side and make the platform more valuable for them (Staykova & Damsgaard, 2015).

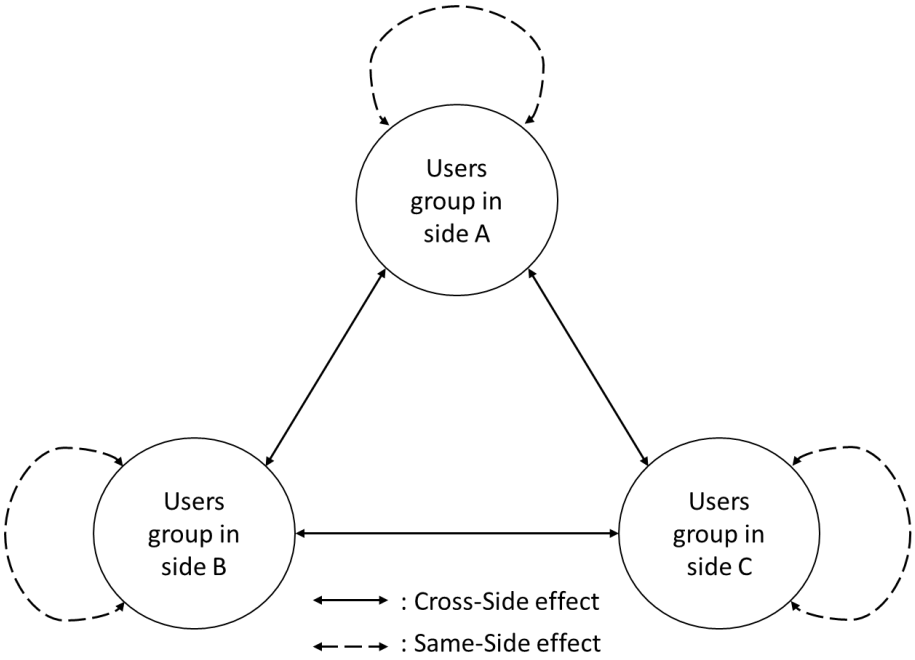

Figure1 Network effects within MSPs

This attraction for the cross-side network effects can be reciprocal, for example the number of users of an exploitation system attract more applications developers and the more useful applications available for an exploitation system this will attract more users. Or, it can be attracting a group of users in only one way, the number of users of a social media or search engine will attract more advertisers but no user is attracting to such platform because of the increasing number of the advertisers (Hagiu, 2014).

2.3 The Business Model framework of Digital Platforms

A business model describes how an organization is combining its resources in a way that value is created, delivered and captured through transactions (DaSilva & Trkman, 2014). This implies that the model is dynamic rather than static. Consequently, the business model for digital platforms is studied as Amit and Zott's models of the sources of value creation in e-business (2012), they assume that there are three characteristics that define a company's business model, content, structure and governance, if any of them change the whole business model changes (Amit & Zott, 2012). Building on their work, Staykova and Damsgaard (2015) proposed a framework to help understanding the digital platforms's business model by proposing the three following elements. The features refer the content or activities included in the platform. The architecture refers to how those activities are structured and linked between

them. Finally, the governance refers to who is performing each activity (Staykova & Damsgaard, 2015).

2.3.1 Platform features

In order to boost their network effects and market value in consequence, digital platforms leverage their ability to significantly reduce the transactions costs between different market players. The lower are the costs for a transaction, the more transactions will occur in a market (North, 1987). And for a transaction to take a place, it depends on how costly to search and find a partner, negotiate and sign a contract, revisions and adjustments, finally monitoring and enforce the deal (Stavins, 1995). Therefore, the business model of the most successful digital platforms makes use of digitalization and act as intermediary between the market players to drastically reduce those transactions costs (Von Engelhardt *et al.*, 2017).

Being an important portion of the transaction cost, many features of platforms tends to reduce the search costs (Hagiu, 2014). Indeed, sometimes the different players are even unable to get to each other unless they go through the platform. Hagiu (2009) have divided those search costs into two categories depending if it is two different sides that are looking for each other or it is only one side who is searching for the other. This differentiation on the search costs have huge impact on the design of the platforms (Hagiu, 2009) and should be taken into consideration in the pricing strategy.

2.3.2 Platform architecture

Due to their dynamic nature, digital platforms evolve into more complex system as they consolidate their network and can grow from being a simple side platform to a multi-sided platform like in the case of the social media Facebook. Hence, the initial main functionalities for the first number of sides that the platform was designed and created for is called the core of a platform. While in order to enhance the growing potential of the platform, developers will added the so-called peripheries, they are supplementary sides added to the platform as modules with distinct functions than the one carried by the core but they still connected to it and are part of the whole platform (Staykova & Damsgaard, 2015).

Depending on their core function, digital platforms can be divided into two categories, transaction-centric and data-centric platforms. The first type of core activity shapes the platform as a facilitator of transactions by bringing supply and demand players in the same field like a

classic market place. While the data-centric platform core compiles and analysis data flows from hardware and software to create an integrated digital system (Von Engelhardt *et al.*, 2017).

2.3.3 Platform governance

One of the platform most important criterion when it comes to governance is its pricing strategy. Decisions makers should choose between charging both side of transaction, *symmetric pricing*. Or, just charge one side, then it is called *asymmetric pricing* (Evans, 2013). As we have seen earlier the applied difference in the research costs depends on who is the most relevant group of users for a platform, especially in the case of non-reciprocal cross-side effect. MSPs will usually subsidy the side that constitutes the group of users that are highly valued (Evans, 2013). While other MSPs decide to provide their services for free (freemium model) or even pay users (negative pricing) in the highly valued side when entering a market in order to reach critical mass and create a positive network effect. In the starting of the platform PayPal, they offered USD 15$ for users when they register for a new account (Staykova & Damsgaard, 2015).

Platform openness is also another aspect of the platform governance. Which is defined by the absence of restrictions regarding the contribution of the development, the usage and the commercialization of platform, or if those restrictions exist, they are reasonable ones and equally applied to all participants (Evans, 2013). Platforms may open up *horizontally* by providing access to other established platforms providers or platform's sponsorship, or *vertically* by giving up third-party complementors access to the development platform and sales market of complimentary application (Benlian *et al.*, 2015). Based on those definitions, the openness of a digital platform can be framed as presented in figure 2.

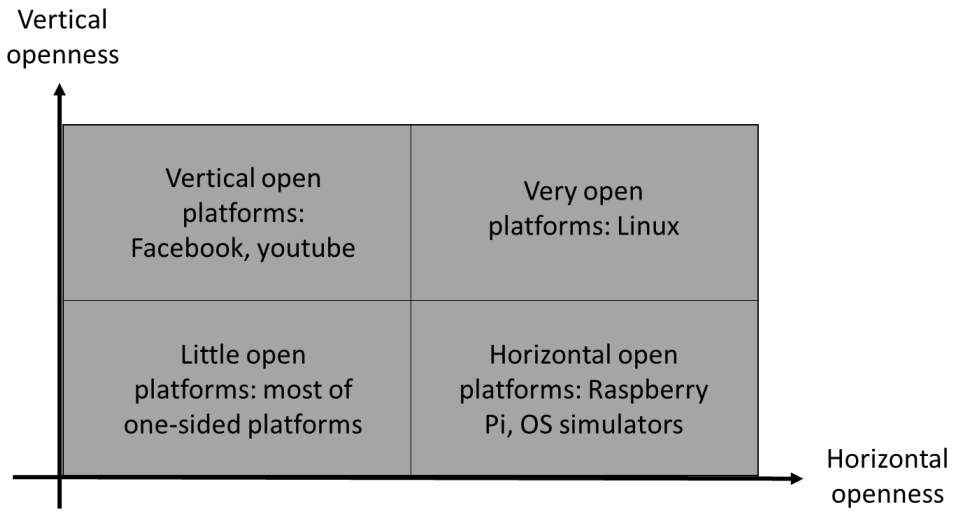

Figure 2 Plot of a platform openness with provided examples

2.4 Big Data

Like in all digital markets, data is a fundamental factor for digital platforms in the maritime industry. Indeed, 81% of the world maritime leaders interviewed during the Singapore maritime week (SMW) in 2016, recognize the importance of the big data in the future of the maritime domain. (Sea Asia, 2019). And as the industry is gradually embracing the era of technology and digitalization, there is an important amount of data that are being generated from navigation systems such radars, auto-pilot system, voyage data recorder (VDR), automatic identification system (AIS) and other related system in the bridge. And data related to the ship performance from machinery rooms regarding the engines functioning and power efficiency. Furthermore, special purpose vessels like drillship, cable-laying vessels and so on, require additional instruments relevant for their operations that will generate even more data.

2.4.1 Definition of Big Data

The term Big Data was initially created to describe a huge amount of data that is so large and complicated that traditional software was unable to analyse or deal with them (Snijders *et al.*, 2012). Nowadays, managing and analyzing such data is not an issue anymore thanks to the increasing capacity of computers to process and thanks to the advanced developed algorithms. The concept of big data today, includes also the data analytics (Mirovic *et al.*, 2018) that unable businesses and decision makers to discover hidden patterns, correlations, market trends and other useful information of the respective data sets (Perera & Mo, 2017).

Big Data can be structured or unstructured and is characterized by *volume* (How much data?), *variety* (what kind of data is it? Is it pictures, text, numbers, videos …?) and *velocity* (How fast are those data generated and analysed?) (Mirovic *et al.*, 2018). Another characteristic in the extended definition is veracity, which represent the quality of the data (Onay & Öztürk, 2018).

2.4.2 Application of big data in the maritime industry

In their published strategy regarding the use of Big Data in the maritime industry, DNV-GL highlighted six key application areas: technical operation and maintenance, energy efficiency, safety performance, management and monitoring of accidents and environmental risks from shipping traffic, commercial operation and ship operation (Mirovic *et al.*, 2018).

As there is no doubt that corrective maintenance is costly for operators, scheduled maintenance can also be a waste of money and time if there is no real need for it. Hull cleaning and propeller polishing are not realised regarding the actual vessel performance but just by estimations for example (Trelleborg Marine Systems, 2018). Data analytics can help technical managers to plan the optimal maintenance schedule.

The extracted data from a ship machinery such fuel consumption in input and the produced energy, exhausted gases, ship speed and other relevant outputs in different configurations, such wind speed and direction, waves, average draft, trim, etc, constitute rich source of useful data that can be used to develop navigation strategies to improve ship energy efficiency (Mirovic *et al.*, 2018) or to be compared to a baseline model reference to have and overview of the actual ship performance.

The safety of the vessels wherever during sea voyage or in ports, can also be improved thanks to Big Data analytics. The automatic identification system (AIS) combined with GPS, meteorological and oceanographic systems can create scenarios of the upcoming situations and assist the pilot during close manoeuvres.

Big Data analytics can provide commercial managers with information concerning delays due to bad weather or congestion and estimated times of arrival, predict bunker prices as well as the freight forecast and other market information so they can reduce the operational and logistics costs (Mirovic *et al.*, 2018).

2.4.3 The key challenges

While other industries have significantly took competitive advantage from the use of big data. Its implantation within the maritime industry has been relatively slow. The majority of the leader companies in the Norwegian maritime cluster agree that the adaptation of digitalization within the industry is quite slow. Therefore, they share an optimistic view about it (Imset, 2018). Batra (2017) from Eniram invested this issue and got feedback from 50 operators. He reports that the strong engagement and interest from top management alone is not enough, it looks that the lack data specialists and a proper project team was a common reason for failing (Batra, 2017). The lack of data-skilled workforce was outlined as a major challenge in the survey of the world maritime leaders released by Sea Asia (2017) (Networks Asia staff, 2019) and the demand of specialists in data-related engineering was even expected to exceed supply by more than 50% by 2018 (Trelleborg Marine Systems, 2018).

Another major challenge is the risk of attacks from cyber criminals and terrorists. According to Joseph Carson, ESC Global Security's head of cyber security division, the use of Big Data in the maritime industry will increase the vulnerability to cyber-attacks (Trelleborg Marine Systems, 2018). Also, the legislative framework that will dictate the boundaries of using data is missing (Vlahogianni, 2015), unfortunately, this leaves the door open for the misreporting of data. In a report published by windward in 2014, they claim that at least 1% of ships broadcast fake IDs and only less than the half of them report their next port of call accurately (Windward, 2014).

Even if data are not intentionally misreported, they may be erroneous due to sensor faults or mistakes during manual entry (Mirovic *et al.*, 2018). Perera (2017) points to another major challenges when handling Big Data and categorize them as internal and external challenges. While the external challenges relate mainly to the cost effectiveness of handling large data sets during communication and storage. The internal issues relate to the data quality and quantity. He proposes a machine intelligence-based data handling framework for ship energy efficiency and to deals with the quality issue in two layers. First, the study proposes to identify the sensors faults by observing the mean and variance of each parameter as it should not exceed his settled range or it will be eliminated in the data pre-processing step before being classified and compressed to be sent to the shore. Secondly, other sensor fault situations, the unusual behaviors, are identified by the covariance value among the corresponding parameters (Perera & Mo, 2017). However, the data cleaning from noises and the rejection of extreme

values may result of the loose of very useful ones (Vlahogianni, 2015). The data quantity results in challenges for the transfer of data between the vessel and the shore when it is in deep sea because the bandwidth and costs of communication via high sea satellite are limited (Mirovic *et al.*, 2018).

3 Method

This chapter outline the applied method used during the research study in order to answer the research questions evoked in the Introduction chapter. According to Bryman & Bell (2011) "*A research method is the processes and technique for collecting, analyzing and interpreting data to realize the objectives of a study*". Therefore, the first part discusses the research strategy and research design. The second part, present the plan to collect the data. Followed by a part where it describes the data analysis procedures. The last part focuses on the research challenges and quality.

3.1 Research strategy and research design

Research studies can be classified according to many different parameters: Data collection method, objective of the study, data availability, the research questions, etc… Given this, the complexity and the length of the design can differ significantly. But the main purpose remains the same, which is to find the most efficient way to collect data, analyse it and interpret it in a way to achieve the main goals of the research (Bryman & Bell, 2011). Following are the most common classification based on the method, the design or the purpose of the research.

3.1.1 Methodology of research: qualitative vs quantitative

Qualitative Research offers comprehension of a problematic that it is not well studied yet. It is an exploratory research used to gain an understanding. It generates a theory by the interpretation of the research's finding or helps to develop hypotheses for potential quantitative research (Miles *et al.*, 2014).

The data collection methods for the qualitative research method vary using unstructured or semi-structured methods, and the sample size remains small (Miles *et al.*, 2014).

In the other hand, quantitative data collection techniques are much more structured. The data collection methods include surveys, interviews, longitudinal studies, systematic observations, online polls, and website interceptors. Used to quantify defined variables like activities, attitudes, and opinions. Those quantifiable formulate facts and help discovering new patterns in the research. Then, it generalizes results from those large sample population (Bryman & Bell, 2011).

3.1.2 The Design: Experimental design, cross-sectional, case study, longitudinal design or comparative design

Further, the research study is also classified regarding its design. Following are presented the five most common design types.

In experimental design, researchers manipulate the controlled variable and measure its outcome effect on the experimental group compared to a control group, groups should be identical. If it is difficult to fulfil this condition, a quasi-experimental design is used instead (Gray, 2014).

Unlike experimental design where researcher control the situation, cross-sectional design has a reliance on already existing differences between different groups who are not selected randomly but based on their differences. The study will provide a "snapshot" in the time for the outcome associated with each characteristic (Bethlehem, 1990).

A case study design is a very specific study usually used to narrow down a wide field into easily researchable cases. The case may be an event, organization or individuals providing detailed descriptions but they may not be generalized to a wider population (Yin, Case Study Research: Design and Methods, 2009)

Longitudinal studies observe the same sample during a period of time and realise multiple observations. This design enables to discover patterns of change over time and even help the prediction of future outcomes (Anastas, 1999).

Comparative study design is made in order to compare different groups of samples to draw conclusion about their similarities and differences. It widely used in social science studies and in cross-cultural research (Hantrais, 1995).

3.1.3 The Purpose: Exploratory, descriptive, explanatory or interpretive

David E. Gray (2014) have proposed that we can also classify the research studies into four categories regarding their purpose:

Exploratory studies are conducted when there is not enough known about a problem and no previous or not sufficient studies have been made before. It is a useful approach to gain basic information about a particular phenomenon.

Descriptive studies are realized to provide a picture of the event, situation or sample. While it is mainly a descriptive study it may also compare the collected data to some standard, but it cannot deliver explanation.

Explanatory studies are made to find the reason behind the studied problem and therefore may ask the questions why and how.

Interpretive studies focus on social contexts and seek out peoples' experiences trying to derive a theory about the phenomenon from the collected data.

3.1.4 Triangulation and the chosen methods

In practice, multiple methods can be used because a research study include different research questions and every question require different approach. This will also enable the use of Triangulation, which refers to the collection of data from different resources and over different period of time. All methods have their strengths and weaknesses, so the use of multiple methods will create balance and avoid the dichotomy (Gray, 2014).

Therefore, to answer the research questions mentioned in the introduction chapter and to properly cover this phenomenon of merging digital platforms in the maritime industry, the following methods will be used:

Since the research subject is at its early stages the qualitative research methodology is more appropriate. And a multi exploratory case studies design is chosen to narrow down the wide field of maritime digital platform into easily researchable cases with an exploratory purpose because no previous study about the subject have been found. So, these methods will provide a well-grounded picture of the phenomenon with focus on the most relevant data.

3.2 Data collection

The qualitative evaluation of the digital platforms in the studied cases require specific information from all pertinent sources to answer the research problem. The relevant data are resulting from four field-based activities: Interviews, Observations, Collection and examination of materials and feelings (Yin, 2011). Therefore, the data are collected from multiple data sources to enable triangulation when gathering information from what have been already published about those digital platforms especially in the owner's online portals. Later, the information that are difficult to find and impossible to observe are gathered through semi-

structured interviews and e-mails exchanges aiming to ensure a greater level of depth understanding.

3.2.1 The samples

In order to provide an answer to the research question I identified two multi-sided digital platforms. The sample were selected to illustrate the heterogeneity between the platforms even if apparently, they are promoting the same kind of service. The two companies behind the development of those digital platform are world leaders in the maritime industry and having both companies investing in the same technology is a sign of the importance of this innovation idea and the scale it is going to take in the near feature.

Kongsberg Digital released its digital platform Kognifai on Mars 2017, an industrial digital platform and ecosystem aiming to enable users mainly from the maritime industry to capture, transfer, process and cost-efficiency process the data generated from their assets and extract valuable information from it. The platform is presented as an open ecosystem and promoting openness value.

The second studied digital platform is developed by DNV GL and called Veracity. It was released on February 2017. The aim of the platform is to be an intermediation between professional parties from mainly the maritime domain. Providing them access to both data sets and applications and services for purpose of benchmarking or to process the raw data and turns them into valuable information.

3.2.2 Data collection procedures

There are many interviewing techniques suited for a qualitative research study, it can be totally open interviews or more structured ones. Open interviews are more similar to a conversation, without the need of close-ended questions. Semi-structured interviews still have a flexible structure, but still contain a sequence of questions to be asked. The sequence of questions is built based on an interview guide containing topics to be discussed (Bryman & Bell, 2011).

The interviews, were prepared by an “interview guide” with questions and topics linked to the research questions. The guide helped me as an interviewer to follow a direction and a structure but it is also tolerable to cover the topics through different orders. The analyse of the officially published documents by the platforms owners has also been an important part

of the data collection method. Finally, a series of e-mails exchanges has been also established with different parties presenting the platforms in order to get more specific information about certain area during the process of the raw data.

3.3 Data analysis

The main goal of the analysis is to understand the phenomenon by examining qualitative data, it is trying to discover patterns and circumstances that are related. Unlike the quantitative research, the collected data in qualitative research are not structured, this is why there is no rigid process on how to do it. Therefore, having a set of clear and directive guiding procedures that can be followed is critical in order to draw a constructive conclusion.

Another unique feature of case studies, is while in most other methods the process of planning for data collection, collection of information, analyse and then report is chronologically ordered. In case studies, the analysis of the data is performed as it becomes available (GAO, 1990). Baškarada (2013) had built on Yin (2009) work and had described this complex process for the case studies research in six interdependent stages (see figure 3), where the arrows point to the order in which we can move from one stage to another.

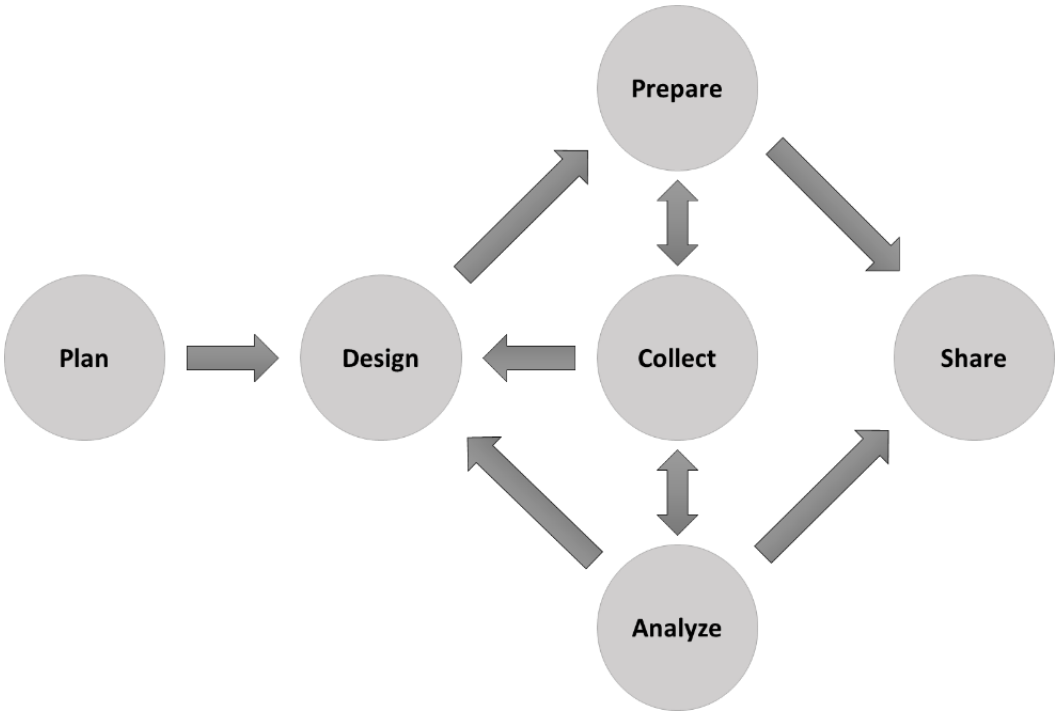

Figure 3 The Case Study Process (Yin, Case Study Research: Design and Methods, 2009)

As presented in figure 3, the analysis stage is concurrent with the data collection stage and can even lead back to the design stage before sharing the results. For this reason, an analysis method developed by GAO (1990) is going to be used for this research. It is referred to as OTTR, which stands for "*observe*", "*think*", "*test*" and "*revise*". This sequence is an iterative process where the observations are reflected upon and form the subsequent data collection.

Observe refers to the stage where observations are made in an attempt to formulate a possible hypothesis. *Think* is about thinking of the meaning of the information, what is happening and why, what does it imply. Usually this stage and the observation are interconnected and the analyzer start to think as he is observing. And this leads to the need of new information. So, we have *Test*, where based on the previous interpretations additional information is collected and examined. Finally, the *Revision* stage, which reconsider initial interpretation and may lead to another *test* phase. This loop is broken when a satisfying explanation is developed, there are no unexplained data left, no more possible interpretation can be made or additional data will not lead to new information (GAO, 1990).

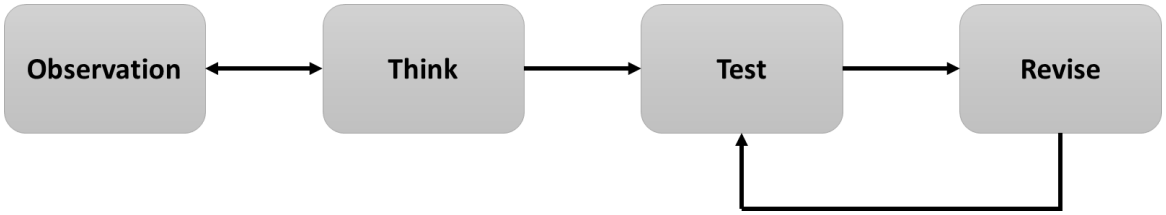

Figure 4 The OTTR process

Another important tool used in this qualitative analysis of the gathered data is the Platform Business Model Framework developed by Staykova & Damsgaard (2015). This analytical tool helps outlining the differences and resemblances among the studied cases. And, it highlights its features, architecture and governance. Which is very useful for answering the sub-research question about the characteristics and structure of the studied maritime digital platforms. The framework has been previously presented in the literature review chapter. When applied to a case of digital platform.

3.4 Research quality and ethical consideration

The quality of the research is usually evaluated by the validity and the reliability, while the first indicate if the research really measured what was intended to, the second represent to what degree a method will produce the same consistent results. But due to the unstructured and

dynamic nature of an exploratory qualitative study, they may be not suitable for accessing it (Bryman & Bell, 2011).

For that reason, a guideline for reviewing case study reports, developed by GAO (1990), is adapted for accessing the quality of this study. It's about a checklist that review the design of the case study, the data collection methods, the data analysis techniques, the reporting and the impartiality and generalizability of the report. The check list is provided in the appendix in table I.1. These guidelines are standards that can be applied to all case studies and present the minimum standard of quality (GAO, 1990).

While the case studies design adds depth and pragmatism to the research by making it more realistic, the described digital platforms in and the results of the analysis cannot be generalizable. Data may not be statistically reliable or valid as explained earlier. So, special consideration should be taken to avoid inappropriate generalizations.

Also as seen earlier in the techniques of data analysis, Yin (2009) recommend a back-and-forth approach between the design, the data collection and the analysis stages. This present a challenge on how effectively manage the intense velocity and scale of treated data due to the limitation of the time scale of a master thesis.

Ethical aspects of the study are considered and high ethical standards are maintained at all stages. This study does not need approval by the Norwegian Centre for Research Data (NSD), because there is no collection, recording or storing of information that may be linked to the interviewed persons (Norwegian Centre for Research Data, 2019). No names or personal information are citated in this thesis or even saved in my personal files. Furthermore, the collected data are purely technical and commercial, and does not include any sensitive personal data. The interviewed persons have been informed about the study that being conducted, its description, aims, methodologies and whatever if they accept that the collected data will be publicly published. In addition, the names of informants are held anonymous to ensure the respect of ethical standards. Also, legal considerations such as copyrights, sensibility of some data regarding competitiveness and conflicts of interest have been considered during the data collection and the presentation of findings.

4 Findings

In the following section, I present the processed data about two different digital platforms. Data were gathered from publicly available sources and from directly interviewed informant and exchanged e-mails. They are structured and organized in conformity to the literature review chapter.

According to Yin (2009), in the case of exploratory case study, it is very important to develop a descriptive framework for organizing the study as it helps as well with developing a story line. This is why an adaptation of the Business model framework developed by Staykova and Damsgaard (2015) is also used in order to highlight the characteristcs of the platforms.

In the end of this chapter, I present a summary of the main finding in a table to highlight the differences and similarities between the two platforms.

4.1 Characteristics of the platforms

4.1.1 The features

Kognifai brings together two different sides of users' group to the platform. The first side is the customers from the maritime industry who owns and generate data sets from their assets. While the second side of the platform are the developers of the applications and services that will be processing the generated data and transform it into useful information. The last users' group is considered as a third party and are in a contractual relationship with Kongsberg Digital, the owner of the platform.

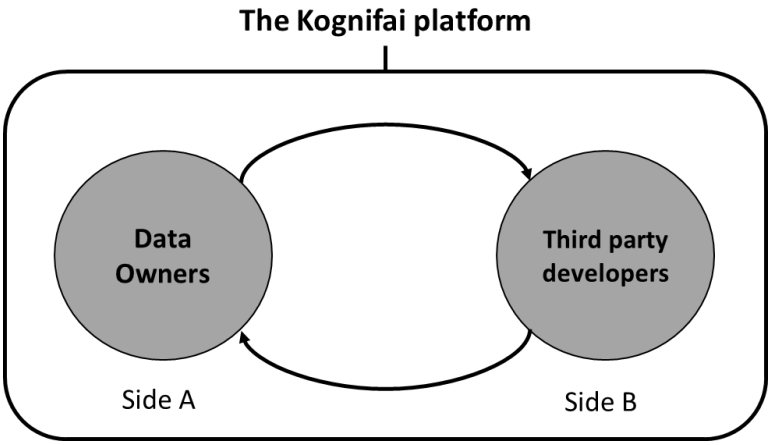

Figure 5 The nature of attraction between the sides of the Kognifai platform

The data owners and the developer of applications have mutual attraction to each other, where the so called cross-side effect. There is no same-side effect. This means the users of each side are only interested to the other side and not to the users of his own side (see figure 5).

Many of the proposed applications in the market place of the platform are already developed by Kongsberg Digital, and there is big focus in the marketing strategy of the platform to attract more developers' partners.

Those developers benefit from an easier access to the market place thanks to Kongsberg promoting their applications making them one click away from potential customers. While the data owners realize a cost reduction by standardizing the capture, transfer and analyze of their data sets.

The veracity digital platform has also two sides but a different framing. The first side is called consumer, which is any user who is granted access to a content on the platform, it can be data, applications or services. While the second side is called content provider which is any user who makes available and offers provider's content on the platform to the other users. it can be data sets, information or services and applications. This means a data owner can be a provider and consumer. The same applies to the developers of applications and services, they can also be consumers and providers. It creates a dynamic network effect between sides and results in both cross-side effect and same-side effect (see figure 6).

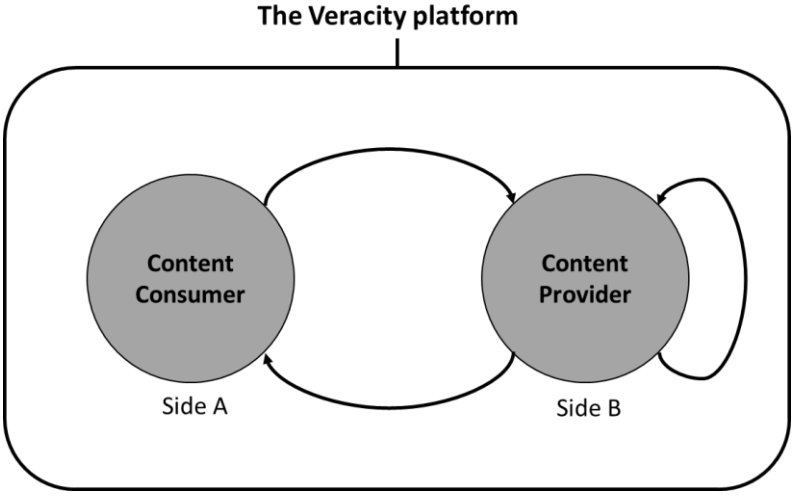

Figure 6 The nature of attraction between the sides of the Veracity platform

The cost reduction for the both sides is achieved through an easier connectivity between the industry players. A consumer has a fast access to different industrial applications and data analytics services, he can also get access to others' data sets for benchmarking to create new insights or solutions. Developers and contents providers can propose their services and products in the marketplace and benefits from the marketing made by Veracity.

4.1.2 Architecture

The Kognifai ecosystem digital platform core function is to enable the users of this platform to capture data from their assets in the maritime industry and to securely transfer it to the edge hardware or to the cloud using the platform infrastructure. Data can be technical performance indicators or financial performance results.

The Veracity platform core function is also to be an intermediation service between professional parties. Its purpose is to provide access to data and applications providers to the users of the platform.

The core of both platforms is meant to be a transaction-centric type, with also a slight aspect of a data centric one. Because at their lunching phases, they are offering services which are applications developed by the platforms' owners to capture data, assist managing it and process it to the purpose of generating valuable information.

As a periphery of the platform. Kognifai provides a way for the third parties to develop and deploy their applications using the Poseidon Next-framework and other sets of tools. Veracity also realised a developer program aiming to assist and empower services and applications providers as a periphery to the core of the platform.

4.1.3 Governance

The main aspect of a platform governance is the pricing strategy. For the platform Kognifai, a symmetric pricing strategy has been applied because both of the sides of the platform are priced. Customer's use and access rights to the platform is subject to monthly fees independently from the services or applications he subscribes too. The third-party developer is also subject to pricing from Kognifai in a three-level partner program with benefits and responsibilities leveling up. There are also pricing and revenue sharing applicable for the sale of the integrated service on the platform.

The veracity platform has a different pricing strategy. It is asymmetric regarding the platform's sides; it has a freemium pricing model for the content consumer users 'side. Unless they want to gain the right to upload data to the platform and acquire storage capacity and more data bandwidth proportionally to monthly fees. The services and applications developers have three pricing models with onboarding fees and 30% of the gross revenue.

4.2 Platform openness

As mentioned in the literature review chapter, different parameters and two dimensions can define the openness of a platform. The usage of the Kognifai platform has no special restrictions applied to the customers as far as it is in respect to the terms of use. The development is restricted to the development of services and applications that will be offered on the platform to the costumers and if they are in respect to the partnership agreement. But no part of the platform is subject to a development without prior written consent with Kongsberg Digital. The partners can still commercialize their service or applications globally without restriction and can combine the KONGSBERG brand with their own brand when marketing their integrated service through the platform. The platform proclaim that they are in a partnership with other digital platforms like OceanHub but no further details could have been acquired regarding the nature of those partnerships.

Restrictions of the usage of the Veracity platform are specific, the access to data on the platform for example can only be shared with other users of the Platform. Also no resell, sublicensing or distribution of the service and application is allowed outside the platform environment. The development part concerns only the services and application provided through the platform, no reverse engineering, modifying or creation of derivative work is allowed regarding the platform itself or any of its contents. Veracity do not specify any special partnership with other digital platforms but they are allowed to offer their services and contents providers through the platform as any other user. The partnership with Microsoft Azure is mainly for the infrastructure as a service (IaaS).

4.3 Area of applications of the platforms

The major focus of the platform Kognifai at the moment is the dynamic digital twin technology that meant to create digital replica of complex offshore oil and gas facilities. It is a dynamic model developed by the owner of the platform used during the different phases of a project to stimulate the assets behaviour and be able to improve the design, leverage the performances and maximize safety. There are also a large set of services focused on the windfarms industry to provide overviews of the whole production chain. Key performance indicators and calculations are carried out thanks to the incoming flow of data gathered from the facilities and hence monitored continuously. The software methodology being used is an analytics maturity model consisting of four levels with the value of analytics and the level of difficulties increasing gradually (Sverdrup, 2017). The model is presented in the figure 7.

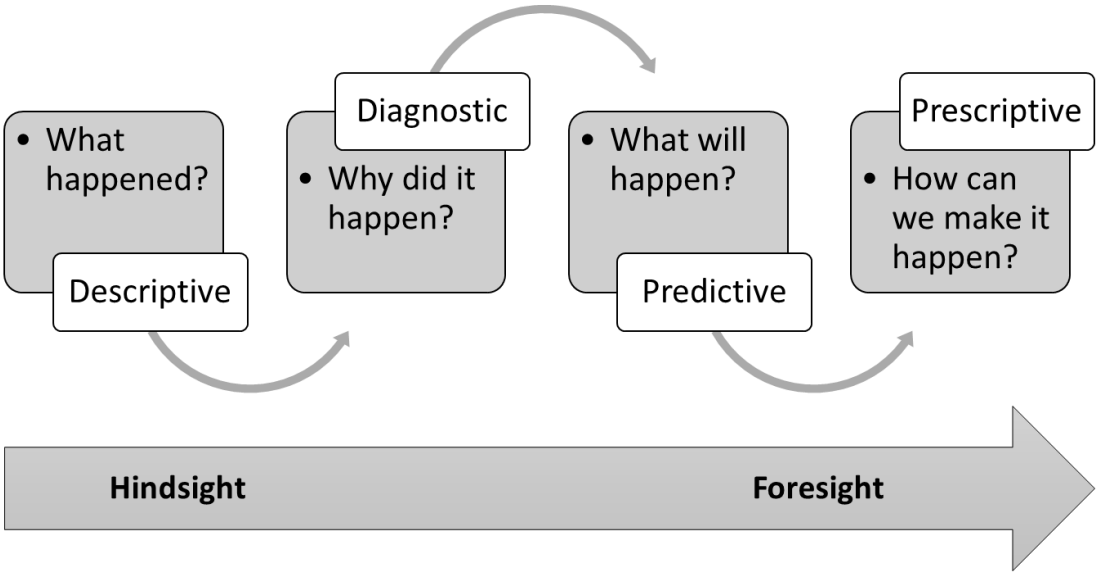

Figure 7 Analytics maturity model for Kognifai applications

As previously mentioned in the literature chapter about the six-key applications area predicted by DNV GL for the use of big data in the maritime industry, the collected data about the platform veracity reveals that those six areas are approximately equally represented. Technical operations applications like AGR software for example gather data from well drilling to generate time and cost budget about the project. The analytic services from analytic innovation centre content provider ensure safety performance. Alternative fuel insight platform proposes their services through Veracity to counter energy and fuel challenges for ships. While

applications developed by DNG GL like Arundo maritime suite support ship operation by ensuring the stream of data from ships in disconnected areas to their onshore counterpart. Or service like Assets monitoring from space which manage assets accidents and environment risks.

4.4 The challenges

4.4.1 The lack of data specialist in the industry

To counter the challenge of deficiency in the number of skilled data work force willing to invest in developing new services and applications for the maritime industry. Kognifai ensure full support for the costumers and owners of row data both from the platform support team and from the third parties' applications and services providers. Those third-party developers are also provided training to use PoseidonNext, Galore and other development tools which are provided free of charge. Free online training for the basic partners and on-site training boot camps for the more involved.

The platform Veracity provides also support and easy access to tools for applications and services development purposes, there are abundant detailed free tutorials on the platform website and possibilities to attend free workshops. The platform owner and the content providers will offer data quality management services upon request. These services will back up data managers in evaluating, understanding and leveraging the quality of their data sets, and making their data better suited for analytics.

4.4.2 Security and cyber attack

Kongsberg consider the security as part of their culture. To keep both data and services on the platform secure, they employ a layered security approach consisting of physical protection for data centres locations which are audited for compliance with ISO 27001. Secure Edge hardware for capturing, encrypting and transmitting the data to the data centres using Kongsberg global secure network. But the developers are solely responsible for the third-party applications and related content on the platform. Kongsberg Digital mention in their term of use document that they shall have no obligation or liability arising from such content provided by a third party, but in an interview, they confirm that they will assist in handling any conflict between the parties. Hence, they pledge that their services are tested to ensure resilience against threats and cyber-attacks. Also, third parties' applications are tested and certified. Finally, there

is an administrative control, permanent monitoring of services and continuous scanning for threats and vulnerabilities to comply with the specification for information security management system ISO 27001.

The Veracity platform relies on Microsoft Azure Infrastructure, which a cloud computing platform, to physically protect data integrity. Manage the user's authentication process. And encrypt to keep the data private and protected both at storage or when transmitted between terminals and data centres. Those data centres are managed, operated and administered by Microsoft operations stuff and of course complies with ISO27001 security management system standards. Hence again, in their term of use. The platform owner point to the fact that the platform shall have no obligation or liability arising from Provider's content or any transaction and only the relevant provider is responsible for the content he offers on the platform.

The quality, accuracy, integrity, legality, reliability and appropriateness of all customer data in both of the platforms is the sole responsibility of the provider.

4.4.3 the ownership of data and contents

Kognifai precise that any data, including text, sound, video, image files, software, payment data, administration data, and support data which is uploaded by the costumer to the platform shall remain his property. He owns and retains all right, title and interest.

Same applies to the Veracity platform where each party shall remain the sole owner of any intellectual property rights existing before the use of the platform. There should be no implied transfer of rights unless explicitly mentioned between different parties since the access to the data for example can be transferred or shared. But such transactions may only be granted to other users of the Platform.

Both platforms acknowledge that they may access, use and process the user's data but only for the purpose provide and optimize the platform service.

4.5 Summary of the findings

Based on the analysis of the interviews and documents the summary of the findings are summarize in the table 1:

Table 1 Summary of the findings

The platform	**Kognifai**	**Veracity**
Characteristics		
Features		
Sides (users 'group)	2 Sides: - Data owner - 3rd party developer	2 Sides: - Content consumer - Content provider
Nature of attraction	- Both sides attracted to each other. - Cross-Side effect	- Both sides attracted to each other, and the content provider is also attracted to other content providers. - Cross-side and same-side effect
Cost reduction feature	- Bring the data owners and data analytics services together to reduce the search cost	
Architecture		
The core	- Enable users to collect, store and connect with analytics providers to extract value from their data. - Mainly transaction-centric platform, but also important data-centric tendency.	- Connect content seeker and content provider from the maritime industry. - Mainly transaction-centric platform, but also slightly data-centric.
The peripheries	- Provide tools and support for analytics providers to develop and deploy their applications and services through the platform.	
Governance		

Pricing strategy	- Pricing both sides of the platform with monthly fees. - Revenue sharing with the developers of applications and services - Symmetric pricing strategy	- Pricing only the content providers side. - Revenue sharing with the developers of applications and services. - Asymmetric pricing strategy, freemium model for content seeker side.
Platform openness	- Open for the development of new services, but restrictions on the development of the platform. Reasonable restriction on usage and commercialization. - Partnership with 3rd parties and other digital platforms - Fairly open both horizontally and vertically.	- Open for the development of new services, but restrictions on the development of the platform. Reasonable restriction on usage and strict ones for the commercialization of contents. - Transactions regarding data are only allowed inside the platform environment. - Developers are considered only as content providers and not 3rd parties. No obvious collaboration with another digital platform unless to propose a service.

		- Poorly open vertically and horizontally.
Applications	- Dynamic digital twin technology with a focus on the oil and gas offshore industry. - Renewables energies and wind farms. - Maritime domain	- Technical operations and maintenance - Energy efficiency - Safety performance - Managing accident and environment risk - Commercial operation and ship operations
Challenges		
The lack of data specialist	- Full collaboration and provided support for the 3rd parties developers including free online training, detailed tutorials online, free access to development tools and on-site training boot camps for special partners. - Data owners are promised support by both the platform owner and the 3rd party partners.	- Users receive data quality management services from both the platform owner and other providers upon request. - Provides support, tools and tutorials for the services and applications developers. - Free workshops at DNV GL site for developers.
Security and cyber attack	- Layered security approach consists of physical security, Edge hardware, data communications, secure development,	- Microsoft Azure infrastructure security standards for data protection at rest and in transit.

	monitoring and administrative controls. For both the edge and the cloud. - Audited 3rd party data centres for the storage of data. - 3rd parties' applications are tested and certified.	- Certified secure operations and Incident management system. - Strict administrative controls. - Relevant provider is solely responsible for his content on the platform which may subject to separate terms and conditions.
The ownership of data	- Data owners retains all rights and titles after they upload their data to the platform. - The platform owner may access and use the customer's data only for the purpose to provide services to customer.	- Each party keep the sole owner of their intellectual property rights existing before signing the agreement. - Data ownership can be transferred or shared with other and only the users of the platform. - Platform owner is entitled to access and use the user's data to optimize the platform service.

5 Discussion

This chapter present the discussion reflecting the findings presented in the previous chapter in light of the academic literature and it holds critical reflections discusses limitations. The discussion follows the same structure of the findings and the literature review chapter.

5.1 Characteristics of the platforms

5.1.1 The features

Based on the definition provided in the literature chapter about a multisided digital platform from Von Engelhardt *et al.* (2017), two important things can be deducted. First is the importance of defining the sides of a platform or so-called groups of players in the definition. Since the core function of a platform is involving them. A remarkable difference is observed when comparing the approaches made the two studied platforms. The aim of this study is not to compare them but it is important to highlight those differences or similarities in order to gain a better understanding of this technology and its implications. Second, is the importance of the groups sizes and what they represent for each other.

The platform Kognifai has a basic separation between her two sides. The data owners who seek services and applications from analytics providers to process those raw data and extract valuable information from them. The analytics providers or third-party developers are also seeking those data owners as they are potential customers for them. This results in mutual attraction between the two sides and in a cross-side network effect.

In the other hand, the platform Veracity has a different approach, data owners and applications developers are considered content providers for the platform and can be presented in the same side. In the opposite side you have the contents consumers. So, both sides are seeking each other which result in a mutual cross-side effect and a same-side effect at the level of content providers, since a data provider can be looking for a data consumer on the other side, or for an application developer in his side. Same applies to the applications developers.

Those network effects, same-side or cross-side, they will be creating interactions between the sides, and consequently generate value for the platform. The intensity of those

network is defined by the level of attraction between the sides and will result on attracting more users to the platform (Staykova & Damsgaard, 2015).

Users' groups benefit from the size of the other groups as it enables more efficient interactions (Von Engelhardt, 2017). So, the studied platforms are trying to maximize the size of their users' group with different approaches.

5.1.2 Architecture

The core of a platform constitutes the main functionalities for the initial number of sides (Staykova & Damsgaard, 2015), Kognifai and Veracity converge as intermediation service platforms between professional from the maritime industry. According to Von Engelhardt (2017) definition, this is a transaction-centric platform. But with a close look at their respective market place, Kognifai has an important number of applications and services developed by Kongsberg Digital which are the owner of the platform, this turns the platform into a data-centric one. This could be the owner strategy to counter the causality dilemma of attraction between the users' group. Veracity also propose some contents developed by the owner DNV GL, it makes sense to leverage the asset of both companies' capabilities and expertise in digitalization and in maritime domain at platforms early stages release. But it was presented at the literature chapter how successful platforms do not hold any production system and focus only on bringing more users to their sides. Hagiu (2014) also argued how the strength of such platforms is to enable interactions between two or more different sides. The case of Kognifai for example can turns into a simple product platform if they do not succeed at attracting more third-party developers.

Then the importance of modularity or called peripheries and how they can increase the evolutionary potential of a platform (Staykova & Damsgaard, 2015). Both platforms are almost in a race to appeal more applications developers and lunched programs to assist and help in developing and deploying new applications using a set of free tools provided by the companies. It may not create new sides as explained in Staykova and Damsgaard study (2015), but will defiantly empower one of the sides and make it more interesting to the users.

5.1.3 Governance

According to the theory, the pricing strategy is built upon on the value that each side represent to the other (Hagiu, 2009), it means a platform owner will decide which side is more valuable. Evans (2013) also claimed the same, depending on who is the most relevant group of users, the platform owner will decide to implement a symmetric pricing strategy or an asymmetric one, or even goes for the freemium or negative pricing model if this users' group are highly valued. I could not get a clear response to which is the most valued side for each platform, but in the light of the theory it is possible to get an insight about the matter. For the Kognifai platform, a symmetric pricing strategy is applied for the sides, a deduction will be that both sides are valued the same for the platform owner. Unless one of them is subsided and not fully charged. I don't have access to the financial studies of the companies neither expect them to share it publicly. Veracity has an asymmetric pricing strategy. The content consumer account is completely free of charges, unless he wants to upload his own data that he will have to upgrade his account and be monthly charged for that. The applications and services providers are charged, even if in the marketing on the platform's website it says that a certified developer account is free but in reality, he still needs to sign the provider agreement that implies 5000 USD as onboarding fees plus 30% of gross revenue with a minimum of 1500 USD per year. This is to be considered as asymmetric pricing strategy that according to the theory implies that the content consumers are a highly valuable side for the platform. Which may sound absurd at first glance, since those who are going to invest their data, and energy to develop applications for the platform should be more valuable. But after all those second users won't show up unless they feel the potential of customers in the first side. Therefore, Veracity is proudly promoting that they have more than 150 000 users since any internet user can easily create an account and even get access to some free services to become a user in the content consumer side.

5.2 Platform openness

The concept of platform openness has been proven to be crucial element in the development of digital platforms thanks to what have been observed and learnt from successful cases. While Evans (2013) proposed to measure the degree of openness regarding the restriction on the usage, commercialization and development of the platform. Benlian *et al.* (2015) proposed the theory of tow dimensions openness for platforms, depending on if they open to third parties or to other digital platforms. Combining the two theories, it helps to situate the studied platforms on virtual plot of openness (see figure 8). The observation of the platform

Kognifai and the analyse of the processed data show that the platform has not implanted strict restrictions on the third parties for the use, commercialization of the platform or the development of their services and applications. It was not possible to get clear data about the nature of collaboration with other digital platforms but based on interviewer declaration, it can be assessed as a fairly open platform both vertically and horizontally, with slightly more openness towards third parties' developers. Veracity in the other hand just consider the applications developers and services providers as users and do not recognize them as third parties. Same for other digital platforms where they just offer their services through the platform. This is purely theoretical assessment and maybe there is no big differences at practical level. But still, appellations and terminology used by the platforms when promoting their services and most of it the ones used in the term of use agreements reflect the platform culture and strategic positioning towards this aspect.

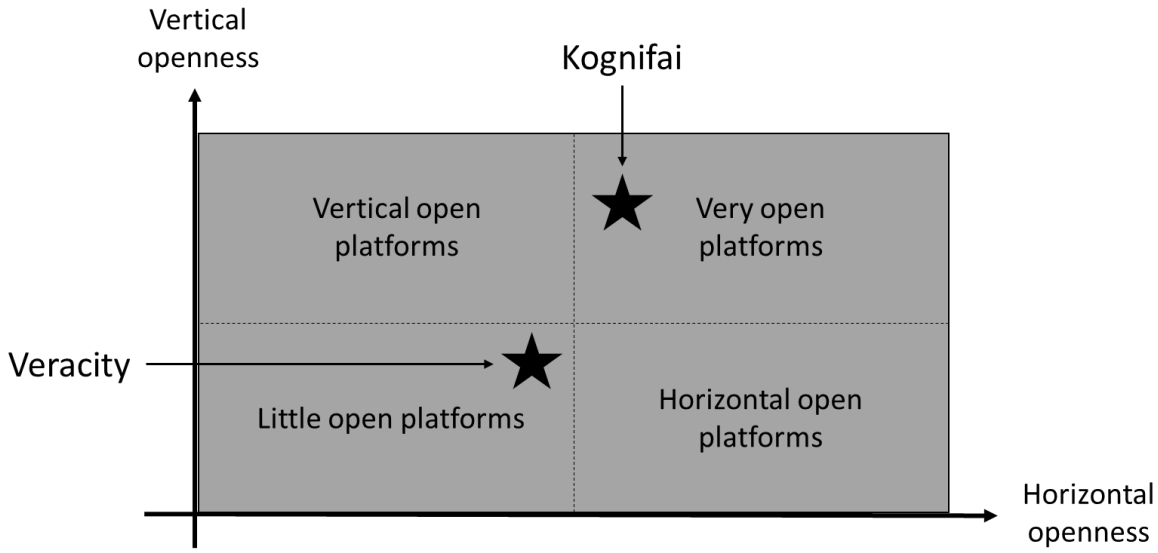

Figure 8 The openness level of the studied platforms

5.3 Area of applications

The main area that Kognifai platform is focusing at is the offshore oil and gas industry, mainly during the develop and production phases. The platform has been combined with the new dynamic digital twin technology invested in by Kongsberg Digital to create virtual model of unmanned production facilities for the oil and gas assets. The 3D virtual models are continually fed by the gathered data from the offshore facilities to support the creation of 3D

models and process stimulations. This enables users from the onshore to have a better insight on what is going on and take better decisions that will improve the performances and reduces the risk. Veracity has a more diversified market place, still a good portion is dedicated to the offshore oil and gas industry but DNV GL kept loyal to the five applications area of big data evocated in the literature chapter; Technical operations and maintenance, Energy efficiency, Safety performance, Managing accident and environment risk and commercial and ship operations (Mirovic *et al.*, 2018).

It was also observed a growing interest into the renewable energies by both platforms, especially for the offshore wind farms. This presents a good support for the future of the maritime industry as the oil and gas sector is expected to collapse sooner or later. Indeed, the Norwegian Water Resources and Energy Directorate (NVE) has lately identified 13 new areas to be considered suitable for windfarms (Karagiannopoulos, 2019). But those onshore farms were completely refused in the north by the indigenous Sami people, and Norway's biggest civil society organization (DNT) are arranging support march all over Norway in opposition to the selected area in the south of the country (The Nordic Page, 2019). This leaves no many choices but the development of offshore windfarms as they will progressively take the place of the retired oil and gas industry.

The application of big data requires a maturity level when dealing with the volume, velocity, variety and the veracity of the data sets. The greater are the data the more important analytics infrastructure will be required (Grossman, 2017). The adaptation of the analytics maturity model by Kognifai in the developing of their services interpret a strategic way to assist companies in using their data as they grow, from simple descriptive statistics to predictive ones, into the era of machine learning to automates the analytical model building thanks to artificial intelligence and minimize the human intervention as a consequence.

Mirovic *et al.* (2018) highlighted the importance of benchmarking to measure ship performances and for maritime companies to compare their fleets. It is a practice that was made available by the platform Veracity as users have the possibility to trade their data. This confirms the theory and provide a support for this practice in the maritime industry.

5.4 The challenges

According to Batra (2017)'s investment about digitalization challenges for the maritime companies, he reports that the strong engagement and interest from top management alone is

not enough, the lack data specialists and a proper project team was a common reason for failing. The lack of data-skilled workforce was also outlined as a major challenge in a survey of the world maritime leaders (Networks Asia staff, 2019). The finding in this study supports this idea, this is why both platforms are investing their resources to support and assist the analytics providers. But the hypothesis of the use of Big Data in the maritime industry will increase the vulnerability to cyber-attacks from Joseph Carson, the ESC Global Security's head of cyber security division (Trelleborg Marine Systems, 2018), turns out to not be a major challenge at all, or posing any kind of threat to the functioning on the platforms as both of them are using solid protocols and standards to encrypt the data during transfer and storage. The issue may raise when a data owner has to trust a third-party developer on the platform for the processing of his data and to deliver back the valuable information. Theoretically, he can also keep a copy of the results, if the process phase is not fully automated, and trade those results with other competitors' companies. The Facebook privacy case disaster or lately the suspicion of Huawei involvement in spying for the Chinese government reveals the issue of trust even when dealing with big brands so how a manager is supposed to trust a small firm in the other side of the globe. The platforms mention that analytics providers are solely responsible for the content provided through the platform. When this challenge was discussed with an interviewer, he stated that any application or service will be test and certified before being made available on the platform. Cautious should be made when purchasing services and before entrusting an applications provider for the process of data, separate terms and conditions that constitutes a sperate agreement between the two parties may help providing legal protection for both parties but it will make transactions less fluid and reduce their numbers, consequently reducing also the interest of the users into such platform.

Regarding the external challenge of cost effectiveness when handling huge amounts of data mentioned by Perera (2017), Kognifai responded to the issue with the Edge computing solution to make their services and applications more efficient by displacing them from clouds servers to physically closer to the terminals. In other words, data will be processed just after being gathered before being sent to the storage servers. Veracity propose Arundo software to both process the data onboard ship when she is in disconnected area and storage the data onboard until she connects again, this will help to solve the issue stated by Mirovic *et al*. (2018) regarding the handling of big data and the limitation of the bandwidth in deep sea navigation. Together with the machine intelligence-based data handling framework proposed by Perera (2017), this leads to the conclusion of the importance to start processing data as they are being

gathered onboard facilities before transferring them to the platforms' storage data centers will help solving several issues.

6 Conclusion

This study deals with the merging technology of digital platforms in the maritime industry. The aim of it, was to gain an insight about what is going on and help decision makers in the industry or academic researchers have a better understanding of the situation. For that reason, the main research question was proposed: *What are the digital platforms available for the maritime industry and their role in supporting the industry?*

Two multisided digital platforms developed by two world leaders' companies in the maritime industry were studied to answer the research question. And the outcomes of the studies have been sorted into the characteristics of the platforms, their area of application and the challenges they are facing.

For the structure and characteristics, the study highlighted the importance of the network effect created between and within the sides, as it is a key element in boosting the platform users' number and their interactions, and therefore the value of the platform for all the parties involved. Successful digital platforms focus on lowering the cost of transactions so more interactions will occur and avoid holding any production system, proposing self-developed product is a tactical move to counter the causality issue at the early stages of lunching a platform but should be avoided in the long run. A manager from the industry should understand the implications of the pricing strategies before choosing a platform also the level of openness and how this will affect the development of the platform on the long run. Both platforms are promoting for almost the same services but have different managerial strategies, the study raised a critical question if there will be enough data and analytics providers so both of them will be evolving side by side, will one just vanish and be wiped out by the other or do we expect them to merge in the future.

The applications that have been implemented have a big interest in the offshore oil and gas industry but there is a growing interest for the offshore windfarms turbine as a renewable source of energy which present good opportunities for the future of the maritime industry especially after the decay of the fossil fuels.

Regarding the challenges that digital platforms are facing in the maritime industry, this study confirms that there is an important growing demand for data skilled specialists to integrate the industry, and that the cyber security attacks seems to not be posing a real threat for the digitalization of the industry and the use of digital platforms. But in the other hand, the study emphasized the trust issue when dealing with data and information in an open platform, this

can be subject for further research, and a red light for data manager in the industry before entrusting their data to third parties or other users of a digital platform. Another conclusion from this study regarding the area of applications is the importance to invest in the edge computing technology and start data processing onboard ships or other maritime facilities to counter the external and internal issues of handling data.

The aim of the study was achieved to a certain degree with an important outcome for both further research studies and decision makers from the maritime industry, but there are certain limitations that can not be neglected. The limitation of time and the pressure from the deadlines regarding the submission of the thesis made it challenging to realize a longitudinal study as advised by Mark *et al.* (2017), but it was more as Snapshot study. Also the restriction of time made it difficult to fully apply the OTTR process (GAO, 1990) and Yin (2009) recommendations regarding the case study process, the loop in the OTTR process between the Test and Revise phases could not be complete due to some limitations when gathering data and trying to get in contact with professionals from the industry.

It has been brought to the light the importance on investing in the causes for success or fail for digital platforms, as different laws and theories applies to them than the ones for classic businesses models. Studying the circumstances in which digital platforms grow and succeed while other fail and sort them regarding their impact on the development of the platform, will assist and provide clear vision for already existing platforms and enhance the release of new platforms not necessarily as intermediaries between the data and analytics providers but for many other transactions that are not occurring through digital platforms in the maritime industry.

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Appendices

Appendix I: Checklist for Reviewing Case Study Reports (GAO, 1990)[p119]

Table I.1: Checklist for Reviewing Case Study Reports (GAO, 1990)[p119]	
The questions	**Yes / No**
Design	
1. Are the evaluation questions stated clearly and explicitly?	
2. Is the case study application clearly described?	
3. Was the time span of the study long enough to address the core issues fairly?	
4a. Is the basis for case selection presented?	
b. Is it appropriate for the purpose of the case study?	
Data collection	
1a. Are the methods of data collection presented?	
b. Are they appropriate for the purpose of the case study?	
2. If more than one investigator collected the data, were the other evaluators properly selected, trained, and supervised?	
3a. Are information sources described clearly and fully?	
b. Are they appropriate?	
Data base information and data analysis technique	
1a. Are the procedures for the formation of the data base described?	
b. Are they appropriate?	
2a. Are the techniques of data gathering and data processing explicitly described?	

b. Are they appropriate?	
3a. Were there interpretation differences?	
b. If so, how were they resolved?	
4. If other studies relevant to the issue are available, have their results been presented and reconciled with the case study findings?	
Reporting	
1. Are methodological strengths and limitations identified clearly?	
2. Are the arguments for various resolutions of the evaluation question presented?	
3. Are the arguments against various resolutions of the issue presented?	
4a. Does the case study identify the factors explaining the phenomena that were observed?	
b. Does the study state clearly whether identification of these factors was based on insight and recognition or on quantitative techniques?	
Impartiality and generalizability	
1. Have proper safeguards to ensure the competence and impartiality of the investigators been taken?	
2. Are comments on the draft report available?	
3a. Is there adequate information for judging generalizability?	
b. Have appropriate limitations to generalizations been observed?	

Appendix II: Interview guide

1. What is the main purpose from the platform?
2. Is there some kind another service or product that the platform is offering or plan to integrate in the future?
3. Who are the group of users joining the platform?
4. Why will they join the platform, what kind of service or product are they looking for?
5. Which is group do you think is more valuable for the platform?
6. How do users interact and realise transactions through the platform?
7. How is the platform pricing their users and how did you plan your pricing strategy?
8. Is there any kind of collaboration with third parties or other digital platforms?
9. Are there restrictions for the use of the platform? What about the commercialization? and the development?
10. What is the area of the applications for the platform?
11. What are the external challenges you are facing for managing the platform?
12. What do you think about the involvement of data specialist in the maritime industry, is there enough?
13. How do you deal with the threat of cyber-attacks?
14. Is there special measurement for the report of wrong information or data into the platform?
15. About the data ownership, who have the rights and intellectual properties of data during transfer, storage or processing?