MASTER THESIS

January 2019 | **SERVICE DESIGN PROGRAMME**

"Paperwork operations in the Maritime Industry"
A Case Study of New Service Development
for the Danish Maritime

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A B S T R A C T

Master Thesis | CHAPTER 1

This thesis showcases a Service System Design M.Sc. thesis targeting "Paperwork operations in the maritime industry". The maritime industry is dealing with inefficient procedures relating to the handling of official certificates on ships.

The thesis presents the service system design processes from Discovery of the problem over Defining and narrowing insight. To Developing a service idea and finally elaborating in detail on Delivery of a service solution.

Along the process official goals set out by Danish Maritime Administration have been our inspiration in addition to the official international guidelines. Extensive use of qualitative interviews and co-design activities with industry experts has been the backbone of the process.

The alternative service solution presented in the final phase is eDocs, a digital service solution that would greatly improve the daily handling of existing inefficient procedures.

Keywords: Design thinking, Multi level service design, Operational management, and Co-design.

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ACKNOWLEDGEMENTS

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Alborg University
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Companies
 FORCE
 DANCERT
 OSM people
 DNV GL
 MDA

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LEARNING GOALS

Master Thesis | **CHAPTER 1**

This section comprehends the official learning goals for the thesis, as well as my own personal learning goals.

Study Guide Goals
According to the Master's Program Curriculum the following qualifications are to be obtained:

Knowledge
Must have knowledge about the possibilities to apply appropriate methodological approaches to specific study areas.

Must have knowledge about design theories and methods that focus on the design of advanced and complex product-service systems.

Skills
Must be able to work independently, to identify major problem areas (analysis) and adequately address problems and opportunities (synthesis).

Must demonstrate the capability of analysing, designing and presenting innovative solutions.

Must demonstrate the ability to evaluate and address (synthesis) major organisational and business issues emerging in the design of a product-service system.

Competences
Must be able to master design and development work in situations that are complex, unpredictable and require new solutions (synthesis).

Must be able to independently initiate and implement discipline-specific and interdisciplinary cooperation and assume professional responsibility (synthesis).

Must have the capability to independently take responsibility for own professional development and specialisation (synthesis)"(Aalborg University, Faculty of engineering and science, Board of studies for Media technology, 2012)Board of studies for Media technology, 2012.

Personal Goals

Exploit the advantages of working with a real-life-case to include users into the development process and thereby gain more experience within facilitation, prototyping, co-design and testing.

Rehearse the service design process and use the final result as reference when entering the job market.

Gain "hands-on" experience in the process of designing a Distribute System.

GLOSSARY

Operator:
The person or entity ashore doing the operation of a ship –
planning the cargo to load, supply of stores and fuel, crew
changes etc.

Ship owner:
The same as Operator.

Flag State:
The country where a ship is registered can be different from
the country of operator or crew etc.

Danish Maritime Authority (DMA):
Flag State of Denmark.

International Maritime Organization (IMO):
It´s an organ under United Nations coordinating
international maritime safety and environmental issues
among the member states.

Classification Society (aka Class):
It´s an organization that undertakes inspection and control
(surveys) of ships on behalf of the ships Flag State.
PMS: Planned Maintenance System

DNV GL:
A Classification Society

Digital Certificate:
Certificate in digital form (e.g. PDF) without an electronic
signature.

Electronic Certificate:
Certificate issued in electronic format AND containing an
electronic signature.

Electronic signature:
Data in electronic form attached to an electronic certificate
to serve as a method of authentication of the issuer and
contents of the certificate.

Certificate issuer:
Third party supplier company providing testing or inspection
services a ship owner.

Counterpart:
A person or thing that corresponds to or has the same
function as another person or thing in a different place or
situation.

The maritime industry

The global maritime industry is characterized by many as being traditional and with an overall resistance to change (Erhvervsministeriet, 2018) (BPI Network, 2017). The industry is faced with tough competition in the world market, a market undergoing rapid changes because of alterations in the global distribution of work, consumer behavior and digital and technological developments.

The Danish maritime industry meets similar challenges, none digitized process, and inflexible IT systems are real showstoppers for its development (Erhvervsministeriet, 2018). This is reflected on the way that stakeholders manage operations and handle important documentation. Ships operate with paper-based certificates or else digitalized copies exposed to cyber risks. This not only jeopardizes the authenticity of the certificates, but also increases the risk of fraud and puts on risk the safety of the ship and the crew.

However, in the last years a new shift towards automation and digitalization has been perceived. This gradual move targets operators and their suppliers, challenging their search for more efficient forms of improving operational performance and services through better use of technology (BPI Network, 2017).

To foster a proper environment for change the Danish Government has created a "Plan for growth in the Danish maritime sector" aiming to positioning the country as "Global maritime hub by 2025" (Erhvervsministeriet, 2018).

This project's overall goal empathizes in the needs, pains and experiences of the maritime stakeholders concerning certification; which will be use in the user-centered solution supporting the industry. Therefore, the first problem formulation stands as:

> How can the maritime industry reduce the pain related to the handling of paper-based certificates?

Furthermore, the solution will target or incorporate some of the government's initiatives for 2025 related to "Digitalization and new technology" (Figure 1).

THE MARITIME DENMARK - A DIGITALIZATION HUB BY 2025

1. Digitalization and new technology as well as entrepreneurship play a central role in the Plan for Growth, which contains the following initiatives: Denmark should become a leading laboratory for testing new maritime technologies, digital systems, types of production and operation as well as the generation of energy.
2. Denmark should specifically be a frontrunner within the development, testing and use of maritime autonomous technology, inter alia as an accelerator of new business models. Efforts should be made to utilize technological potentials in the best possible way, for example in the Danish Register of Shipping.
3. A consultative partnership should be established for digitalization of the Danish maritime sector.
4. Efforts should be made to handle maritime cyber security challenges, including increased resilience within the maritime ICT infrastructure, based on common EU and IMO standards and principles
5. Efforts should be made to introduce a common European ship reporting platform so that ships experience a reduced amount of administrative burdens when calling at EU ports.
6. Efforts should be made to ensure increased use of released maritime data and the further availability of relevant maritime data to promote maritime innovation and business development based on publicly available data.
7. Together with the industry efforts should be made to strengthen the maritime entrepreneurial cluster.

Figure 1. Government's initiatives for 2025

Operational management

Operations management encompasses managing things, people, and process in a set of positive prospects or fewer probabilities. John Kamauff (2011) in his book Manager's Guide to Operations Management defines it as both a science and an art.

"The science includes understanding the processes, tools, and techniques. The art is in applying them effectively within the context of the people who provide the inputs, the people who process the inputs into outputs, the people who deliver the outputs, and the people who buy those outputs" (Kamauff, 2011).

Kamauff's concept illustrates a traditional infrastructure model where people perform operations. Our automation era, however, allows people and systems to be more agile and efficient by making use of technology. This perhaps adds a degree of complexity to the equation when designing a service system and the user experience, nevertheless, it also unfolds new forms of value-creation and foster innovation (Patrício, Fisk, Falcão e Cunha, & Constantine, 2011).

The maritime industry encompasses complex operations concerning machinery, man, and overlapping processes. Patrício (2011) suggests Multilevel Service Design (MSD) as a way to the understand operations by decomposing them into subsystems (individual service channel and human activity). This systemic approach assists diving into particularities of the operations and explores critical factors or areas that require improvement (Constantine, 2009).

Throughout the development of this project Patricio's (2011) systemic approach will be used to understand the maritime operations in connection to certification. As explained in the introduction the maritime industry characterizes for being very conservative and this is well reflected on operations. Therefore the overall research question of this thesis is to:

"How can the practice of service design contribute to the improvement of operational performance in the Danish maritime industry?"

The traits, benefit and contribution on using the Multilevel Service Design (MSD) methodology will be the premise along this thesis journey. The next section will contribute to further elaboration of the methodological approach and methods.
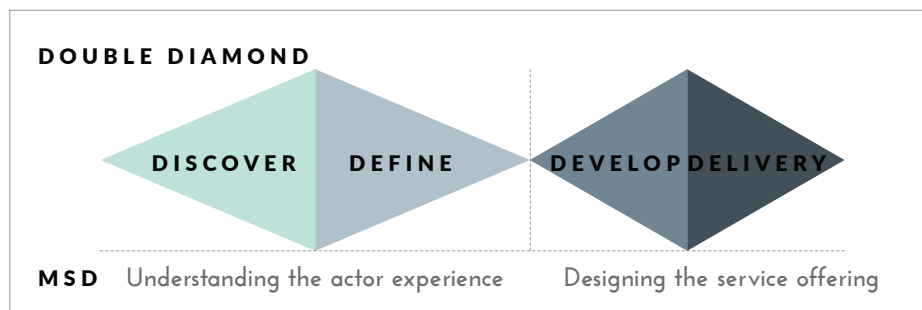
Master Thesis | CHAPTER 1

This thesis is grounded under the premises of Design Thinking (Interaction Design Foundation, n.d.). Involving co-design practices in combination with user-centered methods, Design Thinking approach focuses on human stories and insights to build empathy for users, and ensure the ideas being developed are relevant (Design Council, 2017).

On this arena of mutual learning, where empathy, co-creation, and actor's feedback are the keys to unlock creativity and innovation; it is important to settle a framework that assists as references point and guide throughout the design process.

The Double Diamond (Design Council, 2017) is the chosen methodological framework. It supports four different phases: Discover, Define, Develop and Deliver. The divergent characteristic of the model supports exploring broad-spectrum points of the challenge.

DOUBLE DIAMOND

DISCOVER DEFINE DEVELOP DELIVERY

MSD Understanding the actor experience Designing the service offering

Figure 2. Double Diamond

As the process evolves, the convergent thinking is purposefully applied as we screen, select, evaluate, and refine the options (Figure 2).

Following the authors' (Design Council, 2017) words the Double Diamond, "... *is not a rigid protocol to followed unthinkingly, but framework that can and should be adapted to the task at hand*". Multiple iterations may occur in the same phases where both diverging and converging approaches shall be used. Parallel methodologies such as the Multilevel Service Design (MSD) methodology will be used. (Patrício et al., 2011)interaction design, and the emerging field of service design. MSD enables integrated development of service offerings at three hierarchical levels: (aThis is not considered as moving in multiple directions in the exploration, but as a new layer of information built upon the existing knowledge and phase.

Both methodologies facilitate acknowledging the process of continuous "empathizing with the users" (Interaction Design Foundation, n.d.) while forming the basic backbone of the design process.
In this first phase of the design process it's important to build a strong knowledge foundation with visions and insights. The research can be triggered in different directions involving industry tendencies, new behaviors, type of technology or a risen need. What was essential in this phase is to identify the issue, advantages or necessities to be tackled as well as defining some of the limitations of the solution space.

DISCOVER

Chapter 2 | PHASE 1 /4

Photo 14. Discover phase

RESEARCH ACTIVITIES

Chapter 2 | **PHASE 1/4**

At first in the process of discover there was a preparation process that involved a desktop research on maritime stakeholders and general aspects of the industry. Furthermore, as the aim was to do a user-centred exploration it was necessary to find an industry insider to get properly introduced to other sources in the industry. This was not a difficult task, as soon as the contact was established a series of interviews took place.

To have a holistic view of the industry it was necessary to hear the opinions of multiple actors having different roles in the industry. This user research phase lasted four weeks and qualitative methods were applied (Bjørner, 2015).

The research was deepened by direct interaction with industry actors, exploratory research and desk analysis of the factors. Below is a list of activities[1] (Figure 3) covered in this phase contributing to the bank of knowledge of the design process. Full documentation of the interviews can be found in Appendix 1 - 6.

METHOD	DESCRIPTION
Expert interview 1	Naval Architect, Marine Consultant /Surveyor
Expert Interview 2	FORCE - Head of department, Training & Certification
Expert Interview 3	DANCERT - CEO, Denmark
Expert Interview 4	Seafarer, Chief Engineer
Expert Interview 5	OSM Crew Management, Director
Expert Interview 6	Ship owner
Desktop research	Online research to understand services and industry standards.
Explorative research	Mapping user actions, questions and pains to understand the actual experience of the services and gain an overview of what can be improved.

Figure 3. Reasearch activities

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1   *A valid remark, following the last changes in the European policy regarding General Data Protection the names of the participants are hidden since consent agreement was not signed upon the interview.*

THE CONTEXT

The Danish maritime sector is one of the country's most important export sectors and a major supplier of jobs. With an estimated 90 percent of the country's trade transported via sea, a high level of efficiency and precision is indispensable for its performance (Danmarks Statistik, n.d.).

International and national organization such as the International Marine Organization (IMO) and the Danish Maritime Authority (DMA) ensure compliance of the norms and regulations in the industry. Many operations onboard the ships must follow a written procedure and a proper certificate shall follow. From technical specification on engine, fuel and ship maintenance to crew and safety emergency procedures, the number of certificates exceeds one hundred (International Maritime Organization, 2017).

Through the interview with the Ship owner (Appendix 4, Expert interview Ship owner) it was found that most ships carry a folder containing the most important 20-30 certificates, usually called "Certificate Folder" (Photo 1).
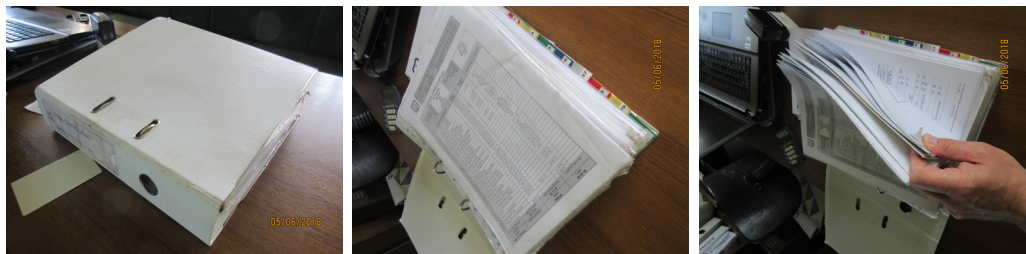
Photo 1. Sequence showing the Certificate Folder

Crew members follow a similar procedure, they are also required to carry a folder with their up-to-date personal certificates and credentials while on duty (Photo 2).

This form of handling documentation in the traditional paper-based form is very common all over the world and this is mainly due to the fact that the certificates work as proof of compliance and therefore a certificate is often the only method to demonstrate compliance to a third party. Some regions of the globe such as Asia-Pacific, Eastern Europe and The Middle East are more rigid when handling originals whereas in the Western and Central Europe and in the Nordic countries electronic certificates are gaining popularity (Appendix 2, Expert interview Force, Denmark).

In addition to the environmental waste, the hassle of carrying and safeguarding the documentation there is the aspect of authenticity. As a rule, paper-based certificates must be originals and in case they are in electronic form they must contain a tracking number and an electronic signature serving as a method of authentication of the issuer and contents of the certificate.

Scanned copies where traceability is difficult to verify and the content is easy to modify are not allowed. In case of suspicion Surveyors and Flag States controllers might prolong the inspection of the ship until the authenticity of the certificate is confirmed (Appendix 1, Expert interview marine consultant).

Photo 2. Sequence showing the seafarers folder

Photo 3. Certificates examples

Moreover, aspects such as the expiration nature the certificates and the partial lack of overview from the keeper can harm the costs and increase collateral damages for the ship. For instance, the onboarding impediment of a crewmember because his medical certificate is expired can retain the ship in the port,

which will consequently raise transportation costs and delay delivery of the cargo to its final destination (Appendix 4, Expert interview Seafarer, Chief Engineer).

What makes paper-based certificate authentic?

After taking a deeper look at different certificates, it was concluded that there is not a standardized form or rigid template for a confection of such a document. As illustrated in photo 3, certificates defer in content and style according to the issuer. However, there is a common denominator in all such as name and company logo, issue and expiry date, archive number, company stamp, and signature of the company's representative.

According to independent consultant "...to prove authentic the certificate must contain the expeditor's stamp and the original signature has to be clearly shown"(Appendix 1, Expert interview marine consultant). However, these attributes do not ensure fraud avoidance. When handling to paper-based certificates there is always a risk of content alteration. Surveyors handle with extra care prints of scanned originals.

ORIGINAL

Paper-based containing issuers signature and stamp.

DIGITAL CERTIFICATE

Certificate in digital format (e.g. PDF) without an electronic signature. Prints of this format can often be seen as a momentary replacement for originals.
This type of format do not comply because it does not meet the requirements set by IMO.

ELECTRONIC CERTIFICATE

Certificate issued in electronic format and containing an electronic signature.

ELECTRONIC SIGNATURE

Data in electronic form attached to an electronic certificate to serve as a method of authentication of the issuer and contents of the certificate.

Figure 4. Format differences

Format differences

At this point it is important to make a clear definition of the format differences of the certificates (See figure 4).

Throughout the interviews it was found that maritime stakeholders often use a print of scanned copy (Digital certificate) as a replacement for original (Appendix 2, Expert interview Force, Denmark). This behavior is more common in the Nordic countries, and perhaps has to do with the high level of trust that characterizes this region (Hopkin & Rodríguez-Pose, 2007).

Although the scanned PDF doesn't comply with the electronic certificate standards defined by IMO (International Maritime Organization, 2016) these formats are slightly more accepted.

"I still get goosebumps when I have to check an unknown scanned copy because I have no possibility to check the authenticity of the certificate and I am left with two options - either simply trust the content of what is shown to me or to initiate a very time consuming procedure of chasing a proof of authenticity" (Independent consultant - Appendix 1, Expert interview marine consultant).

Original certificates are sent via post and it can take weeks until it reaches the ship depending on the geographical trade. They go from the issuer to the ship owner and from there to the next destination of the ship. This slows down the ship´s operation, and therefore ships and operators are likely to ask for a scanned copy via mail to keep operations running until the original paper-based arrives. The scanned copy is usually an insecure PDF format, which is not in compliance.

As an answer to this situation IMO has issued a guideline on how electronic certificates should be prepared in order to replace the "old-fashioned" paper-based certificates (International Maritime Organization, 2016). Furthermore, the Danish flag state (DMA) has directly encouraged the industry to enhance the use of electronic certificates (see also The Law section below) and in fact DMA has already started to make use of electronic certificates.

The desktop research shows that the great majority of the certificate issuers in Denmark issue two format, a Digital PDF (insecure and not in compliance) and an Original paper-based. Recent initiatives point to the utilization of software for adding "a sort of" digital signature (e.g. Symantec Software) to the certificate. Unfortunately, this initiatives proof ineffective when the certificate gets printed, as the paper-based format has no form to authenticate the digital signature's validity.

The electronic certificate, on the other hand, has proven to be a good alternative to the paper-based. As long as the nature of the format is respected, ships and operators can receive the certificate right away and without compromising its authenticity.

However, the industry's dependence on paper-based certificates is still very high. Ships and operators have a strong preference for print. Electronic certificates end up printed, but these have the advantage of a printing footnote with a reference ID to an authentication portal where interested parties can validate its authenticity. Paper-based certificates by default have a high risk of content alteration. "...we know that doubtful cases are related

to paper-based, therefore the more digitalization the better. However, we still issue originals because our customers insist on having them" (Appendix 2, Expert interview Dancert, Denmark).

The ship's co-dependence to paper-based certificates is a weak link on the system. Furthermore, without a way of verifying the validity of the print there is no way to counteract content alterations. This fact underlines the vulnerability of the paper-based certificates and the risk for fraud in the industry.

The law
In the battle against fraud, the industry struggles to find a common ground between paper-based copy and digital format. Certificates issuers look for new ways to authenticate and preserve the content of the certificates through better use of technology. The International Maritime Organization, on the other hand, aims, to address this issue by promoting the use of electronic certificates and has set a standard requirement for it (Figure 5).

Figure 5. IMO's guidelines for electronic certificates

However, some experts argue that law is not explicit enough in relation to the authentication process of the digital certificate or a print copy of an original (Appendix 1, Expert interview marine consultant).

In a usual scenario, the surveyor takes for granted the authenticity of the certificate once he is presented with an original. In the case of being presented with a print version of an electronic certificate, he checks its validity on the Internet validation portal. However, in case of being presented with a scanned copy of an original, there is no form of authentication unless the issuer is contacted.

According to the marine consultant, the authentication of the certificate is truly valid once the surveyor can compare the certificate he is presented with the original (Appendix 1, Expert interview marine consultant).

Inspections and authentication
Inspections happen usually unannounced, the usual frequency for Flag State inspection is once a year, unless the ship has proved deficient; then it requires regular follow-up from part of the maritime authority.

Port state controls, on the other hand, can happen any time at any port of the globe and they can check aspects related to cargo, crew, ship condition etc.

The experts' interviews provided insights about the different process of handling paper-based certificates. These insights are illustrated in the user journeys shown in Figure 6 & 7. interaction design, and the emerging field of service design. MSD enables integrated development of service offerings at three hierarchical levels: (a

As shown in the line of perceived emotion all actors involved in the process co-depend to original paper-based to complete their operations. While the seafarer tends to find a temporary alternative by presenting a copy of an original, the surveyor is forced to call the issuer or accept a certificate that doesn't meet the industry requirement.

On the other hand, the certificate issuer lacks an effective "after service". Meaning there is not organized procedure for dealing with enquires after the certification is completed. Therefore, they see this as a burden and extra task on their workload.

SEAFARER

PERCEIVED EMOTION

Necessary | Expendable | Compulsory | Urgent

FLOW OF ACTIONS

Wating for original | Post Delayed Issuer sends email | Momentary solution (Scanned PDF) | Unannounced Inspection | Original arrives

SUVEYOR

PERCEIVED EMOTION

Necessary | Compulsory | Urgent

FLOW OF ACTIONS

Preparing for inspection | Limited vessel's info | Onboard inspection Scanned PDF | Vessel retention on port | Authentication completed

Figure 6. User journeys of the seafarer & surveyor

CERTIFICATE ISSUER

PERCEIVED EMOTION

Usual | Compulsory | Necessary | Urgent

FLOW OF ACTIONS

Receive petition | Plan inspection | Issue certificate | Send by post | Post delayed | E-mail scanned certificate | Athentication via phone or email

Figure 7. User Journeyof the certificate issuer

MAP OF STAKEHOLDERS

CARGO

SERVICE SUP. SYSTEM

COMPLIANCE

STAFF

PRODUCT APPLIANCES

COMSUMERABLES & STORE

IT

Cargo handling

Cargo owner

Cargo Treatement

Cargo planning

Shipper

Monitoring & Automation systems

Port Facilities

Divers

Crew Mgmt. company

Operator

Crew

Port Control

Flag State

Insurance

Ship Owner

CLASS

Certification companies

Safesty Equitment

Provisions

Water

Spare parts

Fuel

Paint

SHIP

Cargo handling appliances

Lubricants

Oil

Ship Yard

MAIN FOCUS

Stakeholders Map

In order to have a clear understanding of the actors, their associations and roles within the maritime value chain (Stickdorn & Schneider, 2015) the stakeholders' map was created.

The map (Figure 8) should to be read from the center out with the ship presented as the focus and the different actors positioned according

Figure 8. Maritime Stakeholders map

to the character of their relationship and frequency of interactions. The actors closer to the center have a stronger bond to the ship and are the parties with greater co-dependence. This is the case of the port and the surveyor.

Subordinate stakeholders are featured in the second ring. These have a supportive role; the relationship is quite stable, but they don't have a direct influence on the daily operations. Insurances companies are in this category.

The third ring illustrates the service suppliers with the least frequency of interaction. In Denmark there are around twenty authorized companies fitting under this categorization. They must be approved by the ship's Class (Appendix 9&10). Certificate issuers are in this category; they are the furthest from the center because their interaction can fluctuate according to the degree of necessity for this service. For instance, when the ship needs to renew its fire safety, it needs an authorized certification company to assist with the equipment check. This operation is required once a year and unless of special circumstances.

Benchmark of existing services

The benchmarking-chart (Figure 9) helps to get an overview of the quality of the service delivered by the certification companies in Denmark. The insights gained from the desktop research and the experts' interviews are the premises of this evaluation.

The companies are measured based on tow criteria: the type of certificate that they issue and the characteristic of their after service (Personal or automated). The chart lists as first the companies with the best performance.

The companies chosen to benchmark are a diverse representation of certification companies in Denmark. They are well known service provider and a point of reference in the maritime: DNV GL (classification company), DMA (flag state), DANCERT, and FORCE.

DNV GL is the leading company handling electronic certificates. The company has eliminated paper-based from its process and has set this as its standard procedure for the

	CRITERIAS	DNV GL /CLASS	DMA/FLAG STATE	DANCERT	FORCE
Certificates	Issues original paper-based			●	●
	Issues electronic certificates	●	●	●	
	Uses Digital Certificates			●	●
	Certificates are protected from modifications and contain a tracking ID	●	●		
Characteristic of the After service	Company offers personal customer support on certificates authenticity			●	●
	Digital authentication service	●	●		
	It possible to see a copy of the certificate online	●	●		
	Ranking	**1**	**2**	**3**	**4**

BENCHMARK OF EXISTING SERVICE

Figure 9. Benchmark of existing services

national and international water. Their website offers a user-friendly authentication service where it is possible to see a copy of the certificate.

In case of print, DNV GL certificates include a tracking ID and a QR code referring to the website validator. The company offers a variety of certification in multiple countries; their authentication portal covers only there own certificates using block chain technology.

DMA ranks in second place mainly because they don't offer a temporary access code. An indicator, however, that might be considered less relevant since their authentication portal is open source, and certificates are available for search by tracking ID or IMO No.
Force and Dancert are middle-sized companies with a less advanced automation process. The expert interviews showed that both companies use Microsoft Word for creating the certificate, which after approved and signed, follows the traditional postage procedure (Appendix 2, Expert interview Force, Denmark).

Their most recent efforts point to the use of programs that generates a digital signature. These types of certificates are close to being electronic certificate but since they don't meet the rest of the IMO's requirements this thesis categorized them still as digital certificates. However, it is a valid remark that shows the pursuing need of these companies for an automation reform.

The after services for both companies are at a similar stage. Dancert uploads the PDF's to MarED, which is a European marine equipment database. Interested parties can require access to MarED and check the certificates from there. Unfortunately not all the certificates are available and these parties must contact the company instead.

FORCE, on the other hand, offers personal authentication as an after service and it has few certificates accessible via their web services.

Both companies are vulnerable to content modification since their certificates lack of protection and counterpart.

User Research

To obtain in-depth knowledge of the maritime actors during this discovery phase of the problem context, exploratory research (Faugier & Sargeant, 1997; Penrod, Preston, Cain, & Starks, 2003), more precisely the method of expert interview, was used (Bjørner, 2015).

The expert interview method is an effective method for studying people; it allows researchers to understand the main actor's points of view, declared needs and thoughts (Bjørner, 2015). This required preparation and research; first it was considered which companies would be relevant and whom and which departments would be more suitable to talk to. Secondly came the planning of the interviews, defining the goal, the questions and juggling the calendars of the participants.

Once the interviews took place aspects such as tone of voice and manners were also carefully considered. Would it run in an interrogation setting where there is a rigid flow of questions and answers, or would it run in a more conversational manner where there is a gap for elaboration and learning of the meaning? The second scenario felt

Photo 4. Sequence showing the engine room and the ship mast

most natural and proved more comfortable for both parties. Because it allowed the exchange of ideas without the pressure of being emanated.

The documentation process is also an important aspect of the research. With the use of technology, it is easy to record the conversations, but not all experts were interested in being recorded and one must respect their position. The majority of the interviews in this research are documented as stories having a descriptive narrative with an empathic approach to the experts (Leonard, 2011).

Moreover, visiting the expert's workplaces offered great advantage for exploring tacit knowledge. The curious observer could gain a better impression of the physical environment in which they operate (Müller, 2010) such as the work dynamic, the volume of documents, the relationship and emotions attached to the work they perform.

This form of exploratory research does not aim to be representative (David & Sutton, 2011). The purpose is to gain an explorative knowledge of the industry actors with emphasis in understanding. Through this process, specific aspect of their challenges arose and new industry insights were also gathered by looking at their interactions (Trischler & Scott, 2016).

Working with none representative sample of the industry might appear as not getting enough data to create a cohesive design. Therefore, it was important to strengthen the collaboration with the experts to have qualitative input and establish a return point of reference during the design process. This was the case of the marine expert and surveyor (Appendix 1, Expert interview marine consultant) who became the main point of contact in the industry and his suggestions added great value to this project.

This ground of mutual collaboration involving co-design activities and common learning, organically shifted the design process from a user-as-a-subject perspective to a participatory arena where it was possible to design with the user rather than for the user (Sanders & Stappers, 2008). These approaches did not conflict in design process, on the contrary, it was seen an additional layer of experience, positively contributing to the exploratory research and future directions of this thesis.

The exploratory research revealed three different aspects: The actor's expectation the actor's interaction, and their understanding of authenticity.

No.1 Experts' expectations of their workplace and context

Expectations are formed by personal vision of the workplace and tasks and reinforced by company policies and procedures. Expectations can be very different from actor to actor, rooted to individual goals and roles. However, the research showed a common interest: productivity and effectiveness.

Photo 4. PMS software

among other functions supports the collection of certificates and provides a comprehensive certification status overview based on colors (Photo 6).

The ship's management, meaning captain and the chief engineer mostly use this program. Onshore the operator and the owner use it. The program allows manual upload of the ship certificates and crew certificates. As shown in photo 4 it manages and keeps track of all certificates and their expiration/renewal dates.

Although the system offers great support with keeping an overview, it has some limitations.

It displays what the user uploads
It doesn't differentiate between copies and originals
For security reason the access is limited to management only

These kinds of management systems are a step towards fulfillment of the industry's needs and expectations. It is valid to remark that although it helps with the overview, it does not eliminate the print and manual archiving of the certificates –leaving the codependence to paper and the authentication issues unresolved.

Whether it is a ship operator, a seafarer, a service provider or an inspector, they all agreed on the fact that they expect progress on their daily activities and smooth operations. They all hope to have more time for the tasks that really require attention rather than spending energy on bureaucratic assignments.

Certificates are among the paperwork tasks that every seafarer must do occasionally no matter his role onboard the ship. To facilitate paperwork operations, it was found that ships use a Planned Maintenance System (PMS) that

No.2 Actor's interaction
One of the focus points from the Danish government's initiatives for 2025 is to "*[...] reduce the amount of administrative burdens when calling at EU ports*" (*Erhvervsministeriet, 2018*).

To understand the burden, it was necessary to understand how harmonious the interaction was among maritime stakeholders. With the interviews it was intended to explore these needs as well as the nature of these relationships.

When talking to the ship owner it was found that operators and ports have a superficial relationship. Every port has its own requirement for handling Ship Report, which is done by the ship before arriving to the harbor. Ship Report usually holds information about the ship, the crew and the cargo.

"*It is usually the same information just asked in different ways*" (*Appendix 6, Expert interview Ship owner*).

The lack of an operational infrastructure for ship reporting in Europe creates friction in the ship-port relationship increasing the burden for the ship that must provide reiterative information.

Surveyor and Port control, on the other hand, have a formal relationship to the ship; they must ensure that the ship complies with the law. Their interaction is merely specialized and both parties feel uncomfortable because of the inquisitorial nature of the contact (Appendix 1, Expert interview marine consultant).

Certificate issuers hold a business-tech relationship with the ship and the crew. Companies such as FORCE, offering a diverse range of test services for maritime, come onboard the ship for sampling a material or a broken part. Once the testing is completed and the certificate is issued, the company still offers authentication in case of need, otherwise the contact is nearly null after service (Appendix 2, Expert interview Force, Denmark).

No.3. Authenticity meaning and practical approach
Throughout the interviews special focus was put on understanding the point of view of the different experts towards the authenticity of the certificates, the level of importance given to electronic versus the paper-based, and how aware they were about the difference between a digital certificate and an electronic certificate.

Certificate issuers have a big interest in having their documentation free of falsification and plagiarism. Throughout the interviews it was found that in recent years extra efforts have been put on cybersecurity. And there seems to be a positive interest from part of management towards solutions that preserve the authenticity of certificates (Appendix 2, Expert interview Force, Denmark).

According to the experts, the majority of the fraudulent cases seen recently are linked to paper-based, therefore they would like to eradicate the paper-based but it is still a question of necessity since ships and operators require certificates in this particular format. Under these circumstances, certificate issuers rely on the stamps and the signatures for authenticating original-paper-based certificates (Appendix 2, Expert interview Dancert, Denmark).

The interviews showed that certificate issuers ensure authenticity and traceability on the electronic format by using an electronic signature and encrypting the certificate's content. The effectiveness of the electronic format lays on its electronic nature; printing an electronic certificate jeopardizes its authenticity. To prevent this, few issuers (e.g. DNVGL and DMA) have added a footnote to the print referring to an authentication service.

Since regular post takes a long time to reach the ship scanned PDF's (digital copies) are used as a replacement for originals. Although a momentary solution, this behavior creates misconception on the factual differences between electronic and digital format misleading the crewmembers to assign less relevant the format.

"What matters to me is to have a tangible proof of compliance to show to the surveyor, I would rather have a copy than having nothing to show" (Appendix 4 Expert interview chief engineer).

Surveyors, on the other hand, are challenged when handling paper-based copies. There is a slight tendency of accepting this format under peculiar circumstances (Appendix 1, Expert interview marine consultant).

SUMMARY OF FINDINGS

Chapter 2 | PHASE 1/4

The Discovery Phase was insightful process that allowed exploration of valuable knowledge in the areas of law data, technology, actors' pains and behaviors. To successfully proceed with the Define Phase, the most essential insights are summarized in the following section.

Paper-based
1. Seafarers must carry their seafarer's book onboard the ship and be aware of expiration and renewals.
2. Ships carry a physical folder containing all the ship documentation, cargo and crew information. A similar folder exists also in digital form.
3. Paper-based certificates must be originals; they are usually sent by post and take a long time to reach the ships.
4. Doubtful cases are usually linked to paper-based certificates.
5. The need for paper-based certificates and the general paperwork slow down daily operations.

Behavior
1. Since postage takes long time, scanned copies of originals are frequently used, although they are not in compliance with the industry's requirements.
2. PMS systems are used the ship management and to managing expiration/renewal date of certificates.
3. There is a big codependence to paper-base certificates. Scanned copies, as well as electronic certificates end up printed, for the purpose of better overview and easy access.
4. Certificate issuers know the burden and risk of handling paper-based, but they still issue it because their customers (maritime actors) require it.
5. Recent efforts of certificates issuers point to the big interest for an automation reform.
6. Seafarers are practical people. They like to spend time on tasks that really require attention rather spending energy on bureaucratic assignments.
7. Ship reporting before entering a European port is a burden for the ship.

Authentication

1. There is no way to authenticate a paper-based copy unless it's compared with the original. Original paper-based can still be altered.
2. Electronic certificate is an alternative to paper-based. To comply the electronic certificate must contain a tracking ID and a digital signature and the content must be protected from editing.
3. The organizations DMA and DNV GL are at the front of authentication service.
4. It is necessary to see another original certificate to compare and validate its legitimacy. DMA and DNV GL offer this service through the internet.

Consequences

1. The lack of predictability in the authentication process and poor IT infrastructure is a real showstopper for inspectors and operators.
2. It is expensive for the ship and uncomfortable for the inspector having to deal with a doubtful documentation.

3. Failure to comply with certificates requirement can result in retention of the ship in port or onboarding denial of the seafarer.

Opportunities

1. The need for improving the after service experience is a good starting point for a new service solution.
2. A platform that authenticates certificates from different service suppliers would be very beneficial and well received in the industry.
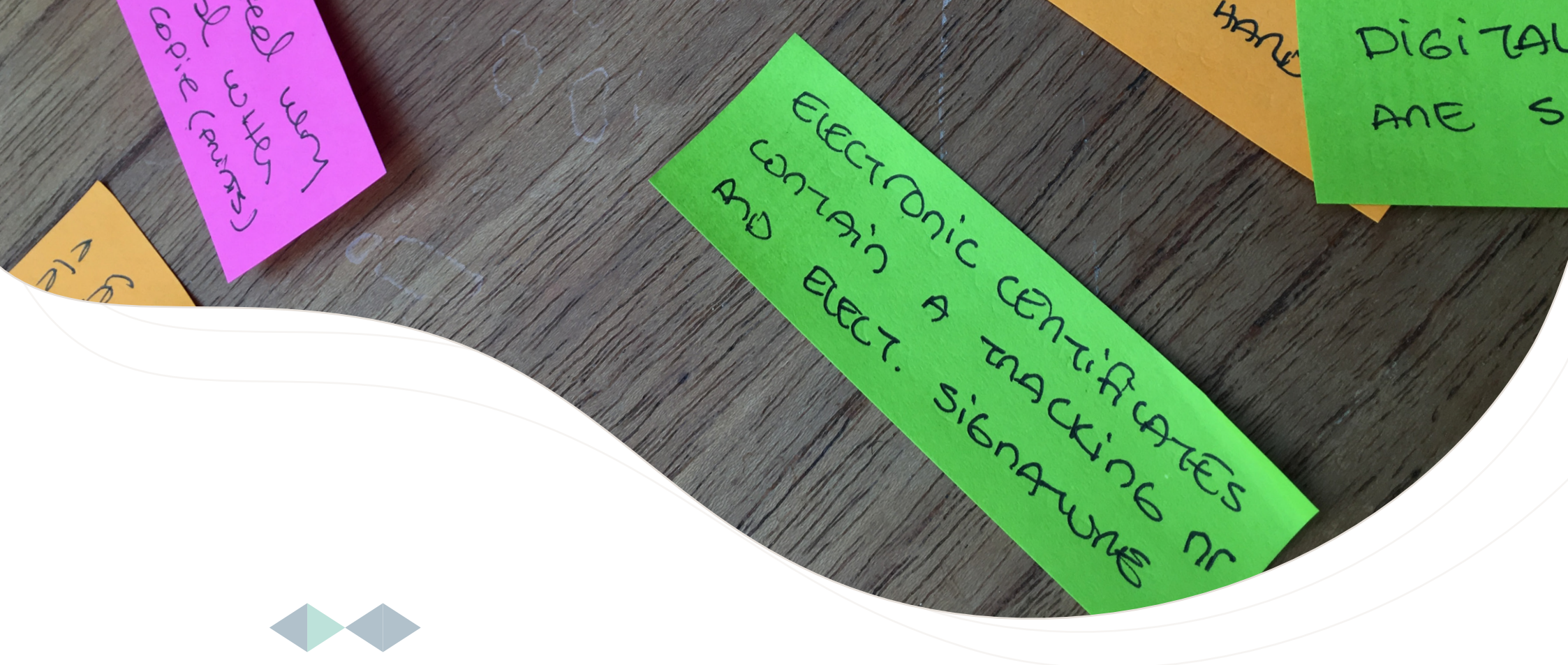
DEFINE

Chapter 3 | PHASE 2 /4

Photo 15. Define phase

THE CONTEXT

Chapter 2 | PHASE 2/4

The Define phase channels problems and opportunities towards actionable tasks. This is done by gathering and analyzing all findings from the previous phase. The final outcome is summarized in the Design Brief (Design Council, 2017).

Photo 5. Sequence documenting the workshop

Synthesizing the findings

Aiming for a concrete direction in the design process all insights from the Discovery phase were tackled through the lenses of opportunity. Several methods were utilized: "Defining the coordinates" (Co-creation workshop), Value Constellation Experience, Empathy Maps, Personas and Design Brief.

The participatory workshop reinforced the collaboration(Sanders & Stappers, 2008) with the industry expert and the understanding the problem. It involved interactive exercises of clustering and interpretation. Furthermore, the Value constellation brought a systemic view of the existing service offering and the aided defining the focus area for further development. (Patrício et al., 2011) interaction design, and the emerging field of service design. MSD enables integrated development of service offerings at three hierarchical levels: (a

The overall premise of emphasizing with the user was present along the creation of the Empathy Maps and Personas. These methods proved to be of great value for defining the needs and expectation of industry actors and stakeholders (Müller, 2010).

Workshop "Defining the coordinates"
To foment expert involvement on the design process (Sanders & Stappers, 2008) and define a direction of the design challenge a workshop was organized. The workshop was a participatory exercise with the industry expert whose feedback and ideas were very much appreciated.

"Defining the coordinates" is an allegory to navigation. As in shipping it is important to define the navigation coordinates to avoid deviation. The workshop aimed to define the course of the design process taking into consideration all the findings of the previous phase.

The workshop was inspired on two IDEO´s methods "Download your leanings" and "Find Theme" which are a well-known practices for organizing a large group of information into concrete ideas ("Find Themes" IDEO, 2018; IDEO, 2018).

First, the expert was briefed about the aim of the exercises and the activities. The first part involved the clustering of the findings. He was presented with a big poll of findings written on sticky notes. We were supposed to take turns on reading the notes, then agree or disagree and elaborate on why, and come up with an overall theme of each finding (IDEO, 2018).

As we observed and discussed the implications of the findings, several clusters emerged. Having a real industry actor as participant, allowed additional clarifications and aided staying relevant to the maritime setting (Photo 5).

The second part of the workshop involved the identification of key themes by making sense of the knowledge we had so far. We looked for patterns and pieces of information that could be connected. The purpose of patterns recognition was to identify opportunities for potential solutions ("Find Themes" IDEO, 2018).

The clustering session resulted in eight themes, grouping issues and opportunities. Through the analysis it was found that some themes could be merge. Therefore they were rearrangement and synthesized them again concluding in a list of six key themes (Fig 10).

Seafarer's behavior

Seafarers' don't want the hassle of waiting for the original, carrying the physical certificates or worrying about expirations and renewals. Though digital certificates are not in compliance they would rather show them than having nothing to show.

Operators and Ships behavior

Ships and operators tend to make use of scanned paper-based copies as a replacement of originals. This behavior blurs the meaning of these formats.
Printing and archiving is very normal behavior. This enhances their codependence to paper-base.

Inspector's behavior

Validating either physically or digitally represents a challenge for inspectors. It is very uncomfortable to have to stop a ship without having sufficient evidence of fraud. The tendency is to accept scanned paper-based copies.

Certificate Issuers Behavior

Certificate issuers know the burden and risk of handling paper-based; still they are faced with the demand for originals in the industry. They are on a search for technology and better automation of their services.

OUTCOME OF THE CLUSTERING	OUTCOME OF THE SYNTHESIZING
1. Seafarer's behavior	1. Seafarer's behavior
2. Operators and Ships behavior	2. Operators and Ships behavior
3. Inspector's behavior	3. Inspector's behavior
4. Certificate Issuers Behavior	4. Certificate Issuers Behavior
5. Shortcomings of today's process	5. Maritime and Digitalization
6. Smart Certification	6. Smart Certification
7. Authentication	
8. IT infrastructure	

Figure 10. Workshop outcome

Maritime and Digitalization

The Danish political settings envision the maritime segment as a future digital hub. This is a favorable environment for the digitalization to foster breakthrough the silos attitude and the attachment to paper-based. Companies such as DMA and DNVGL can be seen as influencer of the industry. Since they already operate with electronic certificates this can be seen as the starting point the paperless era.

Smart Certification

Technology and automation can be a key to value creation and personalized experience. It can be a powerful alias for fraud avoidance, transparency, and authentication. The codependence to paper-based certificates will perhaps need a slow transition. However, the fact that electronic certificates are already in used offers a great advantage.

This participatory workshop (Sanders & Stappers, 2008) had numerous benefits, it boosted involvement, it encouraged the debate of ideas, it created awareness of design challenges, and it allowed knowledge sharing among participants -an aspect very much appreciated when working alone.

They six themes served the formulation of a new problem and defined the course of the design process. It was evident that the new solution should benefit the most affected parties: The ship, the inspector and the certificate issuer. Furthermore, the main issue was the industry codependence to the paper-based certificate and the lack of authentication alternatives. Therefore it was clear to us that the direction should be towards exploring new ways of using technology for smart certification.

New Problem Formulation

In the Discovery Phase of the design process, the initial problem formulation was defined as follows:

How can the maritime industry reduce the pain related to the handling of paper-based certificates?

Which allowed the in-depth exploration of the maritime setting in connection to paper-based operations.

The Define Phase implied converging thinking throughout the selection, evaluation and redefining of the findings. The themes, which emerged from "Defining the coordinates"

workshop, directed the course of the design process towards smart certification and authentication. The findings indicated that there are different approaches to certificates' authenticity and different circumstances can blur the meaning of what is stipulated by law.

Furthermore, it was concluded that the process of verifying and validating the certificates is inoperative without relying on technology. Based on the research, it was concluded that authentication is defined by two components: The inalterable nature of the certificate and the traceability of the certificate.

So far, the process was focused on shortcomings and consequences of operating procedure in the maritime. However, since the ship and the operator aren't in control of issued certificates, the focus is now addressed to the third-party suppliers, more precisely, the certificate issuers.

This remark doesn't disregard the maritime actors it rather converges and empathizes in the need of better synchronization between the issuers of the certificate and

the user of the certificates. Therefore, both groups were interesting groups of people to focus on when designing a service solution.

The new problem formulation is therefore defined as: How can technology be utilized on service that facilitates smart certification in maritime?

Value Constellation Experience

As discussed previously, although the operator, the ship and the surveyor are the parties with bigger needs of authentication, they have limited influence on the actual issuing of the certificate. Therefore, it was important to emphasize the role of the certificate issuer and his service-offerings within the constellation of service providers to define the value they deliver to the maritime actors.

The first level of the Multilevel Service Design model (Patrício et al., 2011)interaction design, and the emerging field of service design. MSD enables integrated development of service offerings at three hierarchical levels: (a offers an effective way of decomposing the service-offerings, enabling new understandings by enhancing the institution value

VESSEL'S VALUE CONSTELLATION EXPERIENCE

CERTIFICATION SERVICE REQUEST › **TESTING PROGRAM** › **WAITING FOR ORIGINAL CERTIFICATE** › **REQUEST COPY** › **UNANNOUNCED INSPECTION** › **ORIGINAL ARRIVES**

MAIN FOCUS

SURVEYOR'S VALUE CONSTELLATION EXPERIENCE

INSPECTION

PREPARATION FOR INSPECTION › **PRACTICAL CHECK** › **DOCUMENTATION CHECK** › **BRIEFING AGREEING UPON FINDINGS** › **REPORTING**

MAIN FOCUS
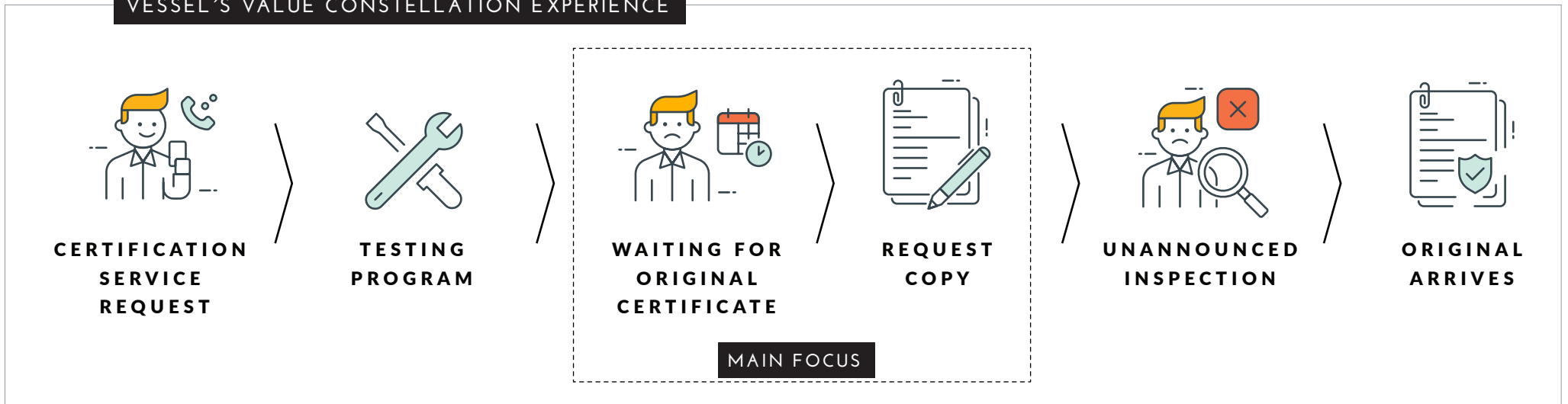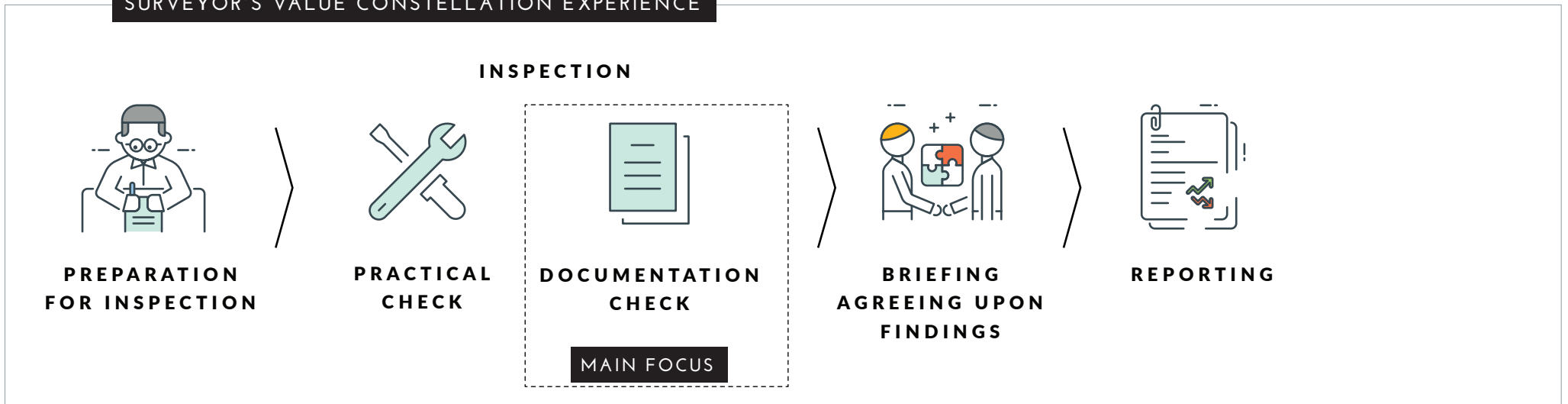
Figure 11. Value constellation experience of the Seafarer and the surveyor

CERTIFICATION COMPANY SERVICE VALUE CONSTELLATION EXPERIENCE

RECEIVES PETITION

PLANS INSPECTION

LAB TEST / ONBOARD INSPECTION

REPORTING

CERTIFICATE IS ISSUED AND SENT VIA POST

POST DELAYED

AFTER SERVICE EXPERIENCE

SCANNED COPY IS SENT

CUSTOMER SUPPORT (PHONE OR EMAIL)

MAIN FOCUS
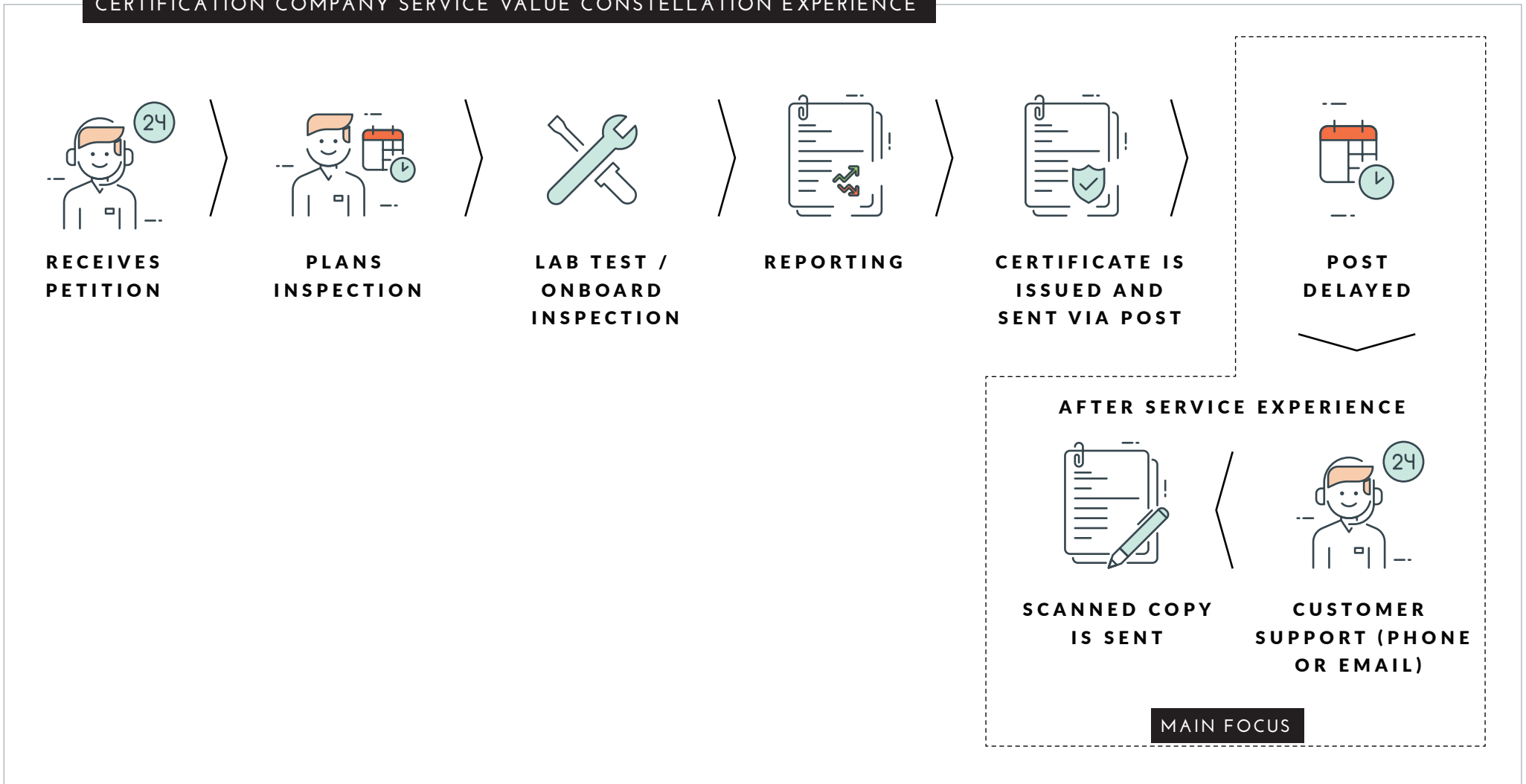
Figure 12. Value constellation experience of the certification company

preposition, and seeing in what way the service-offering could meaningfully evolve for the actors' benefit.

Figures 11t and 12 shows the decomposition of the actors' activities, revealing potential areas for improvement. The biggest issues from the ship's point of view are the certificate format, postage time and archiving. While the surveyor's pains are the certificate's content, the format and the way of authentication. This makes the reception and authentication of the certificate the focus area in the actors' experience.

Figure 13 illustrates six values identified as relevant for the maritime actors. These are information, certification programs, testing, inspections, reporting, and certification. The graphic shows the actors value constellation involving not only the "issuing

CUSTOMER VALUE CONSTELLATION EXPERIENCE

PORT CONTROL
Framework conditions, Safety, Health & environment, Safe water Boyage & navigation, Seafarers & Fishermen, e-certification

FLAG STATE
Framework conditions, Safety, Health & environment, Safe water Boyage & navigation, Seafarers & Fishermen, e-certification

CLASS
Technical assurance, Independent expert advisor, Software, certificcation on supply chain and data manageent services, e-certificates-

SHIP

FLEET MANAGENT SYSTEM
System mantainace, Inventary, certificate & Safety procedures

PROGRAMS
Programs type A-D

REPORTING
IT, Staff, Archivig, Privacy polity and confidenciality

INSPECTIONS
Periodical onboard inspections

CERTIFICATION COMPANIES

INFO
Customer service, Digital assets and Prints media

CERTIFICATES
Content, Protection & sharebility

TESTING
Workshop and Laboratory Test

SMART CERTIFICATION & AUTHENTICATION

Figure 13 Customer value constellation

of the certificate" but also other associated activities such as information and reporting. Moreover, it illustrates the maritime stakeholders delivering similar offerings.
The big players in the industry are aiming to minimize the maritime problems described throughout the customer experience (Figure 13) by using electronic certificates.

This format improves the postage time and minimizes the risk of modification and fraud. However, it doesn't eliminate the pain of the Surveyor who must "nock at the door" of each maritime service supplier to authenticate the ship's certificate nor does it eliminate the ship´s pain of printing and archiving to have a tangible grasp of the documentation.

Electronic certificates improve the actors experience, however the total effectiveness of this solution can only be experienced if the users treat it for what it is – an electronic format. The moment the certificate is printed this solution decreases effectiveness.

Drawing out the value constellation reinforced the direction of this project towards digitalization, and it highlighted the areas for service innovation. When comparing the service-

offerings of the certificate issuer in the context of the value network it became clear that new solutions should target the areas of archiving and authentication (Figure 13).
These areas will be discussed in-depth in the Develop chapter where they will be used as the primary goal when concept developing the service solution.

Empathizing with the actors
The method of empathy mapping by Osterwalder & Pigneur (2010) helped structuring the findings from the user research as the first step towards the creation of personas (Osterwalder & Pigneur, 2010).The tool offers an opportunity to reflect one's own perception throughout a multidimensional process determined by eight aspects: hear, think, feel, see, say, do, pain, and gain (See Figure 14-16).

Applying users analysis in an empathic process is a powerful tool to unfold differences between what is said and what is felt; key aspects to be used in the representation of the final persona (Müller, 2010).

THINKING & FEEL

Paper-based certificates are more risky of falsification.
Doubtful cases are usually linked to paper.
A solution that simplifies the paper problematic and aids authentication would be very appreciate in the industry.

SEE

Some regions of the world have bigger attached to paper-based certification than others e.g. Asia, Middle East and Africa.

SAY AND DO

Issuers have a big interest on technology that preserve the certificates' authenticity (e.g. electronic signatures). Nevertheless, originals are still issued because there is a demand and use for this format in the maritime.
The more digitalization the safe we will be.

HEAR

Companies like DNV GL and DMA are in the front head of automation of certificates.

PAIN

Having to deal with daily authentication enquiries is a hassle.

GAIN

Less complexity and better collaboration with industry stakeholder lays on automating paper-based certificates.

Figure 14. Empathy map of the certificate issuer

THINKING & FEEL

Paper-based certificates have always existed and mush probably stays that way.
Waiting for original and dealing with expiration dates is a hassle; practical tasks are preferred over paperwork.

SEE

Paper-based format is still the preferred format; in the ship everything is printed and keep it at hand in case of inspection.

SAY AND DO

The late arrival of the certificates to the ship causes a lot of problems in the daily operations.
Mistakes or damages on the paper-based certificate also cause big difficulties on the ship.
It is preferable to have as scanned copy than nothing at all to show in case of inspection.
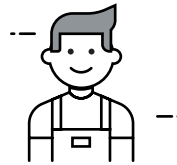
HEAR

New procedures and regulations (e.g. environment and safety) increase the yearly nr of certifications.
Recruitment in maritime is already using automated systems for handling certifications.

PAIN

Having to wait for originals and then having to do all the manual work that paper implies is a real burden for the ship and the crew.

GAIN

Less complexity and better collaboration with industry stakeholder lays on automating paper-based certificates.

Figure 15. Empathy map of the seafarer

THINKING & FEEL

It is very challenging to authenticate paper-based certificates wither a copy or an original without having a reference to compare it with. The retention of the ship in port without having enough evidence is unacceptable. To perform a proper audit it is important to have an overview of the ship, crew and cargo, however this is not always possible.

SEE

Few certificates are easy to authenticate, it is a burden having to go to multiple websites to authenticate certificates. Print copies are becoming "good enough" they are used as a replacement for original paper copies.

SAY AND DO

The Law does not support scanned paper-based certificates. The industry is in need of better-automated forms for handling certifications.
A single authentication source would be very beneficial for all maritime stakeholders.

HEAR

Many seafarers don't see the difference between digital and electronic certificates, as they both are PDF formats.
The inadequate processes linked to paper-based certificates often affect ship's daily operations.
Ships are dissatisfied with the way that issuers, ports etc. handle certificates.

PAIN

Not having a sustainable form of authentication is a real issue.

GAIN

Less complexity and better collaboration with industry stakeholder lays on automating paper-based certificates.

Figure 16. Empathy map of the surveyor

Personas

The empathic maps were used as key components for creating the final Personas (Figures 17-20). This method is a well-known practice for making effective design decision, as both visual and verbal representation of a Persona aid maintaining the focus on the user perspective when designing the service. Pruitt & Grudin (2003) argue that the actual purpose of the method is not the persona description, but the ability to imagine the service/product -a very practical mode of applying the method when designing the service (Pruitt & Grudin, 2003).

According to Lene Nielsen (2012) the main feature of a persona description is "...that you do not look at the entire person, but use the area of focus or domain you are working within as a lens to highlight the relevant attitudes and the specific context associated with the area of work (Nielsen, 2012). Therefore, the objective was to go beyond demographic description and stepping into user particularities strongly connected to the maritime scene. Criteria such as IT proficiency, likelihood to paper, and the frequency handling certificates are a reminder of the needs to target in the future service.

Furthermore, the use of storytelling in the description helps emphasizing with the future user of the service and keeps the attention on what really matters. The following section goes into further details.
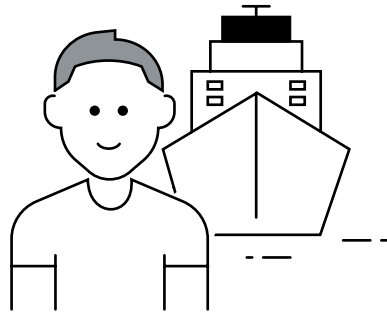
THE SHIP OWNER

Karsten, 62 years
Feet Owner/ Operator
Lives in Nord of Sjælland
with his wife

In his younger years Karsten was a Ship Captain, nowadays he has a small fleet of three cargo ships. Karsten works onshore, mostly doing management and paperwork.

Each of his ships sails with their respective documentation, which Karsten also keeps a copy of at his office. He uses a PMS program to keep track on the expiration dates. The average number of certificates for a ship is around 20, they all have different duration, some are to be renewed annually, others every third or fourth year.

Karsten is a conservative seafarer who follows the printing procedure as the industry expects. Handling original is a hassle for Karsten, who must wait for the regular post-delivery and be extra careful to send it to the ship's next destination.

Karsten would welcome new automized forms of handling certificates if it would mean the total involvement of all certificate issuers towards the elimination of paper-based certificates. Although there are a few certification companies that have chosen this approach, the great majority still handles paper-based certificates.

Currently, to avoid multiple forms of storing the certificates and having to go back and forward between paper-based and digital, he sticks to the traditional printing and filing process.

IT skills

| Beginer | Confident | Super User |

Format preference

| Paper-based | | Electronic Certificate |

Frequency of use of certificates

| Seldom | Once in a while | Regulary |

How relevant is the authenticity in relation to the circunstance

Perceived emotion				
	Necessary	Expendable	Compulsory	Urgent
Flow of actions	Wating for original	Post Delayed Issuer sends email	Momentary solution (Scanned PDF)	Unannounced Inspection	Original arrives

Figure 17. Persona, The ship owner
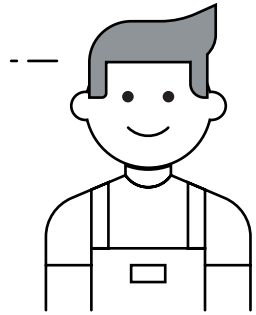
THE SEAFARER

Jesper, 42 years
Chief Engineer
Live in Odense with his wife
and 2 children

Jesper is Chief Engineer with an extensive carrier path at sea. Throughout his work life as a seafarer, Jesper has collected a big number of certificates and accreditations. Every time he goes on board a ship Jesper he must remember to carry a thick file with his work-life documentation.

Since the industry is constantly adjusting to new settings and procedures, Jesper attends numerous training courses yearly. For each course attended, he receives a certificate. Jesper attends these courses gladly since he likes his profession, although sometimes he thinks it is a bit of repetition of what he already knew.

Jesper works in the engine room and uses a PMS to keep track of engine maintenances task and tracking certificate expiry. Every time the engine needs a new certification, an external inspection is performed, and Jesper must wait for the new certificate to arrive by post.

His ship is an oil tanker sailing through Somali waters; since there is a high risk of piracy in that area all authorities have a strong focus on operations and documentation. To minimize risks, the ship must comply with the rules and follow a strict procedure. Usually, he ends up asking for a scanned copy to the supplier, to be used momentarily until the original arrives.

IT skills

Beginer — Confident — Super User

Format preference

Paper-based — Electronic Certificate

Frequency of use of certificates

Seldom — Once in a while — Regulary

How relevant is the authenticity in relation to the circuntance

Perceived emotion	Necessary	Expendable	Compulsory	Urgent
Flow of actions	Wating for original	Post Delayed Issuer sends email	Momentary solution (Scanned PDF)	Unannounced Inspection	Original arrives

Figure 18. Persona, The seafarer

THE INSPECTOR

Søren, 52 years
Master Mariner
Lives in Copenhagen with his wife

Søren has been performing inspection for more than 20 years. Throughout his career he has developed "an eye for attention to detail", especially when it comes to the content of the documentation and expiry of certificates.

Søren works as an independent consultant; sometimes on behalf of insurance companies, other times on behalf of the Operator. He has in-depth understanding of the maritime regulations in a practical sense.

Søren is aware of the industry prerequisite for originals, so once he is faced with a scanned copy, he must question its authenticity. Søren knows a few certificates issuers that have a authentication platform – these are the least problematic certificates.

In case of doubtful documentation Søren must turn to experience since there is no immediate form of authentication for these certificates. In worst-case scenario he must take the uncomfortable decision of having to retain the ship on port.

Generally, Søren spends too much time looking at the certification rather than using quality time with surveying the ship.
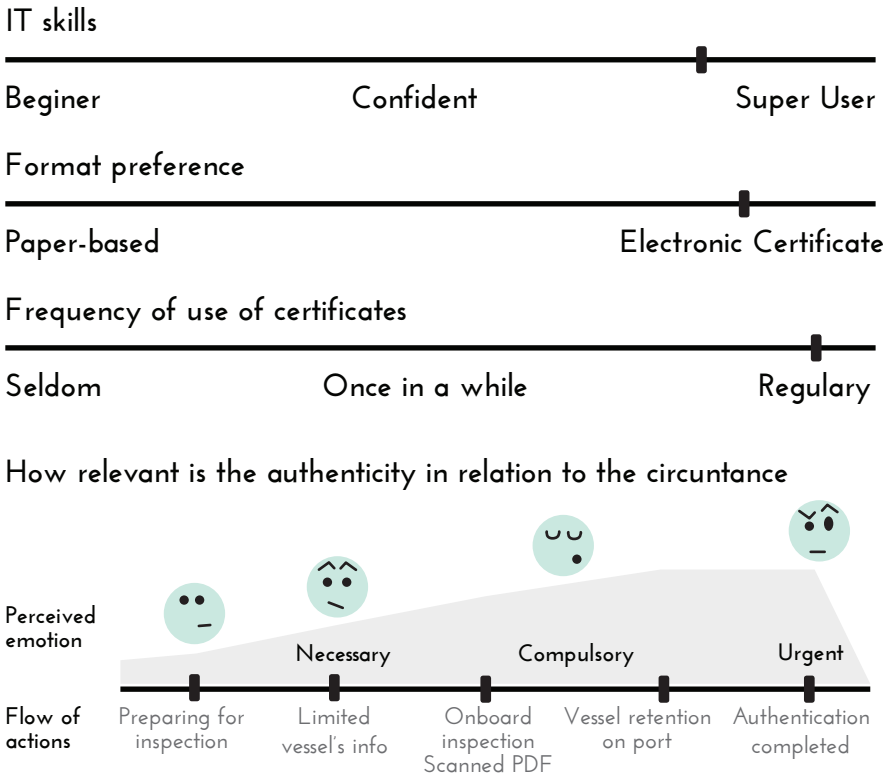
Figure 19. Persona, The surveyor
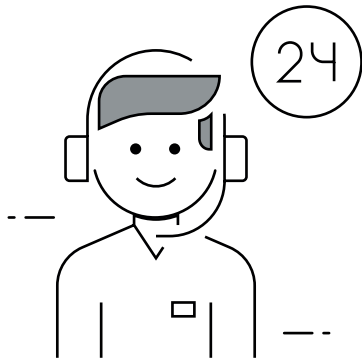
CERTIFICATE ISSUER

Jens, 44 years
Office worker at a
certification company

Jens receives and handles certification petitions, organizes the testing exercises, and keeps the contact with the ship in case of scheduled inspection. Once the testing/inspection is completed, Jens issues the certificate and carries on with the archiving and postal mailing of the certificates.

Jens often receives calls and emails from all over the world with enquiries for certificate authentication. It's very stressful having to deal with office tasks and external queries. He usually allocates 1-2 hours during his day for this task.

Jens would very much like to handle only electronic formats because it is time efficient and client friendly. However, as the ships insist on having paper-based originals, she has no alternative than to deal with it paper-based.

His workplace, on the other hand, is introducing new initiatives for improving the quality of the scanned PDF frequently sent to the ships as momentary solution when the post is delayed. Usually this format is vulnerable to modifications, and it is also hard to trace the source of issue.

The new initiatives comprehend content encryption programs. This is a fine alternative to ensure authenticity as long as the nature of the format is respected. However, the moment the certificate is printed, it loses these qualities, and it becomes a copy considered equivalent to a scanned PDF.

IT skills

Beginer	Confident	Super User

Format preference

Paper-based		Electronic Certificate

Frequency of use of certificates

Seldom	Once in a while	Regulary

Inpact of ustormer expectation on Maria's day performance
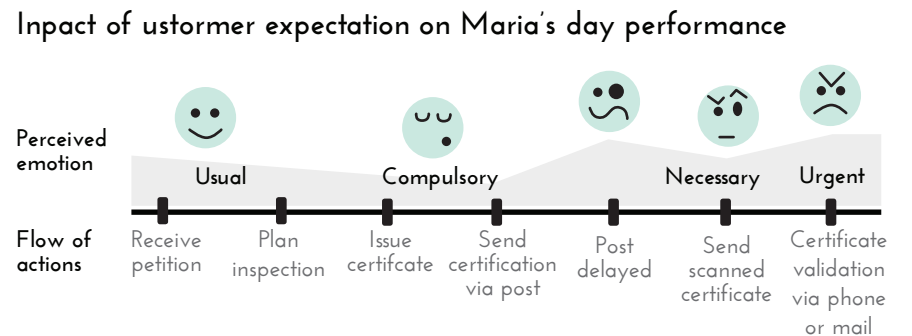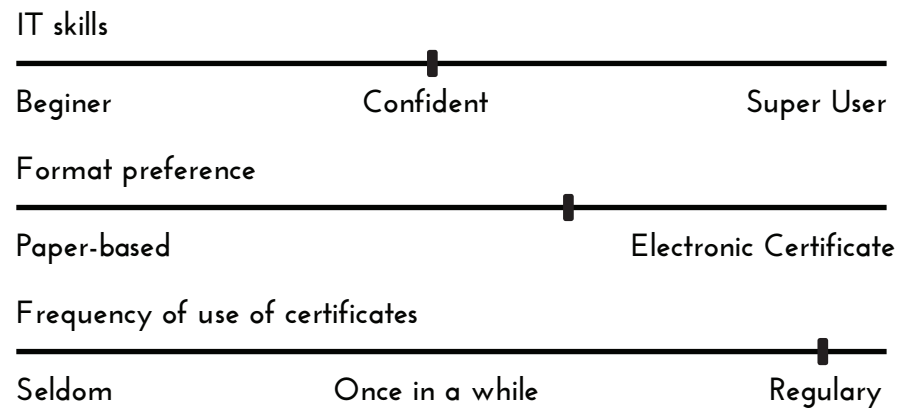
Figure 20. Persona, The certificate issuer

DESIGN BRIEF

Chapter 3 | **PHASE 2/4**

At this point in the process it felt very natural to converge all re-defined aspects in a synthesized form to serve as point of reference for future decision-making. The Design Brief offers a short and concrete way to represent the gathered insights (Design Council, 2017). It frames the problem to be solved with a potential solution, the end users of such solution and their behavior, as well as the overall goal of a future service (Figure 21).

The intention of the Design Brief was to be used as a reference guide for the Develop phase, a tool guiding the concept development towards the real issue and its solution. The Develop phase describes the brainstorm session and the different adjustments done to the chosen concept until the final service is ready for implementation.

Furthermore, this phase explains the service and it's components and reflection on the co-creation activities with the industry expert who is also a potential user of the service.

Details of implementation will be discussed in the Delivery and final phase.

WE KNOW

Ships are to carry official documentation in paper-based. This is done so the Captain/Operator can have a better overview of the documentation, and in case of inspections is able to show tangible proof of compliance.
For some, the authenticity of the documentation is linked to circumstantial facts, while for others it is a matter of law. This is mostly due to industries prerequisites for originals in paper-based format.

THE PROBLEM

It is a hassle to handle official documentation in hardcopy, especially because the ship is not reachable all the time. Since regular post takes too long to reach the vessel, scanned version of originals are used as momentarily replacement of originals. There is no way to validate the content of these certificates.

BEHAVIORS

Goal-oriented individuals with practical mindset and focus on work progress.
Conservative engineers with preferences for print form with a tendency to use scanned copies as replacement for originals.

WHAT TO AVOID

Sophisticated system infrastructure, complex UX and expensive solution.

ENGAGEING WITH

First Target Group: Certificate issuers

Second Target Group: Seafarers & Inspectors.

HOW TO

It should be thought of as a smart certification service enabling digital and physical interaction. The main focus should be in Authentication.

THE GOAL

To offer an alternative to paper-based certificates. To build a service that facilitates smart certification and easy authentication of certificates for maritime.

MAIN MESSAGE

The formats of the certificates won't matter as long as certificate can be authenticated.

Figure 21. Design brief

DEVELOP

Chapter 4 | **PHASE 3 /4**

Photo 16. Develop phase

BRAINSTORMING

The brainstorming session was hosted as participatory (Sanders & Stappers, 2008) activity where the industry expect was invited. The goal was to come up with concrete ideas for potential service solution. The Design Brief and Personas and Customer Value Constellation where printed and used as key references for the discussion.

The Design Brief and Personas aided keeping the focus on the goal of the project and the users need. Special attention was put on better user experience in the "after service" at the certificate issuer and a reliable source of authentication for maritime actors.

The Value constellation experience aided (Fig 7) exploring the authentication issue and other activities associated with the issuing of the certificate, such as signature and stamp content protection, mailing and archiving. These tools enabled us to see vulnerable aspects of the users activities,

enriched the brainstorming and aided the discussion on new alternatives.

Throughout the brainstorm, each suggestion was discussed, sketched (Photo 1-3) and written down on a blank piece of paper. The goal was not to define a perfect solution but to generate as many ideas as possible, in a discussion that embraced creativity and "thinking out side the box." Four points wrapped the brainstorm: Simplicity and easy usability, Reveal a new form of handling paper-based certification, A platform with data driven targeting certificate issuers, ships and surveyors and Smart utilization of new technology. They are further explained below:

Simplicity and easy usability
Since the target group is people with different IT levels and heavy workload the solution should embrace simplicity.

Reveal a new form of handling paper-based certification
The research showed that paper-based certificates are still
a very important part of maritime. Therefore, we aimed to
think of alternatives that minimize the imperative need of
original vs. copy.

A platform with data driven targeting certificate issuers, ships and surveyors
The research showed poor interaction between maritime
stakeholders. The "After Service" offered by the certification
companies also needed extra attention. Therefore, we
thought a dynamic data driven platform as a potential
solution.

Smart utilization of new technology
Technology shapes the life of every stakeholder; it facilitates
work and improves security. The brainstorm incorporated
digitalization and automation as the best alternatives to
paper. The success example of DNV GL and DMA were
sources of inspiration.

A deployment exercise followed the brainstorming session.
This time, we evaluated each scenario by explaining the Pros
and Cons and added a dot to the concept we considered
had the biggest potential (Photo 6).

Some ideas were merged with other ideas and some
were disregarded. After several rounds two main concepts
emerged.
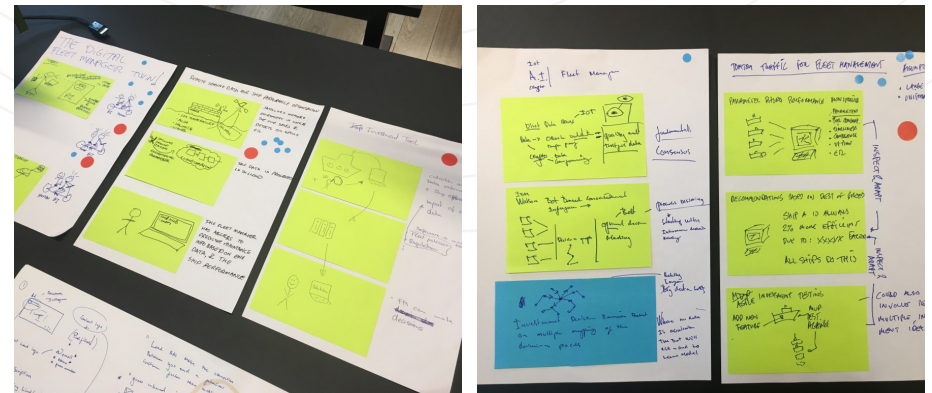
Photo 6. Sequence documenting the brainstorm session
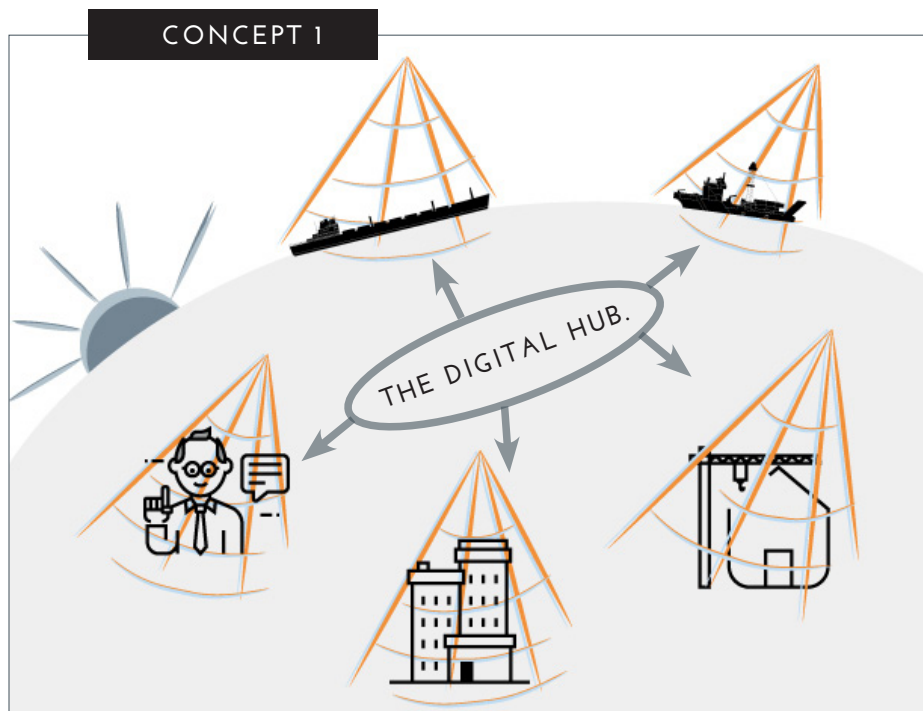
Figure 22. Concept 1, The digital hub.

The Digital Hub

The Digital Hub visualized in figure 22 would be a service, which eliminates paper-based certification by enabling issuing, acquiring and authentication of certifications in a single platform. This will be possible by the using blockchain technology and would require all actors to be connected to a digital chain.

This concept would work as a hub, an interconnected-shared-data-system that allows the exchange of data in a safe and transparent form. It should be accessed via the Internet, allowing different access levels according to the user's rank and purpose. For instance, in the case of a Captain viewing the ship documentation, he has total control of the ship information and he gives consent to what and who sees this documentation.

In contrast, a surveyor, when performing inspection, with the consent of the Captain, he will be able to fetch and view ship's certificates.

Since the certification issuer is also connected to the hub, authentication is not a problem, any longer. Once the certificate is issued electronically in the chain any subsequent alteration to the certificate will be recorded. This way the content of a certificate viewed in the hub corresponds to the content as when it was issued (or alternatively, any alterations will appear unambiguously).

Pros of the digital hub

- It will ensure a high degree of trustworthiness of the certificates.
- It will eliminate the need for the ship to carry original paper-based certificates.
- It will be very user friendly.

Cons of the digital hub

Success of the concept requires participation of all certificate issuers, every certificate issuer must be connected to the hub. Considering many certificate issuers are small entities it must be expected that many would not like hassle of connecting and in turn rejects to deliver to the maritime industry.
The concept suits best to countries with full internet coverage and high level of technological development.
The concept does not meet the guidelines on electronic certificates set out by IMO as of today.

AUTHENTICATION
PLATFORM
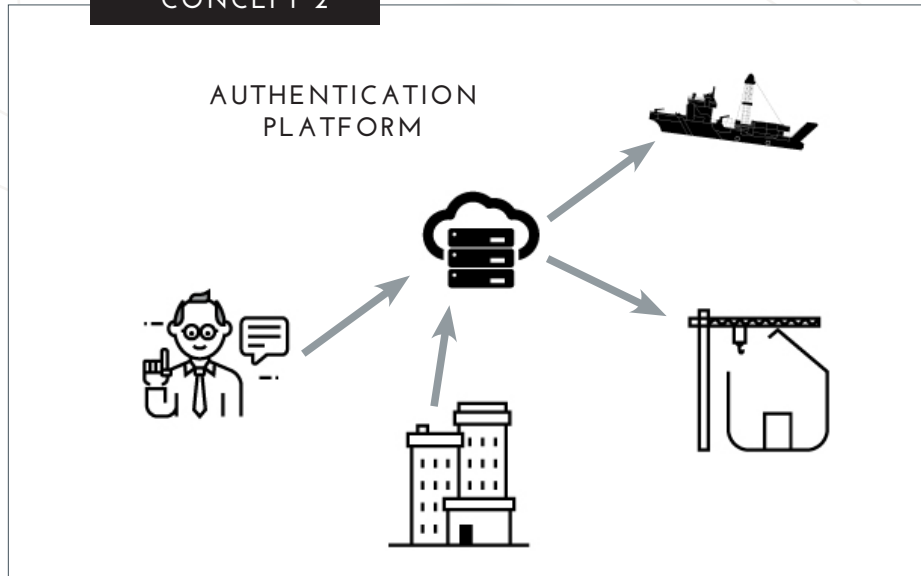
Figure 23. Concept 2, The authentication platform.

eDocs, the authentication platform.
The scenario visualized in figure 23 would be a service embracing paper-based certificates by adding (to each certificate) a facility to authenticate the certificate at hand. Furthermore, the solution enables easy and instant share ability of certificates.

This service would be a cloud-based solution enabling the creation of electronic certificates. An auto generated tracking number would be attached to each certificate, which would facilitate the search and viewing (authentication) when linking to a web-based module.
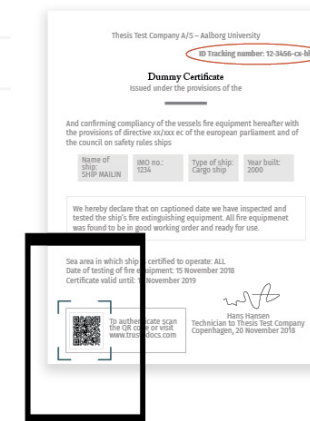
Photo 7. Dummy certificate highlighting the ID tracking number

This concept takes into consideration the global maritime setting and the fact that the industry is not entirely ready for the elimination of original certificates. In this scenario, the issuer will still be able to send an original via regular post (if this should be required) but due to the immediate effect of eDocs the ship won't have to suffer from the time delay inconvenience.

Moreover, the fact that an inspector would be able to compare the content of a paper-based certificate at hand against a digital presentation (regardless if original or not) would ensure authentication and in turn eliminate the need for the ship to carry original paper-based certificates.

Pros of the authentication platform
- It will ensure a high degree of trustworthiness of the certificates.
- It will eliminate the need for the ship to carry original paper-based certificates.
- It will be very user-friendly.
- It follows the guidelines on electronic certificates set out by IMO.

Cons of the eDoc authentication platform
The big challenge for this concept lies on the backend architecture. It requires a robust data infrastructure to secure a user-friendly interface at the certificate issuers and at he same time a high degree of security.

It is fundamental the certificate issuers buy the idea and are willing to spend a certain (small) extra cost to each certificate.

Outcome
All-in-all we found the eDoc authentication platform the most attractive transition towards digitalization of certificates in the maritime setting. Since the Internet makes possible to check the certifications even for those countries with less technological advances.

Furthermore we considered a great future potential for growth laying on the collection of the certificates data. With time this solution could offer a larger range of services to the maritime.

PROTOTYPING

The session reflects the process and benefits of rapid prototyping. After deciding on the most suitable concept for maritime several prototyping exercises were performed.

"Testing the initial appeal and actual usage of a potential new product by simulating its core experience with the smallest possible investment of time and money." (Savoia, 2011)

The method of prototyping is used to illustrate the service concept and get "hands on" a tangible idea from where to draw decisions (Houde & Hill, C, 1997).This is a quick and easy way to illustrate ideas. This practice requires few resources mostly paper and pen. The aim was not to have a very refine product since this requires a big budget over

months or years of work but, more like a "work in progress" a sketch that facilitates discussions about potential issues and particularities of the service to be design (Photo 8).
Some author like Savoia (2011) refers to this quick visualization of sketches and wireframes as "pretotyping". He suggests it as the first step to determine if "it's the right thing to build." Once there is a solid concept, then it is time to move from pretotyping to prototyping (Savoia, 2011).

Following these principles, a series of wireframes were created illustrating the interphase of the solution (Photo 11). When presented to the industry expert new aspects of the service were brought up. Then it was necessary to add complementary elements or adjust the wireframe with more

explanatory information. We found it easier to scan, print and cut copies of the exiting work and then insert them back with the new features in a black page.

Designing eDocs Service System
The service system map suggested by Patrício (2011) was used to support the concept development and reflect on the particularities of the service infrastructure. Since the service concept has a strong IT base it was important to define what kind of technology would suit best each interaction. This required deeper investigation on data encryption and Cloud computing -certainly a necessary step in order to have a mature service solution.
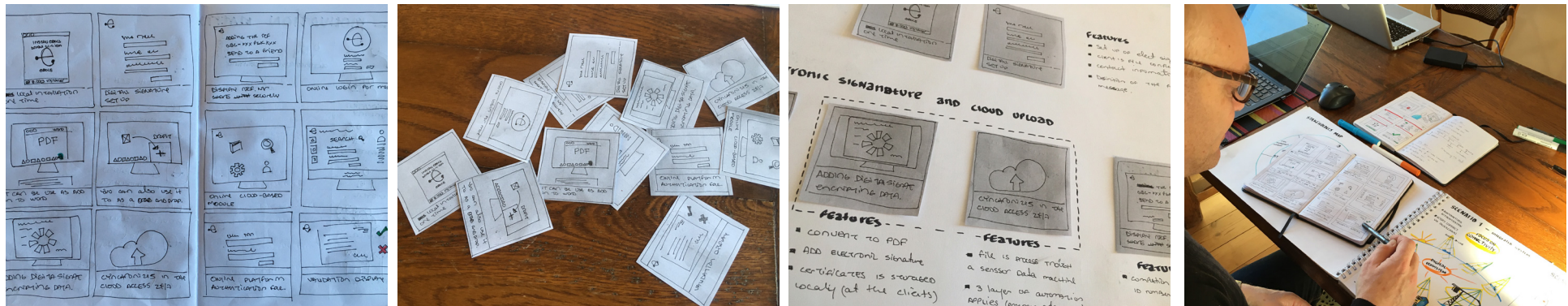
Photo 8. Sequence documenting prototyping

The matrix shown in figure 24 horizontally displays the service journey. The vertical sections show the backstage core component corresponding to each interaction.

The service system map offers a simple overview of both the front-stage and back-stage of the service. eDocs solution is a response to better user experience in the "after service" (Figure 7 customer experience) at the certificate issuer and a reliable source of authentication for maritime actors.

The matrix shows that the new service offered via the Internet reduces the burden of having to spend hours on customer support or days waiting for the paper-based certificate.

The feedback of the industry expert was very relevant on this process. The core components were defined collaborative as we explored the service touchpoint in-depth. The final concept was developed and explored on the basis of the Develop phase, aiming to fulfill the guidelines of the design brief.

After acquiring solid insights with the user through prototyping, the final idea is presented in the following section.

SERVICE SYSTEM ARCHITECTURE		SAAS DOWNLOAD	SERVICE SET UP	MICROSOF WORD INTEGRATION	CLOUD STORAGE	PAAS SERVICE	QR SCAN	AUTHENTICAION PORTAL
Users	Certificate Issuer	✓	✓	✓	✓	✓		
	Suveyor						✓	
Service Info	Interface SaaS	✓	✓	✓	✓	✓	✓	
Backstage support	PaaS	✓	✓	✓	✓	✓	✓	
	Key Management		✓	✓	✓	✓	✓	
	Data Security Encription				✓			

Figure 24. Service system architecture

Platform Canvas

To gain a better understanding of the channels, services, and tools conforming eDocs the platform canvas was used (Choudary, Parker, & Alystne, 2015). The starting point was the checklist suggested by the authors at the end of the chapter. Answering the questions aided with the definition of the content of each building block in the platform (See Figure 25).

The canvas defines producers, consumers, and the platform itself, making an emphasis on "value exchanged" through the platform. In the process the functionalities of the three modules eDocs client, eDocs Cloud, and eDocs authentication portal are explained.

The tool did not only structure all the components that the eDocs solution depends on, it also aspired the reflection about factual meaning the "value exchange". The platform canvas is defined by the authors "...as the infrastructure on which value is created and exchanged." (Choudary et al., 2015). This underlines the importance of the definition of the value exchanged on the platform which in eDocs case is authentication.

PLATFORM CANVAS

PRODUCER

Certification Companies

CHANNELS + ACCESS CONTROL

eDocs client application
eDocs clouds
Asymmetric Encryption
Website
Internet connection

VALUE

Authentication of maritime certificates

CHANNELS + FILTERS

eDocs Web-portal filters according to the inputted ID tracking nr to displays the corresponding certificate.

CONSUMERS

Primary: The ship and the operator
Secondary: The surveyor and any other compliance institutions.

CREATION

Content creation (eDocs integrated App)
Control Pannel (eDocs Client)
e-Signature set up (eDocs Client)
Role-based access control (eDocs Clouds)

CURATION & OPTIMIZATION

Control Pannel (eDocs Client)
File Management (eDocs Clouds)
Search and Display (eDocs Web Portal)

CONSUMPTION

Filtered data
Matching algorithms
Display certificates as issued

PLATFORM

Tools:	Services:
eDocs Client:	Facilitate content creation and control
eDocs Cloud:	File management and storage
eDocs Portal:	Enables authentication of maritime certificates
Phone	Facilitate access to eDocs Portal via QR code scanner

CURRENCY

Data is the primary currency. Moreover, the user's loyalty can also be considered a currency.

CAPTURE

The invariable nature of the certificates created within the platform and the authentication service.

Figure 25. eDocs Platform Canvas

PROVE OF CONCEPT

Chapter 4 |
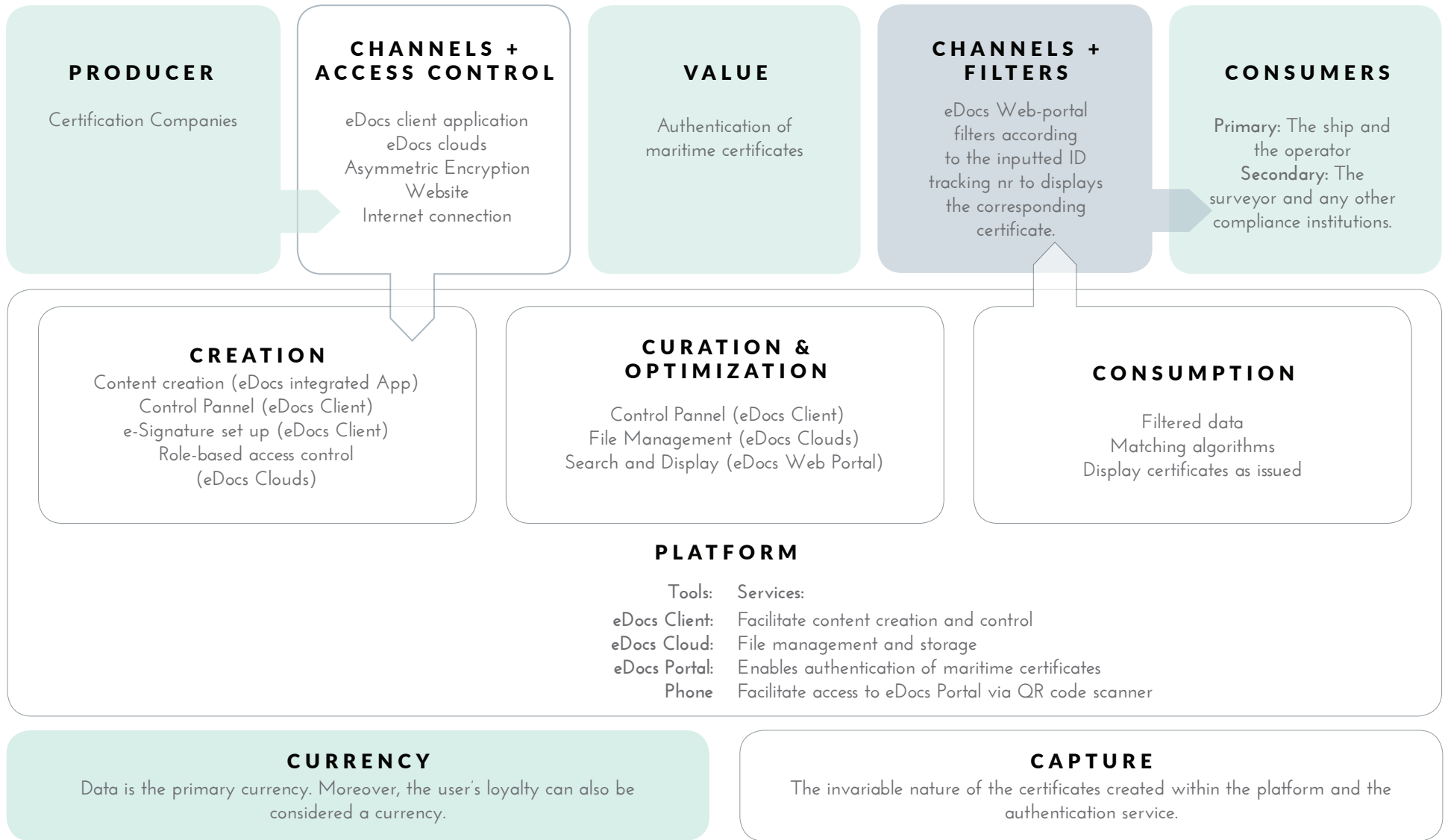
Prove of concept

The service concept presented so far would be a service embracing paper-based certificates by adding (to each certificate) a facility to authenticate the certificate at hand. This is a done thinking of the strong bond of the industry to paper-based format. The service solution aims to provide a smooth transition to digital. By "embracing paper-based" is meant that in case the maritime actor would like to keep the documentation in hardcopy the aspect of Original won't be a hassle.

At this stage of the design process it was necessary receive feedback. To evoke reflections on the service solution a Prove of concept exercises was held. The activity involved the participation of real certificate issuer, the head of certification at FORCE.

Prints of the low-fidelity mockups and the rest the graphics explaining the concept were shown striving to receive an honest feedback and a critical point of view on the concept.

The overall aim of the service solution was understood however multiple aspects of the service concept needed further explanation. The expert's general opinion was that the service lack of a narrative describing how the service helped the users accomplishing their goal.

This feedback was highly appreciated and was the main reason behind the creation of user Journeys (Delivery phase). Furthermore, The Prove of concept exercise highlighted financial aspects that so far were not really considered in concrete. Who would be the one paying for the service? What would be a reusable price? Would it be offered on a monthly membership or one time-year-payment? A discussion worthy of having, considering that the expert had actual insight on prices and real decision power regarding if this idea would be something worthy to prioritize on his year budget.

THE SERVICE

Chapter 4 |

The core value of the service concept is to preserve the authenticity of the maritime certificates. The process involves the active participation of the certificate issuer as content creators, the service provider, with a facilitating role, and the maritime actors as passive participants.

This section aims to describe the service's components in detail, starting with the concept explained. It continues with name, the service provider, users, choice of platforms, and low fidelity mockups of the interphase. The service concept description concludes with the service's functionalities, use of technology and data.
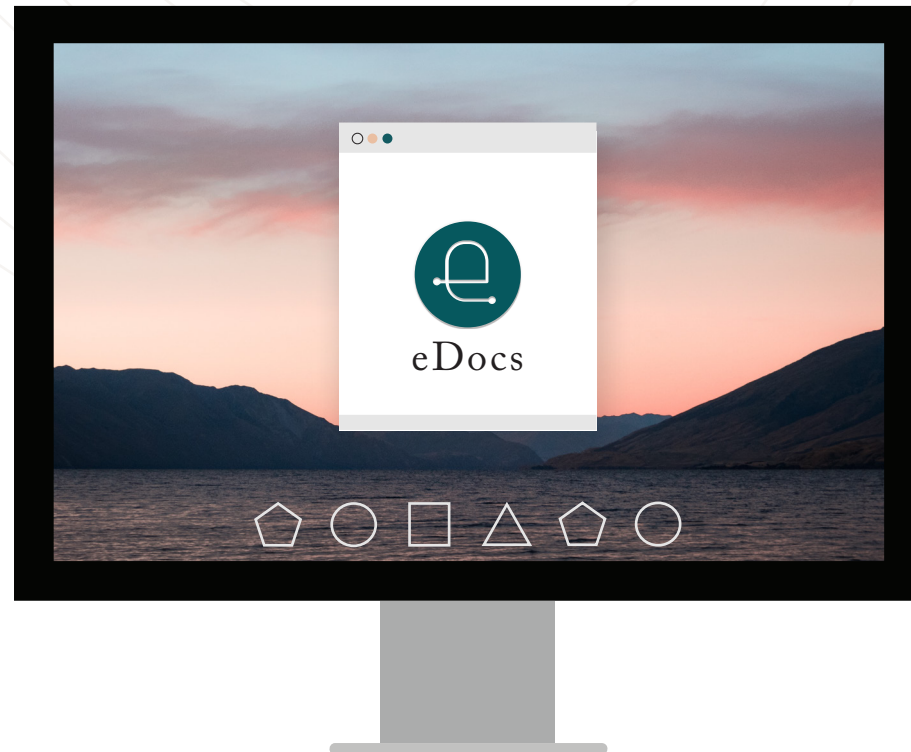

Photo. 9 eDocs Solution

Photo 10. Docs Client

The solution comprehending three modules: **eDocs Client**, **eDocs Cloud**, and **eDocs Authentication Portal**. The solution offers an easy and secure way to authenticate maritime certificates.

eDocs Client facilitates the creation of electronic certificate. It allows safe storage with eDocs Cloud services from where maritime actors can access it via the Internet at eDocs Authentication portal.

eDocs Client is a Paas/SaaS solution to be installed at the certificate issuer's machines (the client). The solution integrates with client's applications such as Microsoft Office etc. eDocs Client generates an encryption key, sign and time stamp the certificates and embeds a tracking ID so the recipients can authenticate the certificate in a secure and auditable way.

Furthermore, eDocs client ensures the safety upload of the certificates to the cloud by using asymmetric encryption. This way even when the external entries manage access to the cloud won't be able exploit sensitive information.

eDocs Client

eDocs is a cloud computing solutions that delivers trust and control whenever a certificates is created, signed and validated because it provides easy authentication via a web-based portal. It ensures that the certificate issued through the platform is both secure and trustworthy. Ensuring data protection and regulatory compliance through encryption, key management, and privileged user control.

Photo 11. eDocs Cloud service

eDocs Cloud

eDocs Cloud safely storages the encrypted certificates in a hybrid cloud environment. The hybrid cloud is a composition of two or more clouds (private and public) that remain distinct entities but are bound together. This particular type of cloud environment enables privilege users (only from the client's side) to perform the work safely while enabling approved users (maritime users) to just view particular information. This cloud attribute is known as role-based access.

Photo 12. eDocs Authentication Portal
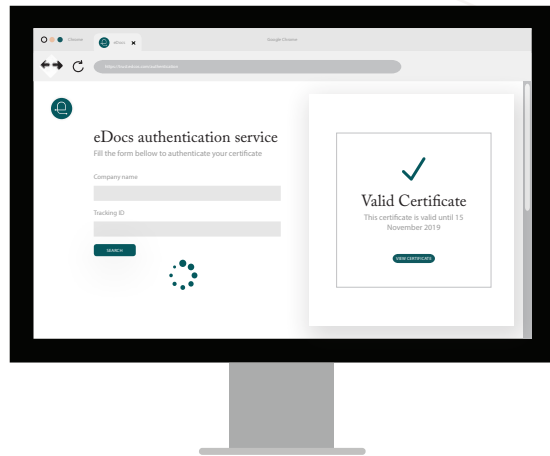
eDocs Authentication portal
Web-based validation portal where privilege users can check the validity and authenticity of a certificate by entering the certificate's tracking ID.

The service is a public domain www.trust.edocs.com and it also uses asymmetric encryption to protect the data pulled from the cloud service.

eDocs

The name
eDocs is taken from the abbreviation of electronic documents. It was thought as fine shortcut that describes the core value of the service. The dots at each ends of the "e" represent the journey of the certificate to be authenticated. The web service www.trust.edocs.com also denotes authentication.

Service provider
The service provider would be an independent IT company, with in-depth knowledge of cloud computing, integrations and data infrastructure. The service supplier must perform a neutral role in the maritime setting, and therefore it is not seen as an existing IT supplier. Responsibility is shared regarding data protection and maintenance.

Users
Certificate issuers
The certificate issuers are the most important users of the service, since they are the authorized party for certifications. They are the content creators and privileged user of the system (See Figure 27).

However, within the organization there will be assigned different roles and access privilege in order to maintain a counterpart system aiming to increase security (e.g. admin, editor and just viewer).

Maritime actors

The secondary users of the service are maritime actors (see figure 27) with the approved credentials: Ship, Operator, and Surveyor. By this is meant that in the authentication web portal, these users have access to specific certificates only. In other words, they will be able to view those certificates for which they have the ID tracking number.

This aspect seeks to preserve the confidentiality of the ship's information -a very common practice in today's context.

Choice of platforms

Mobile Smartphone or Tablet for quick QR scanning
A QR is an easy way to link to the certificate and avoiding misspelling the long tracking ID. Users can use any mobile device QR scanner (smartphone or tablet) to link to www.trust.edocs.com/certificateid and view the certificate in question. This way, the dilemma of "original or copy" is removed. Since the service shows the certificate as it was issued including its validity, it is easy to compare with the physical print.

The web authentication service is thought to have a responsive design interface easily adjusting any device's size.

Nowadays, most mobile devices come with a scanner. This is ideal for good user experience since no installation or extra action it is required from the users to authenticate the certificates.

Laptop or Desktop Computer

eDocs Client is tailored for certification companies and internet access is required. With eDocs Cloud, certificates issuer can easily create the electronic certificate and store it in the eDocs Cloud solution. From where privilege users can access cloud files and settings via log in. Since this kind of user activities requires bigger capacity a Laptop or Desktop Computer is the primary choice of platform.

Use of technology

The technology is a backbone to the eDocs service. Throughout the brainstorm session we discussed multiple functionalities that had to be implemented with the suitable technology. We had an idea of what would enable our solution to be executed in the best possible way, but it required many hours of desktop research and a chat with an IT engineer to grasp the technological aspect of the service functionalities.

This was a challenging exercise mostly because the backstage processes are complex and linked to the field of Human Interaction Design. But in order not to end up in what Carroll (2000) calls the dilemma of "technical knowledge lacking technical design" a deeper analysis of the technology available was made.

Carroll (2000) states that ...the current state of technology development makes some solutions impossible and others irresistible: On the one hand, designers cannot use technology that does not yet exist, though their work often drives technology development toward possibilities that are nearly within reach. (Carroll, 2000)

Carroll's statement is a loyal reflection of the journey through technology aimed to understand if eDocs service functionalities where possible to implement.

The following table (Figure 26) aims to explain the Pros and Cons of the chosen technology as an eye-opener for better service possibilities and user experience.

PROS					
Cloud computing	Hybrid cloud	QR--	Digital Sing	Asymmetric Encryption	Cloud key management
• Minimize up-front It infrastructure costs • Applications up and running faster • Mobility, full-time accessibility, manageability and less maintenance • Enables IT teams rapidly adjust resources to meet fluctuating and unpredictable demand	• Organization pays for extra compute resources only when they are needed • Enables data centers to create an in-house IT infrastructure that supports average workload • Privilege users can transparently deploy and scale applications without knowledge of the cloud's hardware diversity	• Scalable • Low cost • Well-known technology • Easy to implement • Quick redirects to desired URL (Lyne, 2009)	• Helps security apply time stamps to documents. These time stamps deliver high-assurance integrity to digital records and can support a wide variety of applications, for instance long-term archives.	• Transparent encryption for files, databases and containers. Adding extra security to the data storage on the cloud. • Key management as a service Privileged user access control. • Visibility of compliance (DGPR)	• Unify and centralize encryption key management. • Maximize security and compliances by storing the key separately from the protected data. • User's full control Since it is the certificates issuers and not the service provider who owns the encryptions and keys
CONS					
• Security threat • -Compliance mandates • - More data to protect	• Security threat • Compliance mandates • More data to protect	• QR Scanner is needed	• Growing number of application and devices using encryption proliferates adding extra complexity, increases cost and raise the risk of hackers.	• Growing number of application and devices using encryption proliferates adding extra complexity, increases cost and raise the risk of hackers.	• Unmanaged keys could lead to unprotected data, which would result in the unplanned downtime of vital services.

Figure 26. Pros and Cons of the technology

Service Infrastructure

The service system map (Figure 27) aims to explain graphically the data and access flow as well as the roles of the existing network of actors. (Patrício et al., 2011)interaction design, and the emerging field of service design. MSD enables integrated development of service offerings at three hierarchical levels: (a

eDocs performs under the premises of data security and trust. Therefore, the core component of the service is Asymmetric encryption and Cloud key management ("(53) Asymmetric encryption - Simply explained - YouTube," n.d.). It is precisely the high level of assurance of this technology that delivers the authentication factor.

The hybrid cloud environment is exposed to anyone who knows the location. The cloud storage encrypted data that can only be decrypted by the party with the right credentials (private key). In an asymmetric environment both the issuer and the viewer have exchanged private keys. The extra security lays on this exchange. This two-level authentication factor makes sure that the data is secured and controlled by the right user.

When the certificate is stored on the cloud and pulled from the cloud via the http an asymmetric encryption protocol is being performed. If the party does not have the right key, might access the website but not the data from the cloud. Because the data storage in the cloud it is also encrypted if the hybrid cloud is hacked the data is illegible and purposeless.

SERVICE INFRASTRUCTURE MAP

Certificate Issuer
PRIVILEGED USER

Encrypted & Control

eDocs Client

Allow/Block Encrypt / Decrypt

Suveyor

Clear Text

eDocs Authentication Portal

Allow/Decrypt according to key

Seafarer

APPROVED USERS

Clear Text

eDocs Cloud Server

APPLICATION

USER

DATABASE

STORAGE

FILE SYSTEMS

SERVER

Encrypted
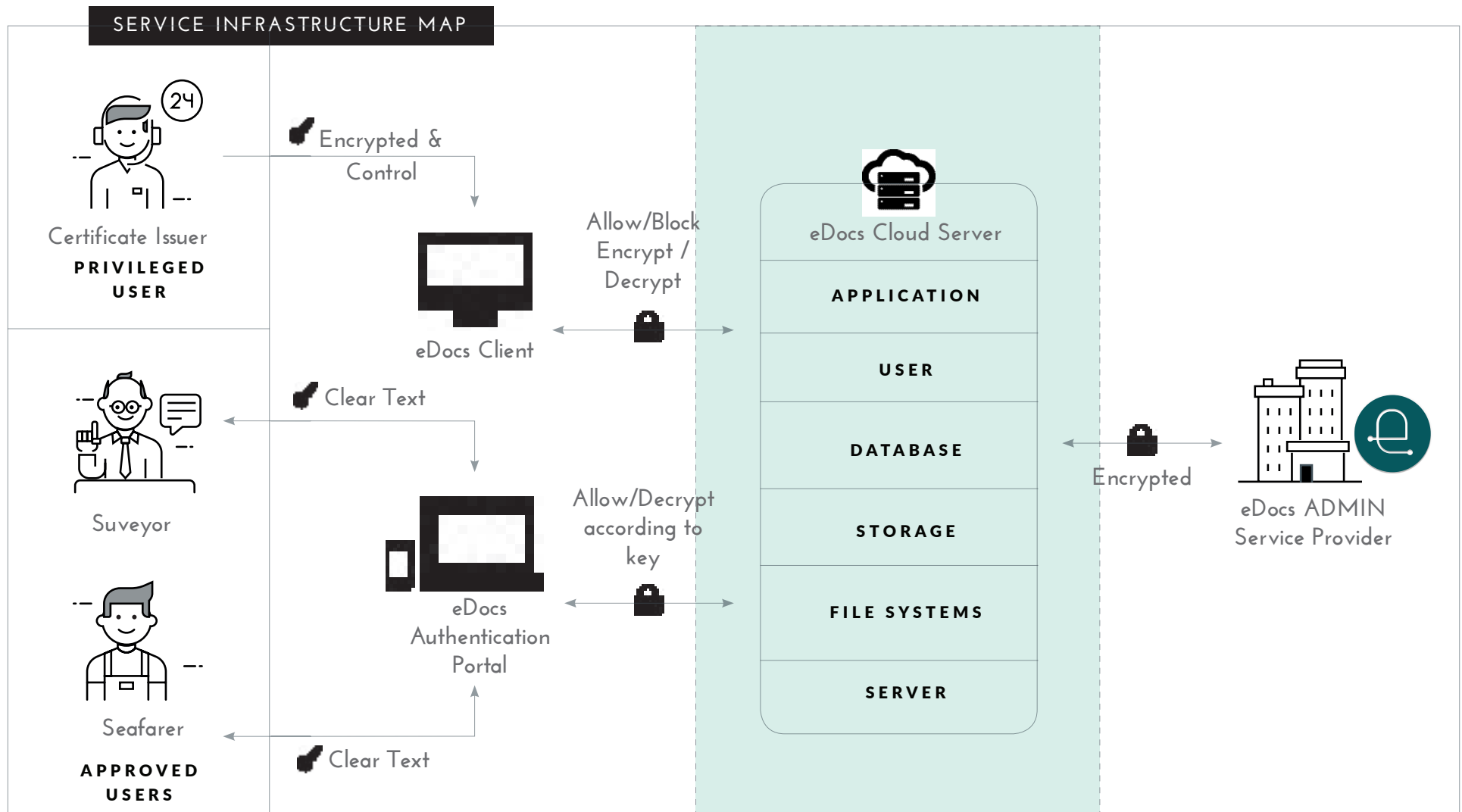
eDocs ADMIN Service Provider

Figure 27. eDocs service infrastructure map

DATA AND ACCESS FLOW

Acymetric encription

Interface mockups
The low-fidelity mockups presented in figure 28, describe the service interface and the different step that the users should take throughout the service experience. To aid the reader through graphical narrative numbers and descriptions are added.
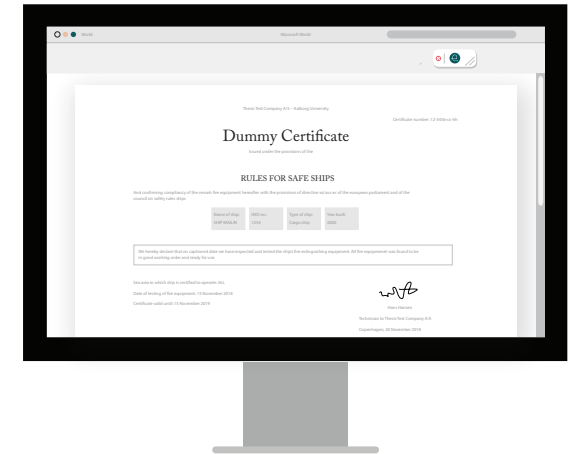
Mockup 1. eDocs Client installation window

Mockup 2. Three steps installation. Users credential and certificates standard details are set up here.

Mockup 3. eDocs Clients integration with Microsoft Word.
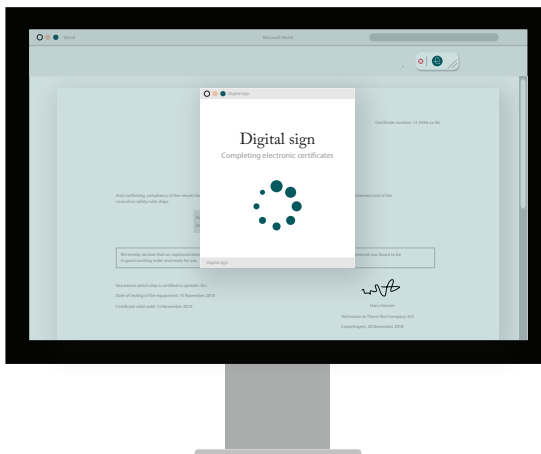
Mockup 4. Creation of the electronic certificate. Digital signature and ID nr are added and the content gets encrypted.
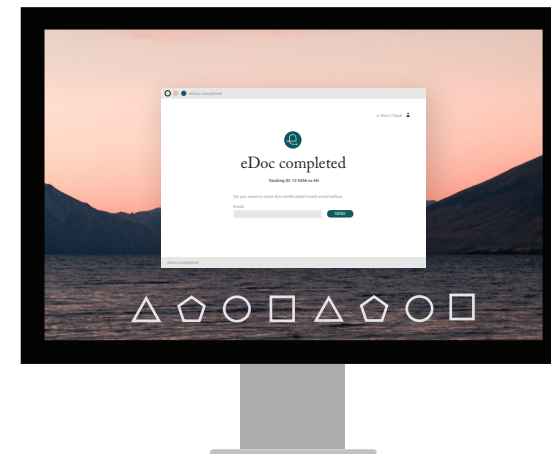
Mockup 5. Completion message. "Send it to a friend" function display. Cloud login is also an option from this window.

Figure 28. Mockups of eDocs interface

Mockup 1. Admin access login to eDocs Cloud

Mockup 2. eDocs Cloud menu service

Mock up 3. eDocs Cloud search function
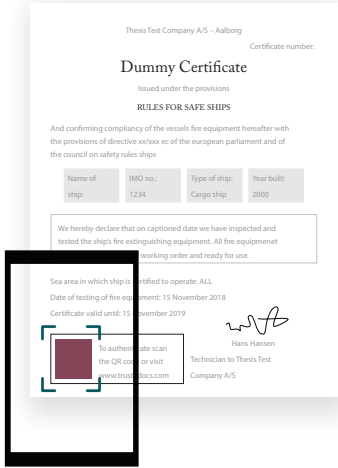
Mockup 1. QR Scan function in used
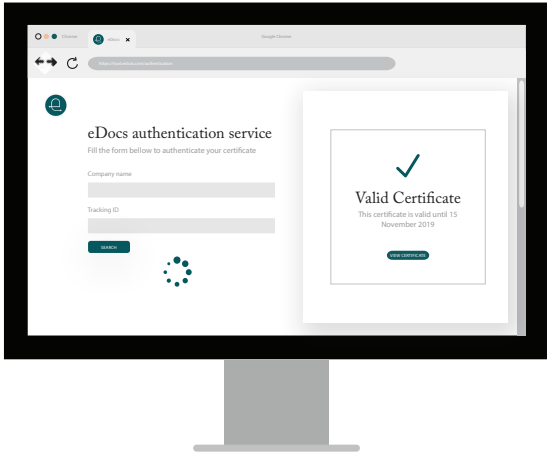
Mockup 2. Authentication function in used
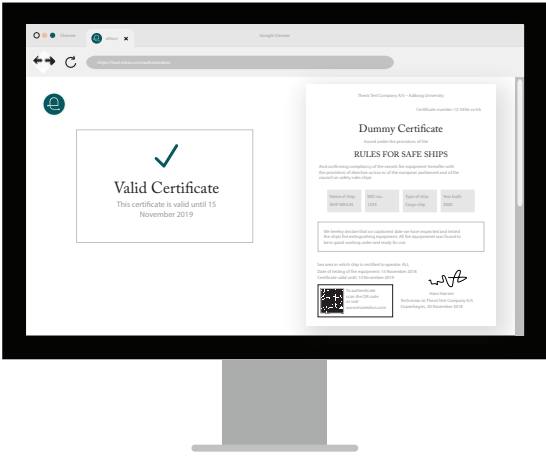
Mockup 3. Certificate display

Figure 28. Mockups of eDocs interface

S U B C O N C L U S I O N

Chapter 4 | `PHASE 3 /4`

The Develop phase proved to be a useful co-creation experience. The brainstorm and the prototyping session aided concretizing the core component of the service solution. Working collaborative with an industry expert and future user of the service helped to keep the focus on the user's perspective.

Moreover, since the service solution was very "IT-oriented" the research on technical infrastructure was essential for the development of the service infrastructure. The Prove of concept exercise highlighted associations in the service's narrative that needed to be improved and financial aspects that so far were not really considered in concrete.

DELIVERY

Chapter 5 | PHASE 4 /4

Photo 17. Delivery phase

IMPLEMENTATION

Chapter 5 | **PHASE 4 /4**

The Delivery phase considers the business and technical aspects of eDocs, as well as stakeholders' involvement and their motivations. Moreover, examples of service applications and functionalities will be represented in the users scenarios and the service blueprint. This phase concludes taking an overall look of the business, internal operational and financial elements in the Business model canvas.

The tools, used during this phase, aim to enhance implementation aspects so that eDocs can be materialized into a real functioning service.

Stakeholders Map

The stakeholders involved in the service and their associations are illustrated in the Figure 29 (Stickdorn & Schneider, 2015). eDocs is found in the center of the graphic for it is the service provider. The certification company controls overall activities related to the issuing of electronic certificates. They hold a strong bond and a business relationship to eDocs.

Middle-sized and big certification companies can enjoy full benefit for yearly membership of DKK 15000. An appealing strategy to for small-sized certification
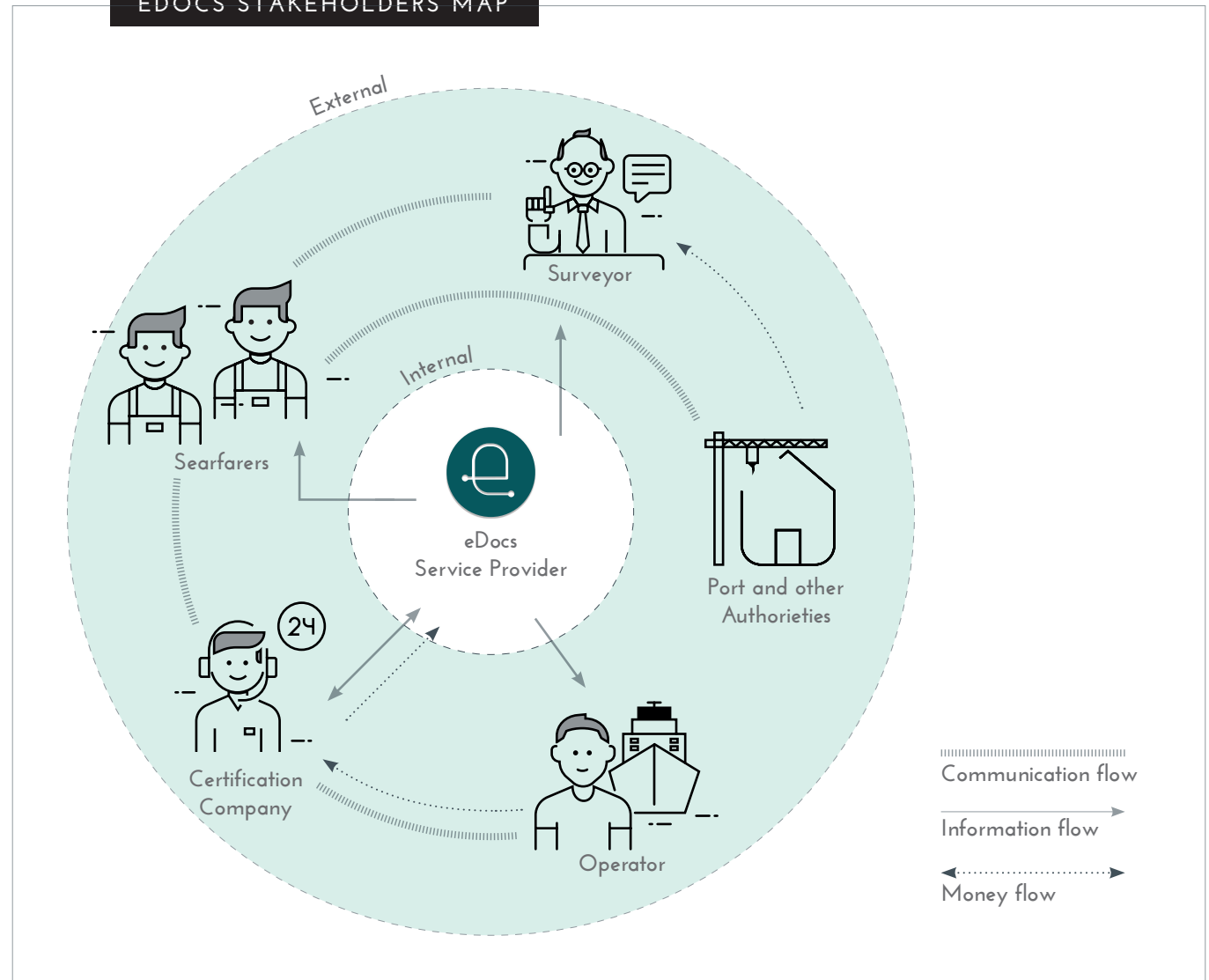
External

Internal

Surveyor

Searfarers

eDocs
Service Provider

Port and other
Authorieties

Certification
Company

Operator

Communication flow

Information flow

Money flow

Figure 29. eDocs stakeholders map

companies can be to offer them a special deal where they only pay when they use the service (DKK 2 per electronic certificate). Theses figures were discussed and analyzed with the head of certifications of FORCE when doing The Prove of concept.

The ship crew, the surveyors and other authorities enjoy the benefit of electronic certificates and authentication service that certificate issuer supply through eDocs free of charge.

eDocs smooth the communication and solidify the relationship between the certification company and the maritime stakeholders. All the necessary certification for the course of the maritime operations can be found in eDocs authentication portal. The data flow displays the different access roles. While the certificate issuer can input and output from eDocs platform the rest of the stakeholder are limited to input the ID tracking number and output the corresponding certificate.

Motivation Matrix

An analysis of the different interest that move stakeholders around the service is framed in the Motivation Matrix (Morelli & Tollestrup, 2009). Special consideration was put in this matrix since the alignment of expectations is essential for the accomplishment of the service (Figure 30).

The matrix shows the different value that the different actors bring to each other and the service. This is an effective way to look at the overall benefits of the service and a point of reference to have in mind when talking to potential stakeholders (Andy Polaine, Lovlie, & Reason, 2013)
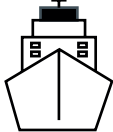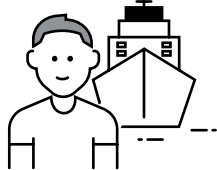
	Service provider	Certification company	The ship	Surveyor	Operator
Service provider		Electronic certificates creation. Authentication Security & fraud avoidance. Secure cloud service	An alternative to paper-based certificates. A service that facilitates smart certification & easy authentication. Inprove operations	Remove the risk of fraud in the documentation. Remote certificate check	Remove the hassle around original. Smooth transition to digital. Authentication service.
Certification company	Data input Profit Main interaction		Electronic certificates Automated after service Faster delivery Better customer support	Automated service Trustworthy certificates	Faster certification delivery. Tranparency on the process
The ship	Increases Awareness on eDocs services	Decrease the need of after service support		Fast facilitation and inprove presentation of the certificates	Easier communication Better relationship Effective operation More profit
Surveyor	Behavioral data Loyalty to the eDocs service	Decrease the need of after service support	Improved service performance Optimized time of inspection Accurate results		Loer Cost Effective operation
Operator	Increases Awareness on eDocs Behavioral data	Decrease the need of after service support	Better support Faster delivery of certificates	Fast facilitation of the certificates Better control over the fleet	

Figure 30. eDocs Motivation matrix

User Scenarios

"...low-fidelity sketches accompanied by the narrative of the
key path scenario, you can richly portray how a proposed
design solution helps personas accomplish their goals."
(Cooper, Reimann, & Cronin, 2007)

A visual representation of the service experience can be
found in the user scenarios (Figure 31 & 32). Here the
narrative focuses on the user's tasks and the system's
performance.

Following up on the feedback received in the proof of
concept (Define phase). This representation method was
used to bring an easier understanding of eDocs solution to
the reader. If having used this tool before it would have
helped the expert to quickly grasp the practical applications
of the service in the life of the people affected by it.
Unfortunately, the visualized scenarios were created after
the proof of concept, making it a learning experience in the
design process.
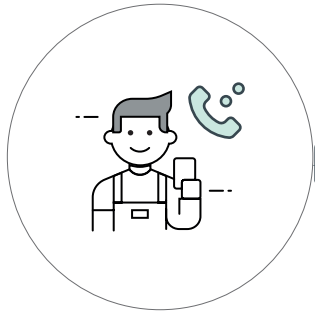
REQUEST CERTIFICATION

Jensper noticed that the ship is soon in need of a new fire equipment certificate. He calls the certification company and request the service.
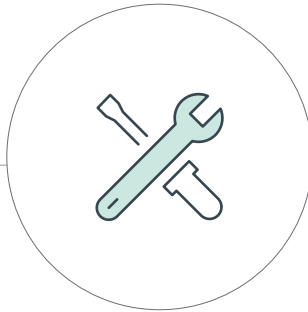
TESTING PROGRAM TAKES PLACE

The certification company proceeds with the equipment check and case report.

JESPER RECEIVES THE EDOCS

After a few day Jesper receive the eDoc via email
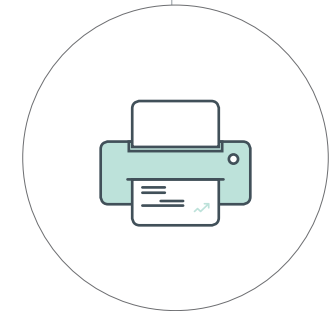
JESPER PRINTS & ARCHIVES

He attaches the new certificate to the ship's file

THE SHIP IS IN COMPLIANCE

After matching both certificates the inspection is completed and the ship is ready to continue to it's destination

EDOCS AUTHENTICATION PORTAL

He notices is a copy so he uses the ID nr to search for the original at eDocs authentication portal.
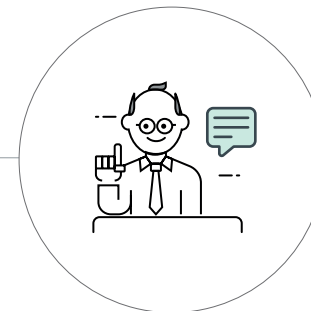
UNANNOUNCED INSPECTION

A few days later a surveyor comes onboard to check the fire equipment and asks for the corresponding certification.

Figure 31. Seafarers new user scenario

RECEIVES SERVICE REQUEST

Jens receives a new petition for fire equipment inspection. He schedules the test and informs the ship.

CREATES THE EDOCS

Once the test report is completed he uses Microsoft Word to create the certificate and eDocs to sing and encrypt the content.

ISSUES THE EDOCS

In just a few seconds the electronic certificate is ready.

SENDS IT TO THE SHIP

Jens sends the eDoc via the sharing function

A VIEW OF PREVIEWS CERTIFICATES

eDocs displays previews certificates

CLOUD SEARCH

Jend accesses eDocs cloud search function and find the ship folder.

VIEWS HISTORY OF THE SHIP

Jens would like to see previews certificates. He logs in to eDocs Cloud to find the ships folder.

Figure 31. Certificate issuer new user scenario

Blueprint

To offer an overview of the different phases, touchpoints, and interactions of each actor as well as the information flow during the service, the service blueprint was developed (Stickdorn & Schneider, 2015). Figure 33 shows the final version of the eDocs service solution.

The pre-service part takes us through eDocs Client one-time installation steps and shows the needs of the seafarer to make initial contact. The current service phase starts when the certificate issuer organizes the test and later on creates, signs and encrypts the certificate with eDocs facilities. Finally, the after service comprehends, the authentication experience via eDocs authentication portal.

The service blueprint is a remarkable tool to visualize the service idea. In the last encounter (prior thesis delivery) with the industry expert, the tool was used (among others) as a reference point and summary of our collaboration. A few remarks were made mostly related to eDocs Cloud but the general feedback was very satisfying.

BLUEPRINT GUIDE

◉ Beginning of process

▢ Action   ◇ User decision

△ Waiting point   ◉ End of process

SERVICE BLUEPRINT

	BEFORE	DURING THE SERVICES

Users Actions

JOURNEY

SEAFARER
- Needs new certification
- Requests service
- Testing program

CERT. ISSUER
- eDocs Client 1 time install
- Receives & process request
- Organises test program
- Receives test report
- M. Word to create the new certificate

SUVEYOR

Service

SAAS INTERFACE
- Display window installer
- 3 steps Installation
- eDocs is ready to go

Backstage support

PAAS / DATABASE
- Allows access
- Register user
- Setting up electronic signature
- Defining eDocs compatibility with other programs
- Register actions
- Sends notification

ENCRIPTION & KEY MANAGEMENT
- New key is created
- Data is encrypted and saved
- New block is created
- Software and credentials match
- Initializing eDocs

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Figure 32. service blueprint

Receives new certificate

Prints & archives

Receives inspection

Shows printed certificate

Receives report of compliance

Issues new certificate

Sends it via eDocs

eDocs Cloud log in is an option

Requests certifications

Receives printed certificate

Access eDocs portal for authentication

compliance consent

eDocs addon for signing & encrypting

Display Send option

Completion window

Display search function

Display certificate

Allows access

Register action

Setting up electronic signature

New eDoc is saved in the cloud server

Initializing eDocs

Process Input

Output Data

Match credentials

Add digital signature

New key is created

Content is encrypted

Allow Decryption according to key

Figure 32. service blueprint

EDOCS BUSINESS MODEL CANVAS

KEY PARTNERS

- Certification companies

- Outsourced services

- Suppliers

KEY ACTIVITIES

- SaaS/PaaS

- Customer service

- Server's maintainace and optimition

KEY RESOURCES

- eDocs platform

- Cloud Computing expertice

- Server capacity

VALUE PREPOSITION

- Remove the hassle around original.

- Smooth transition to digital.

- Authentication service.

CUSTOMER RELATION

Impersonal, subscription based

CHANNELS

- eDocs Client

- eDocs Cloud

- eDocs Authentication portal

CUTOMER SEGMENT

Testing and inspection companies acting as suppliers of the ship owner.

COST STRUCTURE

Knowledgeable staff, marketing, IT infrastructure

REVENUE STREAMS

SaaS/PaaS solution offered as:
Flat rate (DKK 15000 year subscription)
Pay when used subscription (DKK 2 per issued certificate.

Figure 33. eDocs busines model canvas

Business Model Canvas
To complete this phase the Business Model Canvas delivers additional considerations for implementation. By decomposing the service concept into business processes the model explores the value proposition, supported by a number of parameters and characteristics (like customer relations, pricing model, sourcing strategic partnership and applied distribution channels) (Osterwalder & Pigneur, 2010). Some of these parameters had already been discussed throughout the service design process, such as channels and key activities but, through this tool, they are analyzed with a business perspective.

Nielsen and Lund (2014) outline, "A business model is a sustainable way of doing business", and sustainable in their case is a propensity to survive and thus also the ability to stay competitive (C. Nielsen & Lund, 2014).

In the model, the market potential of eDocs is enhanced in the value proposition. As the research shows there is a big need for a solution that eliminates the hassle of carrying original paper-based in the maritime. Another positive attribute is the modularity (Kamauff, 2011) of the solution, once in function eDocs could be easily adapted to other industries facing the paper-based issues.

eDocs provider will incur in initial expenses related to the cost structure of the business. However, once there is a good foundation (in a time frame of 2 years approximately) the eDocs solution should become a sustainable model. Though, at first, the priority should be in market penetration; the more companies involved the better business prospect and consequently better service for maritime.

In addition to a robust IT infrastructure, marketing efforts are essential for eDocs profitability. Selling eDocs solution to the certification companies will imply creating awareness of the value that eDocs adds to their workflow and the impact that this will have on their customers.

Price differentiation could be part of the strategy. It is essential for the business that companies prioritize the benefits over the cost. Specially small-sized companies would be more likely to by eDocs solution if this does not represent a budget constrain.

Furthermore we considered a great future potential for growth laying on the collection of the certificates data. With time this solution could offer a larger range of services to the maritime.

CASE CONCLUSION

To conclude the case, a summary of the design process will be discussed.

Through a transparent research process, it was confirmed the need for digitalization and automation of the paperwork process in the maritime industry. The analysis of the actors' value constellation experience uncovered the actors' pain (experience factors that required improvement) linked to the handling of original paper-based certificates, which are:

1. Co-dependence to original paper-based certificates (Seafarer's value constellation)
2. Manual certification check can't be hundred percent accurate (Surveyor's value constellation)
3. Authentication of certificates is personalized and time-consuming (Certificate issuer's value constellation)

These experience factors were represented in the context of the ship's value network, to identify existing service offerings (that could potentially solve the issues of the industry) or gaps for new service opportunities. This analysis concluded that although there were companies offering an alternative to the paper-based they did not fulfill the entire need of the industry. Which drew the design process toward a solution targeting a cohesive source of authentication.

When designing the service system at first, the aim was to eliminate paper-based but from empathizing with the actors it was understood that the co-dependence to paper-based had it roots on:

1. The industry requirement (the law)
2. Need to probe compliance in case of inspection
3. Quick access to the certification

Therefore when brainstorming on the potential solution it was decided to embrace the paper format by focusing on the authenticity fact. Meaning that if the element of fraud was removed from the issue, carrying the paper-based certificate would be a secondary issue.

When designing the service encounter the aim was to stay true the actor's need. Although the target was the maritime actors the process showed that it was essential to involve the issuer of the certificate first as the play a key role in the new solution and represented the authorized source of the issue.

The posed research question of this thesis was: "How can the practice of service design contribute to the improvement of operational performance in the Danish maritime industry?"

This section will discuss this question in relation to the development of the case and the experience gain through it.

Patricio's Multilevel Service Design methodology proof to be an effective lens from which to look at operations. In this thesis's case, the systemic approach and the decomposition of the different paperwork operations allowed the exploration of potential factors of change.

Operational management and a systemic approach to services can be seen as two sides of the same coin. While managing operations focus on the "what", the systemic approach assists on the "how". Through this thesis, it was acknowledged that the definition of each level/component

enable designers to understand and empathized with people, and process, and thus, create more cohesive solutions that increase efficiency and enhances user experience (Patrício et al., 2011).

The explorative research emphasized in understanding and did not aim to be representative (David & Sutton, 2011). Working with none representative sample of the industry was risky since it might appear as not getting enough data to create a cohesive design.

However, the strong collaboration with the marine surveyor (who became the main point of contact in the industry) added great value when defining which companies, departments, professions etc. would be most suitable for the research. The result was meeting four very capable and cooperative insiders of the industry; amongst them a director of (perhaps) the biggest certification company in Denmark

and a surveyor who is expert in both issuing- and control of certificates. This empowered the research on the gathering of qualitative insights rather than quantitative insights (Bjørner, 2015).

The general emphatic approach embedded in the collaboration with the industry actors was essential to break through the barriers of a conservative field, marked by officialdom and procedure (Leonard, 2011).

The co-design activities, on the other hand, organically shifted the design process from a user-as-a-subject perspective to a participatory arena where it was possible to design with the user rather than for the user (Sanders & Stappers, 2008). This made positive contributions to the exploratory research and put the design focus on the actor's need.

Having explained the different approaches and methods contributing to the development of this thesis case. It can be concluded that the Service Design practices can be a great way to add a new vision to the operation performance in the maritime through:

1.   A systemic decomposition of the operation
2.   Quality focus in a explorative research
3.   Emphatic approach to the design process

Moreover, this project can be understood as an attempt to bring a service design perspective to an engineering field where very often functionality oversees experience.

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Expert Interview - surveyor
Name: Søren
Company: Marine
Title: Owner of inspection and consulting company

Interview 1 | CHAPTER 6

Date: August to December 2018
General information
Søren is an independent consultant with more that 20 year of experience in the industry. Educated as a Naval Architect and a post grade and practical experience as Master Marine Søren is able to understand the industry from multiple perspectives: engineer, regulation, economic, environment, crew and cargo. Søren has being important source for the development of this research.

Goal of the Interview
The aim is to understand Søren's role and work challenges. Furthermore, to understand the industry's settings from the arena of surveyor.

Role
Søren work as independent consultant and among the services he offers, his provides is inspection or audit performance. Occasionally, he acts representing the insurance companies or he is working on behalf the Operator. Either way his main role is to ensure compliance and check that the vessels have the proper documentation. He also assists with damages control and engineering calculations if needed.

The procedure and challenges
Søren has an inspection checklist prior visit and once he is on board he must follow the check procedure, which involves the practical inspection and the documentation check. Søren faces multiple challenges when handling the documentation since part of the documentation is on physical form and part is digital. He must check the certificates are up-to-date, the content meets the requirements and that they are original (the stamp and the signatures must be clear) but often he is presented only a scanned copy.

Søren still gets goosebumps when he has to check an unknown scanned copy because he has no possibility to check the authentication of the certificate and he simply has to trust the content of what he is presented.

Sometime on rare occasions he faces a situation of having to insist on having a certain (-copy of) a certificate authenticated. This is time consuming and may result in retaining the ship until the authentication has been completed.

He would like to avoid this situation for the benefits of all parties involved but the lack of predictability and IT infrastructure is a real showstopper.

However, a certificate issued by DNV GL or Danish Flag State is easier because they have facilitated what they call "Electronically Issued Certificates" where it is possible to check the content of a certificate presented on board against the original content when it was issued (via an online authentication facility).

Expert Interview
Name: Niels
Title: Managing Director
Company: FORCE Certification
Date: 10 to 15 October 2018

Goal: Understand the service value constellation and identify touchpoints. Get a feeling of how is the relationship with Maritime and the after services if any. Secure a contact for a second round of question.

Q: Could you take me through your service journey? (Ex. 1st contact until the certificate is issued)?

A: The journey varies according to the test and the industry but if I have to talk in general terms I would say that we start with a Test Program that is sort of a checklist procedure of what we want to test. Then we perform the test and all the info is recorded in a Test Report (this can take some time) Once the test report is revised and accepted by the expert according to the standards we

issue a certificate. (Module B Certificate) meaning that the product fulfills the requirement.

Now let's take the example of a life raft we could have performed a Module B check and issue a certificate for this particular artifact but we must make sure that the artifact is produced according to the standard of the first test. Therefore, we follow a second check (Module E, F and G) that takes place at the manufacture and it can take weeks of observation and laboratory test. Depending of the result we issue another certificate confirming the production meets the standard requirements.

In the case of marine equipment (MarED directive) as we send electronic certificate to our customer we must also upload the certificate in a Pdf format to MarED website were 3rd parties can find then if needed.

We perform test all year around, as new product and part are constantly produced. We have a very steady flow of returning customers since our tests are standard required on yearly basis.

Q   Client Contact and after Services?

A: Our company is listed by DANAK as one of the certified companies to perform material/ production and equipment test so for many of our clients DANAK is the reference point.

Then we have our own website that elaborate on our services and contact information and in case is needed personal contact we have our secretary that can redirect our clients to the right department.

Q: 2nd Parties Contact
How often do you receive independent call from 2nd parties interested on validating your services?

A: Yes, occasionally we receive parties interested in validating specific reports or laboratory result. They are usually from Easter Europe, Middle East and Asia. China for example, prefers as much signatures and stamps as possible not because they don't understand the concept of digital signature but because it is perhaps a cultural thing.

Q: Do you see a need for stronger security with digital certificates? How do you handle them?

A: Well our archives are indexed and secured properly and our digital signature system is secure. So the risk of malware propagation is low.

Besides, a copy of our Marine Equipment Certificates can be found at Mared.org the EU Commission Database.

Q: Do you have electronic signature or manual signature?

A: Yes, we have a program that assist us generating digital signature for every PDF issued by us (TOKEN/SYMANTEC)

Q: IT and systems: What kinds of software do you for the confection of the certificate?

A: We use Microsoft word for filling the form and once is ready we export it as a PDF format.

Q: What are your daily pains? Do you see any weak links in the process?

A: The concept of digital signature is a safe way to validate a document and if it would become a global phenomena it would make things easier. Inspectors or

interested parties from all over the world should be ably to verify certification.

I believe, the more digitalized a certificate is the less risk of being fake. What we see often is paper format circulating in different offices this is where the weak link is.

Q: Touchpoints: Your client's journey. How is the contact initiated?

A: 1. Online DANAK website
2. FORCE website
3. In person at the workshop for testing
4. Post / Email for certificate and test results.

Company: DANCERT
Name: Jørgen
Title: CEO, Dancert Certification
Date: 10/10/18

Q: Services: Could you take me through your service journey? (Ex. 1st contact until the certificate is issued)

A: We mostly do product testing for building, factory production control but yes we have a small service line for the shipping industry. We accredited by DANAK. Dancert A/S offers various types of certifications. These can be divided broadly into Product Certification and System Certification. Product certification can be with or without product CE marking. System Certification is about management systems and production control systems (FPC). Combinations are possible for certain certificates.

For a production site:
production control system > audit plan> production done> send to the laboratory accoding to the standards the hold production is done on site >yes /NOt and action plan > audit report, standard who is participated conclusion maintain the certificate>

Q: Client Contact and after Services:
A: Email, Post, Calls

Q: Second Parties Contact: How often do you receive independent call from 2nd parties interested on validating your services?

A: Yes, sometimes we receive calls from clients interested in know about specific test. However we show the certified companies, products and persons on our website together with the certificates since our certificates are digitally sign

and restricted against editing it is a very easy to validate our services.

Q: Do you see a need for stronger security with digital certificates that can help you to minimize counterfeiting and ensure compliance?

A: Not really. In our certificates we specify that the PDF document is only valid if digitally signed by Dancert A/S and they are secure. However, we can't control what people do with a print version of the document but since it is accessible on our site I think is easy to compare print copies. We could benefit from a smarter way to avoid copies, but it is not a priority for us since we can always offer personal contact in case of suspicion.

Q: Touchpoints. Client's journey: How is the contact initiated?

A: We are in the list of accredited companies at DANAK's website and since we are a daughter company of The Danish technological Institute we receive a lot of traffic from them.

The fist contact is by email or phone and then once all is

prepare we proceed to do the testing at our workshop and laboratory.

Once the result is ready we call the clients and send an email with the certificate.

Q: Do you have electronic signature or manual signature?

A: Yes, my signature is found in all the certificates. I also have a code for my digital signature.

Q: IT and systems. Do you have a system configured specifically for internal operations? Specify name and function.

A: We use Microsoft Word for creating the certificates and Adobe Pro DC to restrict editing and digitally sign the certificate. Our website collects all the certification by each company, person and product - anyone is able to download it.

Q: From scale of 1-10 how much manual work is involved in the service you provide?

A: For lager companies 1-10 test an report can take

about 2 weeks and there is of course manual work involved. Issuing the certificate is partly manual and partly automated and it is quickly done what takes time is the actual testing an reporting.

Q: What are your daily pains? Do you see any weak links in the process?

A: Well it is challenging when new type of certificates are required because perhaps new expertise is needed and it is resource and time consuming. But I would not call it a pain it is more like a new process for us.

I think the electronic certificates are quite effective, the week link can be on the printed version because we cannot ensure authenticity of a hardcopy.

We know that doubtful cases are related to paper-based, therefore the more digitalization the better. However, we still issue originals because our customers insist on having them.

Q: How do you see the future of your services in the market? If you could improve the service how would you do it?

A: I think there will always be a need for certification. However, certifiers in this business are of course looking for new ways of gain market share. Improving security and transparency on the procedures maybe a way to get more customers. I would be skeptic about digitalization as the only way because our processes are quite complex.

Expert interview - Seafarer

Company: Tanker Ship Owner
Name: Jesper
Title: Chief Engineer
Date: 10 & 18 October 2018

General Info
Jesper is Chef Engineer on tankers with several years of experience. He works two months at sea two months off duty.

Goal of the interview
The aim is to know his role, procedures and challenges and the impact of hard copies on the performance of his operations as key member of the ship's crew.

Background
Jesper's workplace is the engine room his is dealing with lubricants, fuel and taking care of engine performance

among other tasks. There are a lot of procedures involving his operations. For example for the engine to work the oil had to be at a certain temperature therefore there is a machine which main function is to heat the oil. Lubricants improve the life cycle of the machineries and increase performance.

The engine practical tasks are recorded on a Planned Maintenance System (PMS) where Jesper has an overview of tasks related to engine maintenance and performance. The PMS also collects a digital copy of engine certificates and an overview of expiry dates.

The original paper-based certificates most also be within his reach. In case of post delays he must get a PDF copy forehand in order to show prove of compliance in case of inspections.
"What matters to me is to have a tangible proof of compliance to show to the surveyor, I would rather have a copy than having nothing to show."

Challenges and Pains
Lubricants for example, must comply with precise industry standards and a respective certificate must back it up. Without the proper documentation the vessel is in principle not allowed to sail.

The case of the lubricant documentation is a real challenge for Jesper that have to wait for the original copy to arrive. This brings lots of extra hassle to monitor and follow-up on the delivery of originals.

Moreover, he explains that he has to be very pendent to the expiry date of his certifications. For instance, in one occasion he was denied boarding because his Medical Certificate was expired. This incident increased transportation costs and delay on the cargo delivery since the operator had to find a temporary replacement.

Output

• Engine Certificates are normally handled in original paper versions.
• Interim period from a required test or control is performed and paper certificate is issued until it is received on board is covered by an advance e-mail with a scanned pdf-copy of the certificate.
• This procedure is neither time or cost efficient.
• Failure to comply with certificates requirement may result in the retention of the ship in port.

APPENDIX 5

Interview 5 | CHAPTER 6

Company: OSM Crew Management, Norway
Name: Tue
Title: CEO
Date: June 2018

Q: What does the future seafarer's employment relationship look like? (eg ship employee freelancer, permanent employee of a shipping company or other)
A: Get employees and other workers on flexible contracts.

Q: Do you, as a Ship Recruitement company, need a single combined system where you can easily validate and ensure compliance of employees and crew with the requirements of the ship and government?
A: Yes

Q: Do you see a need for each seafarer to have their own app access, where they can collect an overview of certificates and documents, sailing time, etc. and where they can document qualifications, experiences and courses?
A: Yes

Q: Is a system for adding / registering certificates and documents by: 1 the individual seafarers 2 third party as an automated service required?
A: Yes

Q: Is a system that is configured specifically for your business needs needed?
A: Yes

Q: Do you offer courses where it may be necessary to issue a secure digital certificate?
A: Do you register paper certificates (for the crew) that have been previously issued in your system?
A: Yes

Q: Should registration of crew certificates be manual or automated?
A: Automated

Q: Do you need a system where a Port State Controls, Port Authority or Auditor can check and approve crew certificates in advance / from land, thereby reducing the latency? Both digital and paper certificates that are registered?
A: Yes

Q: Do you want a platform where freelancer profiles and new employees can easily be added / removed to your company's C-Log profile upon contracting / termination?
A: Yes

Q: Should the master have the right to validate and manage the system from the ship? (eg make crew list for port, add / dismiss crew, see validation, correct information) Or should this be reserved for management?
A: The master must have rights to the system.'

Q: Do you want a closed system that can be integrated with existing internal systems via API access, where data is stored on: Internally on its own cloud or remotely on third party cloud solution?
A: Preferably on our own cloud.

Q: Do you see a need for stronger security with digital crew certificates that can help you to minimize counterfeiting and ensure compliance?
A: Yes

General comment from Tue:
There is no need for yet another supplier of crew / staff IT systems, as there are already many on the market. On the other hand, there is a need for an application that can complement the existing systems to validate the certificates.

APPENDIX 6

Company: Ship owner
Name: Karsten
Title: CEO
Date: 20 September2018

General Info
Karsten has a fleet of two ships. The ships are fit for different types of cargoes and mostly transporting within Scandinavian destinations. Karsten manages the onshore operations. He takes care of cargo- and crew management, maintenance, supply of stores & provision required for each vessel incl. management of all the documentation.

Goal of the interview
To understand his work process, how he handles the certificates and suggestions for improvement.

Work Process
He has files for each ship containing official documentation

– each ship has about 25 pcs to 30pcs of official certificates. Besides the tangible folder, he has a digital folder where he also keeps certificates digitally and he also end up printing for better overview. His PMS system helps him keep track of expiration dates. He argues that he often receive scanned copies of an original via e-mail because of post delay.

Challenges and Pains
1) The lack of an operational infrastructure for ship reporting in Europe creates friction in the ship-port relationship increasing the burden for the ship that must provide reiterative information.

Every port has its own requirement for handling Ship report, which is done by the ship before arriving to the harbor. Ship Report usually holds information about the ship, the crew and the cargo.

"It is usually the same information just asked in different ways"

2) The biggest issue for him is the authentication of the paper-based-copies of certificates. Because of the post delay inconveniences he is force to use scanned PDFs until the original arrives. Since these certificates do not comply with the industry requirements it is always a concern for him to show prove of the situation to the surveyor.

Q: Could you describe a potential scenario for improvement?

A: Perhaps it could be an authentication system to validate paper-based copies. It would be nice if it could be accessible from central log in instead of having multiple systems and websites.

He referred to DNV GL for inspiration concerning authentication services. On his opinion DNV GL and the Danish Flag State have come with genius system for checking the authentication of the certificates. Furthermore, because sometimes he is requested to forward sensitive documentation he also wished some sort of facility that allows granting temporary access to interested parties.

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POLAND

Certificate No: 01 / S / 2018

BV SZC0/TBA/20151119123252
BV SZC0/TBA/20151119121128
UM 06 / U / SZC / 14

Certificate of inspection

Ship's name   „ ALBA ROUSING "   *data* **2018-01-05**

Place of service: **Szczecin**

We hereby certify that equipment specified below has been inspected and recharged.

1.	*Fire protection system Clean Agent type / Novec* 140 kg. */ Engine room /*	
2.	*Dry powder fire extinguisher / 6 kg ABC /*	20 pcs
3.	*Dry powder fire extinguisher / 2 kg ABC /*	1 pc
4.	*CO₂ fire extinguisher / 2 kg B /*	5 pcs
5.	*Air breathing apparatus / 1800 ltr. /*	2 pcs
6.	*Spare air cylinders /6 l. 300 bar /*	4 pcs
7.	*Escape air breathing apparatus / type 15 MIN/*	1 pc
8.	*Portable foam set (foam applicator, 2 x 20l Sthamex 3% F-15)*	1 pc
9.	*Medical oxygen cylinders*	9 pcs

Date of recharging are indicated on the frame of every cylinder.

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APPENDIX 8

Certificate | CHAPTER 6

Cert no.	Company:	Address:
1	Cralog	Odense
2	Rostock Port Health Authority	Rostock, germany
3	Hydor	Oslo, Norway
4	Lagaay International	Rotterdam
5	RNX Poland	Poland
6	Styrelsen for Patientsikkerhed	DK
7	Strahlmann Service	Poland
8	Ulykkesforsikringsforbundet	DK
9	"laboratory"	Germany
10	Viking	DK
11	Viking	DK
12	Weilbach	Copenhagen
13	Zarek	Poland

All these certificates must be renewed every year

For many of the services the service supplier must be approved by "the ship's class".
Here is taken from the DNVGL database of approved companies regarding fire, radio & life boats.

Fire equipment:

Dk-Brandteknik V/Henrik G Mortensen	Denmark	Hvidovre
Autronica Fire and Security A/S	Denmark	Hvidovre
Survitec Safety Solutions Poland Sp. Zoo	Denmark	Esbjerg
Lotek A/S	Denmark	Sønderborg
Danfoss Semco A/S	Denmark	Odense C
Viking Life-Saving Equipment A/S	Denmark	Esbjerg V
Skandinavisk Brandteknik A/S	Denmark	Odense S
Semco Maritime A/S	Denmark	Esbjerg

Radio:

Furuno Danmark A/S	Denmark	Hvidovre
Scanel International A/S	Denmark	Frederikshavn
Navteam A/S	Denmark	Svendborg
Lindpro A/S	Denmark	Esbjerg
Telenautic	Denmark	Fredericia
ISBAK MARINESERVICE ApS	Denmark	Hedehusene
Hans Buch A/S	Denmark	Albertslund
Polaris Electronics A/S	Denmark	Aalborg Sø
Polaris Electronics A/S	Denmark	Aalborg Sø

Life boats etc.:

CRALOG A/S	Denmark	Frederikshavn
Hytek A/S	Denmark	Sindal

"Blessed are the weak: for they shall be conforted"
Mattew 5:3

T H A N K S

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