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Design thinking methods in early phase of ship concept development

Thesis submitted in partial fulfillment of the requirements
for the degree of Master of Science in Technology

Espoo 24.6.2019
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Abstract of master's thesis

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Abstract

The widely used for ship concept design is the traditional ship spiral. The spiral model has not changed or developed since it was introduced back in 1959. This causes problems in the modern-day work environment, as cruise ship design changes and develops fast and often during the first stages of the concept development. Due to this new model of designing is needed. In addition to a new model, newer methods are also needed. This research aims to study different design thinking models and methods and suggest a new process connecting the double spiral model with design thinking methods.

The design thinking methods are analysed through the point of view of the usage in naval architecture work, and for each method, an example of the usage is suggested. In addition to the example, the methods are also divided into three groups based on the usage of them by Meyer Sales and Design team. Finally, the suggested methods are evaluated by using them to find out the wants and need of the passenger in future cruise ships and is this knowledge important for the shipyard.

Based on the data collected by using several different design thinking methods, the conclusion is that the passengers can point out what does and does not work and if there is room for improvement. In addition, the data collected from the methods support the claim that the shipyard would benefit from the information.

Keywords Design Thinking process, Design Thinking methods, Cruise Ship design, Double spiral model

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Tiivistelmä

Laivojen konseptisuunnittelussa käytetään yleisesti perinteistä suunnitteluspiraalia. Spiraalimalli ei ole muuttunut tai kehittynyt sen jälkeen, kun se otettiin käyttöön vuonna 1959. Tämä aiheuttaa ongelmia nykyaikaisessa työympäristössä, koska risteilyalusten suunnittelu muuttuu ja kehittyy nopeasti ja usein konseptikehityksen ensimmäisissä vaiheissa tarvitaan uusia menetelmiä. Tämän uuden suunnittelumallin vuoksi tarvitaan. Uuden mallin lisäksi tarvitaan myös uudempia menetelmiä. Tutkimuksen tavoitteena on tutkia erilaisia design thinking malleja ja menetelmiä ja ehdottaa uutta prosessia, joka yhdistää double spiral -mallin design thinking menetelmiin.

Design thinking menetelmiä analysoidaan laivasuunnittelutyön käytön näkökulmasta, ja kunkin menetelmän osalta ehdotetaan esimerkkiä tämän käytöstä. Esimerkin lisäksi menetelmät on jaettu kolmeen ryhmään, jotka perustuvat Meyerin Sales and Design tiimin käyttöön. Lopuksi ehdotetut menetelmät arvioidaan käyttämällä niitä selvittäämään matkustajan halut ja tarpeet tulevissa risteilyaluksissa, ja onko tämä tieto telakalle tärkeä.

Useiden eri suunnittelun ajattelutapojen avulla kerättyjen tietojen perusteella voidaan päätellä, että matkustajat voivat huomauttaa, mikä ei toimi ja mikä on parannettavaa. Lisäksi menetelmistä kerätyt tiedot tukevat väitettä, jonka mukaan telakka hyötyisi tiedoista.

Avainsanat Design Thinking prosessi, Design Thinking metodit, Ristilijälaivan suunnittelu, Double spiral malli

Foreword

The idea of combining product development with naval architecture occurred to me during a Summer day at work at Meyer Turku. The thought was crazy, and I had no idea how I'm going to combine the two topics and what would be the outcome. But nevertheless, I contacted Professor Katja Hölttä-Otto, Professor Pentti Kujala, and talked about it with my colleague and friend Liina Vahala. A month later the four of us were sitting at the same table brainstorming how this idea could be developed into a thesis.

At first, I want to thank my supervisor Professor Katja Hölttä-Otto for supporting me through out this whole process. Without her help and support with the ever-changing topic throughout the whole eight months, I would still be working on this thesis. Your guidance after every obstacle I run into, helped me shape the thesis into its current state.

Secondly, I want to thank my advisors Mikko Ilus and Arttu Korpela. Your support, feedback and help the past few months are valuable. I want to specially thank Arttu though, for managing to find time for my thesis while he was in Miami. I want to also thank Meyer Turku for letting me choose such a crazy topic. Even when asked multiple times what the outcome of the thesis will be, and I wasn't able to tell, but I was still told that yes, the topic is interesting and is needed.

Last, but definitely not least, I want to thank my family and friends for all the support and encouragement. Special thanks go to my parents for supporting me through out my studies, supporting all my crazy ideas and helping me achieve my dreams. I want to thank Karam and Tytti for making me smile when it felt like there was no reason. A special "fluid mechanics" thanks goes to uncle Mohannad.

And to my role model, auntie Saba. This is for you.

Espoo 24.6.2019

Basma Al-Murani

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Abbreviations

4D	“Discover, Define, Develop, Delivery” –model
CAE	Computer Aided Engineering
FERU	Floating engine room unit
GA	General arrangement
R&D	Research and development
RCCL	Royal Caribbean Cruises Ltd.
SOLAS	The International Convention for the Safety of Life at Sea
Stanford d.school	Hasso Plattner Institute of Design at Stanford

1 Introduction

1.1 Background

Every product is developed to fulfil customer wants and needs in a certain manner. The size of the product does not affect that criterion; thus, cruise ships are also seen as products that need to fulfil the wants and needs of the passengers. For a company to manage and to fulfil these requirements, it is important that the group of engineers and designers developing a new product understand the customers now, but also in the future. This group of engineers and designers need to be able to see the future of the product through the eyes of the end-user, the customer, and thus be able to design a product that will be bought and used in the future.

When considering the current shipbuilding industry, the main development methods of a new ship design can be divided into two groups. The first group includes designs that are based on research and development projects (R&D) of ship designers (shipyards, design company, etc.), and the second group consists of designs from a continuous development together with the customer (shipowner). The R&D projects are based on long-term strategies of the design company and thus not a contract project, which means that the ship designers have an innovative process based on market studies and new ideas and concepts, and in the end the new ship design will be introduced to the market. On the other hand, the continuous development projects are customer driven projects, and thus the design has to meet the customer requirements. (Vossen et al., 2013.) This could mean that the ship designers might not be able to imply all of their ideas into the concept.

When considering specifically the cruise ship industry, in nearly all cases the ship design process belongs to the second group, the customer (ship owner) driven design. The understanding of the end-users, the passengers, differs from a stakeholder to another. When thinking about a cruise ship and her design, there are three main stakeholders that affect it directly and indirectly; the passengers, the shipowner, and the shipyard. When designing a new ship, the passengers are not directly involved in the process, but their feedback from previous experiences on board is valuable. Usually, this feedback is given through surveys carried out by the ship owners, the second stakeholder, and they analyse it and pick out what they see as useful and needed. Based on this feedback, the ship owner develops ideas of what would be wanted and needed, and what could be changed from the current design to be more suited for future passengers. These ideas are then introduced to the third stakeholder, the shipyard, when the owner is ordering a new ship. The shipyard utilizes the data and ideas provided to them to develop concept that is accepted by the owner. Thus, the link between the shipyard and the passengers is missing, and some of these ideas and feedback never reach the shipyard, the main shipbuilder. This relationship can be seen in Figure 1.

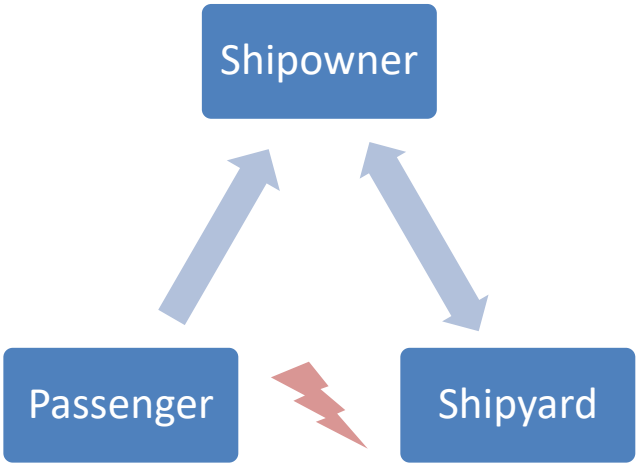

Figure 1. The relationships between the tree main stakeholders.

Another way to tackle a design related problem is by using a design thinking approach and its methods. In recent years design thinking has become more popular over time, and there is multiple number of models developed to be used in different situations and by different people.

Motivation for this Thesis are risen from author's own curiosity of wanting to better understand the passengers. During my studies, I have always been fascinated by how products can be developed to be more sustainable and user-friendly, and majoring in Naval Architecture added an extra challenge to the idea of developing a concept now, that would still be interesting for the customer 30 years after the ship is launched. And what a better way to understand customers than to use better design methods.

1.2 Case company and industry overview

This Master's Thesis is written for Meyer Turku shipyard, which is one of the leading shipyards in cruise ship industry in the world. The shipyard was founded in 1737 and is owned by the German Meyer Werft GmbH since 2014. The company also owns the shipyards Meyer Werft in Papenburg and Neptun Werft in Rostock, Germany. Meyer Werft and Meyer Turku are known for building complex and high-tech cruise ships, cruise ferries and ferries, while Neptun Werft is known for building river cruise ships and recently for building floating engine room units (FERU) for ships built in Meyer Werft and Meyer Turku.

Even though the shipyards are based in different locations, they are still seen as one united company with several branches, and due to that the sales department of the company is one for all shipyards. This department includes the early phase of the ship concept design. This increases the challenge for the sales and design team, as the team is located on two different places, Papenburg and Turku. This means that unified approaches and methods should be adapted by all members of the team despite the location. At the same time, this is a perfect opportunity to introduce new working methods that can be adopted in all locations.

According to the Cruise Lines International Association (CLIA) the 11 biggest future trends indicated in their 2019 Cruise trends & industry overview report (CLIA, 2018) in the cruise industry are

- Instagrammable cruise travel

- Total restoration
- Achievement over experience
- On-board smart tech
- Conscious travel
- Access is the new luxury
- Generation Z at sea
- Off peak adventures
- Working nomads
- Women travellers
- Going solo

As can be noticed, the trends and thus the future demands could be anything. Because travelling has become more accessible and easier, the passengers want more to experience. At the same time, passengers are getting younger, and thus technology plays a bigger role in design and what has to be accessible and provided. A nice spot to take a photo on the phone, while at the same time there should also be an area for total relaxation. On board the same ship could be people working and having their holiday at the same time. Everything needs to be considered already in early stages of design. New ideas to keep passengers interested have to fulfil the passengers' expectations of their cruise. It is a holiday, and experience, and at the same time green travel, while still being able to access one's work emails and not feel that it would ruin the experience.

When considering all these trends and associating it to the current cruise ship orderbook (Figure 2), it can be noticed that the competition is high. There are 4 major shipyards that have 88% of the orderbook; Chantiers de l'Atlantique, Fincantieri/VARD, Meyer Werft, and Meyer Turku. This means that it is important to stand out from the rest and deliver a unique product. This can be achieved from coming up with innovate design and product that is something not seen yet, something that makes the passengers want to travel with the same ship again. At the same time the ship must meet the latest trends while setting new ones. This cannot be achieved without the understanding of the passengers wants and needs.

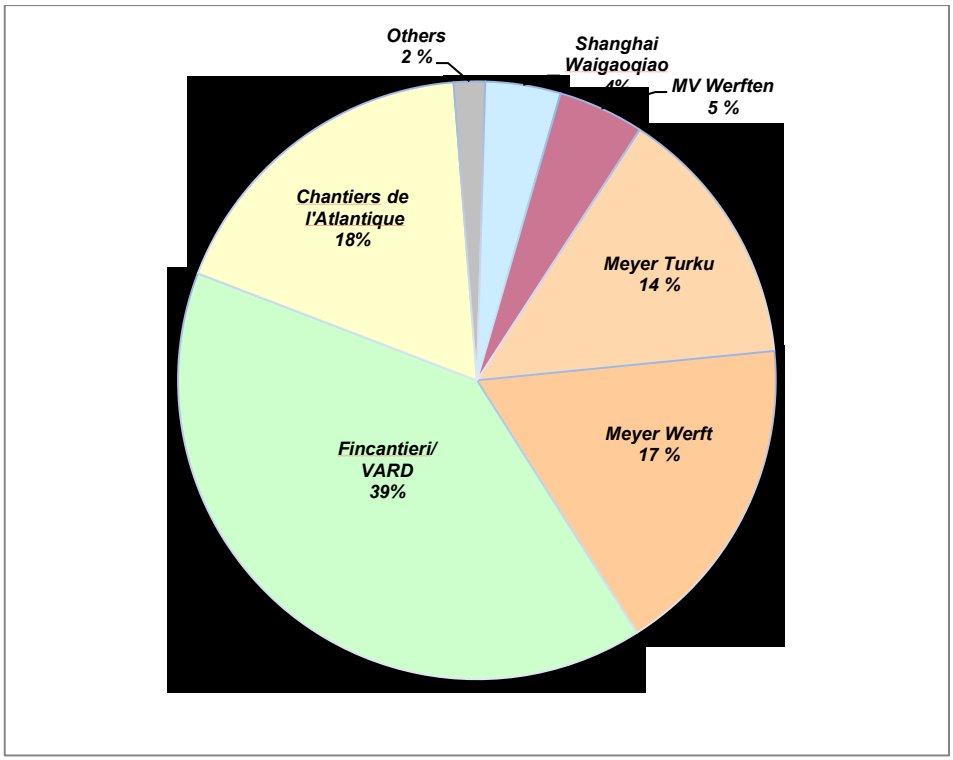

Figure 2. The current cruise ship orderbook (Cruise industry news, 2019)

1.3 Scope and framework

This thesis is divided into two parts; the product development part and the naval architecture part. A literature overview of both parts is covered in chapter 2, though the chapter concentrates mainly on design thinking and the different methods that can be applied in everyday work by the Meyer Sales and Design team. The sub-chapter 2.4 introduces three main theories used in early phase of ship concept design.

Chapter 3 connects the two parts of chapter two, the design thinking methods with the already existing naval architecture method, suggesting a new developed process that could be applied in early phase of ship concept design. The aim of the chapter is to mix the methods into harmonious process that when needed can be used at different stages.

Chapter 4 tests some of the design thinking methods. The chosen methods are observations, interviews, and analysing online reviews. The target of using the methods was to find out does the shipyard need a better understanding of what the passengers want and need in the future ships. This was chosen as an example problem that can be answered using different design thinking methods.

Chapter 5 concludes the validation of usability of the methods with the suggested process in Chapter 3 and suggests how the process can be further developed and applied.

The research question aimed to be answer through this thesis is
"How to integrate some design thinking methods in early phase of ship concept development with evaluation of usability of some of the methods".

The evaluation is carried out by using some of the methods to try and answer the following secondary research question: "What cruise ship passengers want in the future cruise ships

and how can the designers from the shipyard form a better understanding of the passenger's needs."

2 Methods that can be applied in naval architecture

2.1 Design Thinking in general

In 1973, Rittel and Webber argued in their article "*Dilemmas in general theory of planning*" that there are two approaches to solve a problem. The first approach is what they call "the first generation" system-approach, where first the problem is understood, information concerning the problem is gathered, analysed, and synthesised, and as a last step the problem is solved. But according to them, not all problems can be solved using this approach. Rittel and Webber state that there is what they call "wicked-problems" that cannot be solved using the "first generation" approach but can be solved using "second generation" approach. To understand how to solve "wicked-problems", first one needs to understand what they are.

Buchanan (1992) lists the definition of Rittel's "wicked-problem" as the following:

1) Wicked problems have no definitive formulation, but every formulation of a wicked problem corresponds to the formulation of a solution.
2) Wicked problems have no stopping rules.
3) Solutions to wicked problems cannot be true or false, only good or bad.
4) In solving wicked problems there is no exhaustive list of admissible operations.
5) For every wicked problem there is always more than one possible explanation, with explanations depending on the Weltanschauung of the designer.
6) Every wicked problem is a symptom of another, "higher level," problem.
7) No formulation and solution of a wicked problem has a definitive test.
8) Solving a wicked problem is a "one shot" operation, with no room for trial and error.
9) Every wicked problem is unique.
10) The wicked problem solver has no right to be wrong-they are fully responsible for their actions.

Based on the above definition of the "wicked-problem", Rittel and Webber (1973), suggest that "wicked-problems" are problems that cannot be understood without understanding first the context of the problem. One cannot first understand and then solve, but the solution emerges gradually at the same time as the problem itself is understood. Basically, understanding the problem, setting constrains to it and defining it is the solution for the problem itself.

Even though there has been a lot of discussion concerning the definition of "wicked-problem" ((Kunz and Rittel, 1972), (Simon, 1973)) in information technology, the same type of problem persist in other fields of engineering too. The approach of defining the correct problem at the beginning of any design project is the essence of finding the correct solution. To design anything, first one must understand what needs to be designed and by using the correct methods, design solution emerges.

To be able to design a product creatively and innovatively, an open-minded approach is needed. During the recent years, *Design Thinking* has reached high popularity in many fields and is used as a new model for dealing with different problems arising (Dorst, 2011). According to Brown (2008) design thinking is an approach that matches people's needs with what is technologically feasible and what is viable through a business strategy by us-

ing designer's sensibility and methods, and converts them into customer value and market opportunity, as shown in Figure 3.

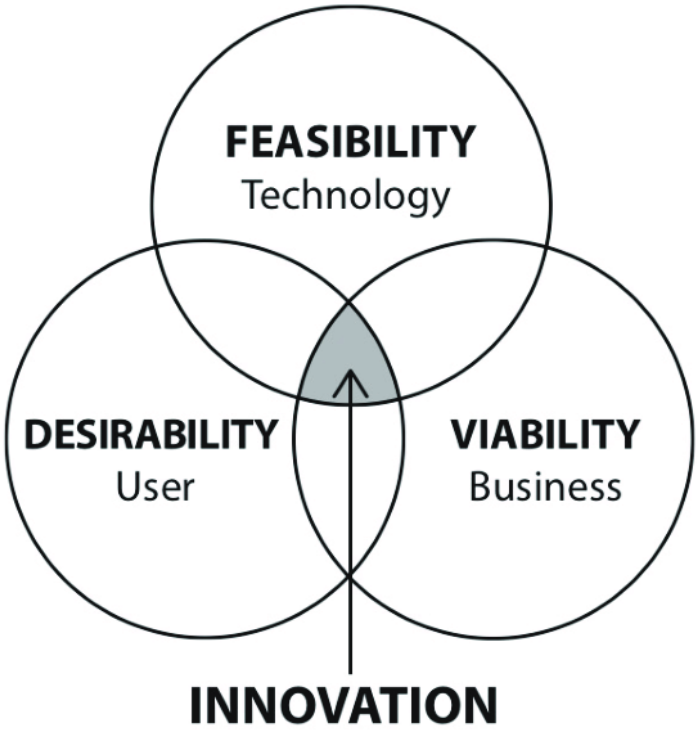

Figure 3. How to find innovation according to Brown (2009)

In addition, Brown, who is the CEO and founder of one of the world's biggest design company IDEO, wrote in his book "Changed by Design" (2009) about the connection of so-called human-centred design and design thinking. First of all, human-centred design is defined in the international standard as the following:

> "Human-centred design is an approach to interactive systems development that aims to make systems usable and useful by focusing on the users, their needs and requirements, and by applying human factors/ergonomics, usability knowledge, and techniques. This approach enhances effectiveness and efficiency, improves human well-being, user satisfaction, accessibility and sustainability; and counteracts possible adverse effects of use on human health, safety and performance" (ISO 9241-210:2010).

According to Giacomin (2014) the roots of the idea of human-centred design comes from fields such as ergonomics, computer science and artificial intelligence. He argued that in such fields the needs of the users of the tools set the goal of the engineering, thus the design of the tool is done based on the need, not the other way around. At this point, it must be pointed out that there has been discussion that human-centred design is not the same as user-centred design, and the two terms should not be used as synonyms with each other. This was discussed in depth in Richard Buchanan article "Human Dignity and Human Rights: Thoughts on the Principles of Human-Centered Design" (2001), where he in the

end of the article states the importance of human-centred design in design thinking, and that it should not be reduced to the term "user-centred design", as this term concentrates more on the usability rather than the human itself.

On the other hand, Cross (2001) defines design thinking as an approach that explains how designers formulate problems and how they generate solutions for them. The solution is connected to the problem via design thinking methods. For designers, the evaluation of the solution is what is important, not the analysis of the problem. Due to that, it is said that designers are solution-led, not problem-led.

There are multiple models that presents design thinking process and its different stages. Each model has its strengths and weaknesses, but the main purpose and target of the models are the same for all of them. These models are developed by companies, educators, universities, and are adapted into the working and teaching environment. When searching online for different design thinking models, some of them tend to come across more often than the rest. These more popular models are presented in the following paragraphs.

Moving back to the connection that Brown made in his book (2009), he argues that human-centred design is a framework that can be divided into three spaces: inspiration, ideation, and implementation (Figure 4). Tschimmel (2012) defines these three spaces of design thinking as the follows. "Inspiration" is the stage, where the design problem or opportunity is identified, the user group is observed, and a design brief is made. "Ideation" stage is when an interdisciplinary team goes through all the material and data, they have collected to form from the insights that can then be used for solving the design problem. As the last stage of the design thinking framework, "implementation" is the space in which the best ideas that were developed are turned into prototypes and further tested. If we consider this framework as the basic model of how design thinking process should include, it can be noticed later in this chapter when other models are introduced that even though they are called and described differently, they all have the same stages as this one.

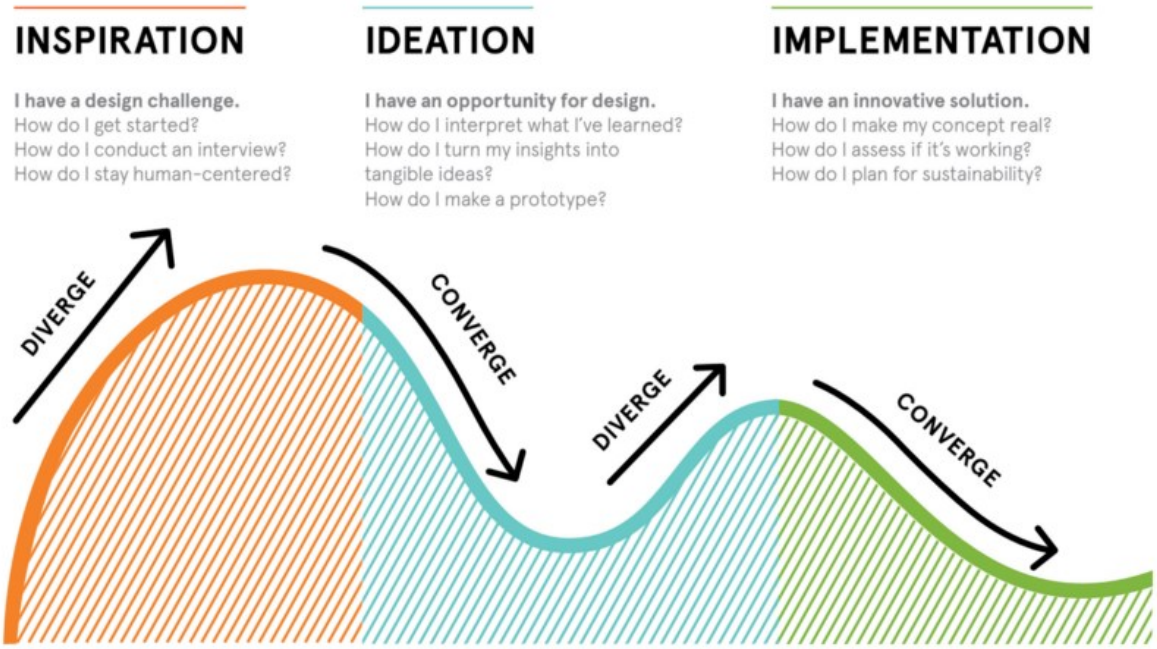

Figure 4. Human-centred design frame-work model (Maxime, 2016)

One of the most popular models of design thinking is the model developed and taught in Hasso Plattner Institute of Design at Stanford (Stanford d.school). The model is taught at Stanford, and it divides the design thinking process into five different stages, shown in Figure 5 (Hasso Plattner Institute of Design at Stanford, 2010).

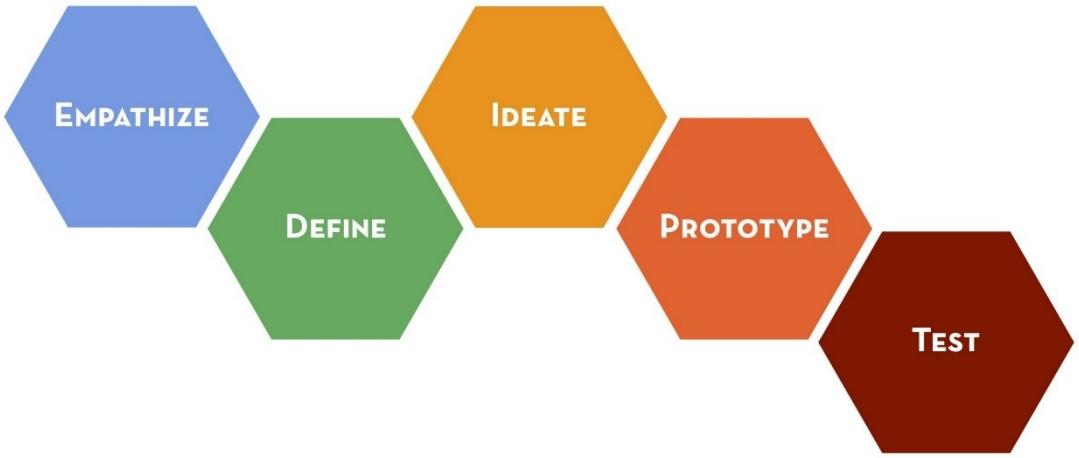

Figure 5. Design thinking model process by Stanford d.school (Hasso Plattner Institute of Design at Stanford, 2010)

The first stage of the process is to empathize with the people. The aim of this stage is for the designer to understand all the about the people, the users of the product or service, on a meaningful emotional level. The second stage is to define the correct problem based on the information ad data collected about the user during the first stage. Basically, the designer needs to make sense of all the data they have collected in a form of meaningful and actionable problem statement. After a problem-statement is defined, the designer moves to the third stage, the ideate stage, where the intent of the stage is to generate the widest possible range of ideas and possibilities, thus the aim is not to come up with the correct idea that solves the problem, but rather with all the possible ideas that might in a way help solving the problem. During the fourth stage, prototyping, the aim is to build fast and cheaply a prototype based on the ideas generated during the previous stage. Using the prototypes from the fourth stage, in the fifth stage, the test stage, the prototypes are tested, and feedback is received from the users. This stage is another stage where the designer can gain more understanding and empathy from the users. After the loop is done and more information is gathered from the users, the designer iterates and refines the ideas and the prototypes and retests them with the users until a correct solution is found. (Hasso Plattner Institute of Design at Stanford, 2010)

The Double Diamond or 4D model is developed by the British council (Figure 6) (Tschimmel, 2012). This model divides the design process into four stages; Discover, Define, Develop, and Deliver, thus the name 4D. The first two stages, discover and define, concern the problem understanding and defining. Discovering is divergent and the aim of it is to find out all there is about the problem. The define stage is convergent, and it aims to define all the information discovered concerning the problem into one main problem or question. These two stages form the first diamond of the design process, and the result of

them is a definition of the correct problem that needs to be solved. The second diamond is formed of the development and the delivery stages, and they concern the solution part of the design process. In this phase, the divergent stage is the development, while delivery is the convergent stage. The aim of the development stage is to find all the potential solutions and concepts, and the aim for the delivery stage is to deliver the final product. (Design Council n.d.)

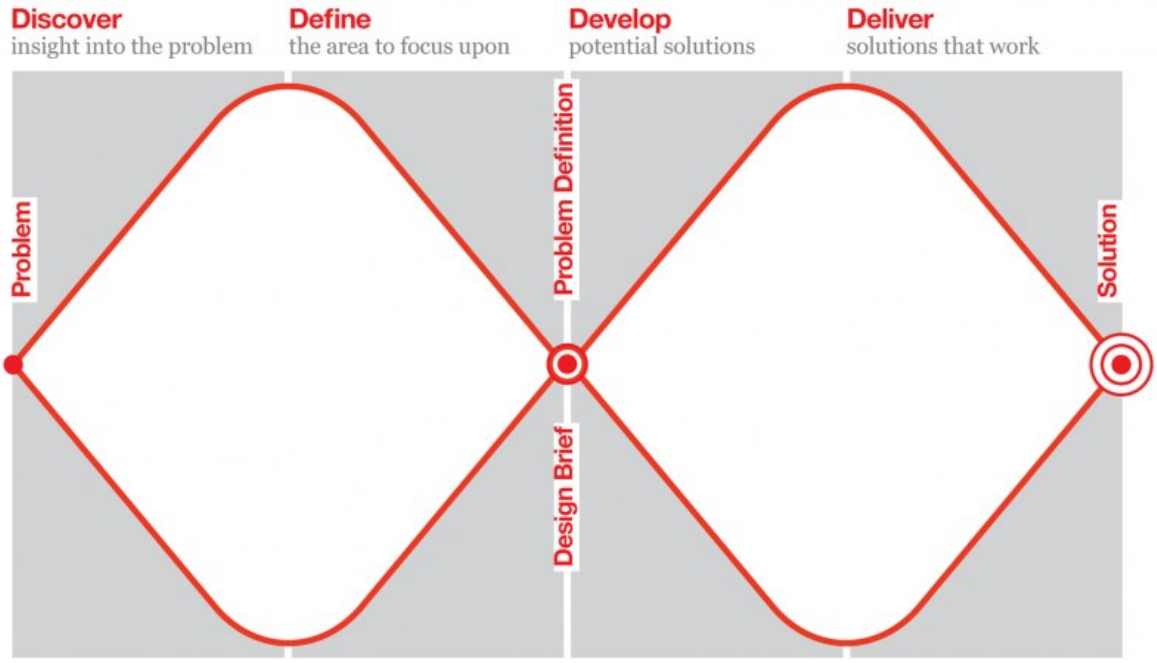

Figure 6. The 4D or Double Diamond model by the British Council (Design Council n.d.)

Comparing the Hasso-Plattner Institute model and the 4D model to the human-centred design framework by Brown, it can be noticed that all three models contain the same stages, but they are named and divided differently. The comparison of the models' stages is represented in Table 1.

Table 1. Comparison of the 3 design thinking process models

Models	Stages					
Human-centred design framework model	Inspiration		Ideation	Implementation		
Hasso-Plattner Institute model	Empathize	Define	Ideate	Prototype	Test	
4D model	Discover	Define	Develop			Deliver

As can be noticed, the major difference between the models is the extra stage, Deliver, that belongs to the 4D model. Deliver aims to give a final solution, while the other two models do not include that part into the design thinking approach. Other than that, the models have the same stages, and thus the aim of the process for each model is the same. Depending on

the project, the team, the company, etc. different processes are used. All in all, the result will still be same.

2.2 Different stages of Design Thinking process used in this thesis

For thesis, I read the following books about different design thinking processes and methods:

- Kumar, V., 2012. 101 design methods: A structured approach for driving innovation in your organization. John Wiley & Sons.
- Hanington, B. and Martin, B., 2012. Universal methods of design: 100 ways to research complex problems, develop innovative ideas, and design effective solutions. Rockport Publishers.

In addition to the mentioned books, I also got familiar with the IDEO's Design Kit that introduces 63 different methods, which are divided according to Human-centred design framework model (IDEO n.d.). As noticed in Chapter 2.1, different process have different names and stages, but the content and the aim of the processes is the same for all of them, the same can be said for the methods. Different authors name and define the methods differently, but in the end, all authors have the same methods included in their works.

I chose Kumar's book "101 design methods" to be a refence book for the process and methods in this thesis, as it was in my opinion well explained.

The book introduces the model as Design Innovation Process and divides it into 7 stages (in the book the stages are called modes) (Figure 7). Each mode contains several methods that can be used to move forward in the process. It must be pointed out though, that even though the modes are numbered, Kumar points out right in the beginning that depending on the stage of the idea or innovation the process is not linear. The usage of the methods depends on the need of the designer and the process can jump from a mode to another in a non-linear manner, and still give an excellent end result.

Figure 7. Design Innovation Process showing its 7 modes (Kumar, 2012)

The modes are defined as the following (Kumar, 2012):

1. Mode: Sense intent

The idea behind this mode is that we understand the where – where is the world moving and what is happening in the future and what is changing. Using the methods of this mode, we should be able to point out where is an opportunity for future innovation development. Where is a gab that needs attention from us designers to come up with an idea that will become an innovation and the next "it"?

2. Mode: Know context

In this mode, we try to understand the surrounding conditions in which the changes from the previous mode happen in. What is the context that surrounds the innovation that will make it successful?

3. Mode: Know People

In this mode, the aim is to understand the users. This mode's methods focus on empathy, observation, personal engagement, and problem solving.

4. Mode: Frame Insights

In this mode, the data collected is analysed using various analytical frameworks, so that the it is possible to gain a clear perspective.

5. Mode: Explore Concepts

In the explore concepts mode, the insights about people and context are turned into concepts.

6. Mode: Frame Solutions

In this mode, the compatible and valuable concepts are combined into reliable and systematic solutions. This is done, because it is unlikely that one concept can fulfil all the principles or design criteria.

7. Mode: Realize Offerings

In this mode, the aim is to understand how to make all the ideas, concepts and solutions into a real product that is tangible.

To see the connection of the Design Innovation Process with the other processes introduced in Chapter 2.1, a similar table is made as Table 1, with the addition of the new process and its stages (Table 2).

Table 2.Comparison of the 4 design thinking process models

Models	Stages							
Human-centred design framework model	Inspiration				Ideation	Implementation		
Hasso-Plattner Institute model	Empathize			Define	Ideate	Prototype	Test	
4D model	Discover			Define	Develop			Deliver
Design Innovation Process	Sense intent	Know context	Know people	Frame insights	Explore concepts		Frame Solutions	Realize offerings

As can be seen, Kumar's process, the Design Innovation Process, follows quite accordingly to the other processes.

2.3 Overview of Design Thinking Methods

From Kumar's book (2012), I have chosen 41 methods that can be implemented in the early phase of ship concept design. The methods are divided into 3 categories based on how they can be used by Meyer Sales and Design team. The division is made as the following:

- Methods for internal usage, not project related:
  These methods are not related to a certain project, but they are more like background methods that increase their value over time if they are properly used and updated by the whole team. The methods do not require outside input, such as field visits, interviews, etc.

- Project based internal methods:
  These methods are project based and they help the project to move forward. The methods can be used as part of the regular design process as needed and seen fit, though it must be pointed out that some of the methods are so useful that incorporating them to all future projects would make the design process easier. These methods, like the methods in the previous group, do not require outside input to be used.

- Project based external methods:
  These methods are also project related methods, but unlike the previous methods, these methods require input that can be achieved from outside the company. Basically, it means that within the team inside the company these methods do not add any input or provide any data that can be used in the project.

The division is made in this manner due to the work process carried out by Meyer Sales and Design team. Depending on the project, there is possibility that one designer must do the whole design process in certain time all alone, thus the methods that this person would choose would be internal methods. On the other hand, there might be cases where specifically external methods are needed, for example when wanting to get to know a new customer and observations need to be done.

In the following sub-chapters, the 41 methods picked are divided according to the division explained above. After the name of each method, there is a direct quote from Kumar's book (2012) that describes the method shortly, which is then followed by a short explanation of how to use the method (also based on Kumar's work) and a suggestion of how to implement this method in early phase of ship concept design. In addition, after the name of each method, I've marked inside parenthesis to which mode Kumar intended the method to belong to.

2.3.1 Methods for Internal usage, not project related

- Buzz report (mode 1)
  "Collecting and sharing information about the latest buzz from a wide array of sources"

In Buzz report method the main aim to share relevant information and news that might concern work or innovation in a way or another.

Everyone in Meyer Sales and Design team should be keeping up with the latest trends. This is done partially right now, but it can surely be developed further. As the methods suggest, each member of the group should allocate a period of their work week, for example, to read about the latest news and trends. Just do some research. And if they find something just mark it out. Right few sentences in their own words about what they found interesting in the subject (for example the citizen hotels) and how this idea can be implemented into shipbuilding. What is really missing is a folder/ drive/ place to share this information internally for everyone. Right now, what is happening is that people might send the article via email or mention it during a coffee break, but it will get lost. What is needed is proper way that is reachable by all and is easy to use. For example, a paper that can be easily filled with website area, date added and pace for a few sentences can be added and shared automatically to everyone. If this is wanted to be done fancier, subfolders with different subjects can be added and thus searching for the article or original piece of news is easier. Right now, everyone is keeping the information to themselves only.

- Innovation sourcebook (mode 1)
  "Finding inspiration from studying innovative offerings, companies, and people"

This is an organization method. In this method different types of innovations are organized into a single source that can be searched.

This method can be used as a database for good idea sources, for example, new hotel concepts that can be applied to cabins, elevator design, ideas for public areas (shows, museums?). This method makes it easy for finding information on new ideas and thus they can be utilized easier. This method can be connected to the buzz report method for saving the news in a systematic way.

- User observation database (mode 3)
  "Organizing and sharing observational data from different projects"

This is organizing method for observation data collected from other methods. The data is tagged using frameworks like POEMS or Five Human Factors. This method requires extra initial effort to enter the already existing data, but once it's there, it would be easier to analyse and more valuable for future projects. This method also makes it easier to share the data with the rest of the team, as it's available in a common place that can be easily found.

If the shipyard increases cruise ship visits and passenger observation, I recommend having this type of data sheet for the data collected, and not just a written report.

- Insight sorting (mode 4)
  "Manually sorting insights from research to find clusters and hierarchies"

In this method the insights generated in the earlier method are sorted int different clusters. Each cluster is then analysed to reveal clustering patterns that give valuable information that might not have been obvious from the separate observations.

If observation is used as data collection method on board a cruise ship, using methods "Observations to insights" and "Insight sorting" is very useful to get a better understanding of the bigger picture. In a sense this method is useful for data analysing and can help in developing new ship concept design, but it's not helpful directly if there is no initial data. It's more of a process, than a direct method.

- Asymmetric clustering matrix (mode 4)
  "Making profile of entities based on a set of semantic scales and comparing those profiles"

In asymmetric clustering matrix, there is two sets of entities that are analysed. This method forms clusters of two separate entities based on their relationship. For example, the entities can be people's activities and places, and by finding how often certain activity occurs in certain place, it forms different clusters.

This method can be used in analysing the passenger's activities as mentioned in the example above. Based on the observations gathered from other methods, this method will give valuable analysis and might give not so obvious patterns that can be used in future designs. I belive that this method would be useful for analysing the gathered data, as it would be easy to see the connection between activities and places or services.

- Concept catalog (mode 5)
  "Organize key information about concepts in a central location for searching and browsing"

Concept Catalog is an organized collection of the developed concepts all saved in one location. This method is another organizing method that should be applied in any project and work for future reference.

- Solution database (mode 6)
  "Organizing all concepts and solutions in a searchable relational database"

Solution Database is similar method as other database methods, where the aim is to organize and archive the solutions in a systematic way, so that they can be easily searched and found later on using key words.

This method like the other database methods is useful in any discipline, as it makes work easier in the future.

2.3.2 Project based Internal methods

- Trend matrix (mode 1)
  "Summarizing changes happening today that leads to a future direction"

This method uses a matrix that has different aspects and it situates trends into the cells. It shows the relationships between the different aspects and the trends, and thus gives a better understanding of the trends in the future.

This method can be easily applied to any design aspect in any project. For example, If we trying to figure out the type of restaurants that are getting more popular and can be suggested to the concept, this method will give an overview. Another example is the future of

travelling itself, what are the passengers looking for in-land and onboard? These are the future analysis. As for different aspects that can be analysed, they could be destinations or activities for example who are the people going to amusement parks, what type of amusement parks are popular? What about theme parks? Can there be theme ships?

- Initial opportunity map (mode 1)
  "Speculating on an opportunity space to move to in relation to the current position"

In this method, a 2x2 map is made by choosing 2 key aspects that form the axis of the map. Existing ideas, trends, and innovations are marked on the plan forming empty spaces for new innovations that can be further developed.

This is another method that can be easily applied in our work for example during the workshop. Coming up with key dimension (for example from owner-shipyard meetings) and based on that situating ideas and trends into the matrix can help us see the bigger picture and come up with new better ideas.

- Intent statement (mode 1)
  "Stating an initial innovation intent based on an identified opportunity"

In this method, basic questions are answered based on the project or innovations raised. Based on this a brief statement or description is made that explains easily the goal.

I think this method is the most used in the company right now, though not directly. It's not the trends or innovations that are analysed, but what the owner gives us as an idea and we further develop it using something very similar to this method, same type of questions and approach. Not directly the same method but very close by, wouldn't see a problem of further developing the already existing method further. Will keep us focused on the overall big picture.

- Popular Media Search (mode 2)
  "Seeking out commentary on the context in popular media outlets"

In this method, media is searched for inspiration. Any media source is used and thus a wide range of sources is available.

This method is widely used specially to find inspiration in the form of photo search. It can be easily applied for further research once the topic is formulated.

- Analogous models (mode 2)
  "Looking at similar models in the world for inspiration, abstraction, and guidance"

In this method, the project topic is divided into separate aspects, and each aspect is then further analysed by using analogous models. These models are behaviours, structures, or processes that can be found in other industries that have something in common with the project.

For example, this method can be used when trying to come up with new concepts for cabins and the similar industry are hotels. Concepts and ideas can be picked out form there

and analysed based on the data that can be achieved from the hotels and then applied in ship industry.

This method is useful when wanting to understand a certain property and what affects it and how these aspects can be defined. I think it would be challenging to use this method in early phase of ship design. It might be useful to understand a brand, but as such in the design itself.

- SWOT analysis (mode 2)
  "Evaluate an organization's strength, weaknesses, opportunities, and threats"

SWOT analysis is a method where the organization is analysed through its strengths, weaknesses, opportunities, and threats.

SWOT analysis usually used to analyse a company, but it can easily be applied to a new idea and see its different point of views and properties. This method could easily help the designer on selling their new idea to the owner, for example if the designer comes up with a new entertainment area that has not before been applied on ships, by doing a SWOT diagram that is shown to the owner, it would make it easier to argue one's point of view.

- Image sorting (mode 3)
  "Having people sort symbolic images to find out their thoughts and attitudes about a topic"

In image sorting, the participants are asked to sort, discuss, and create stories using provided images. This will show the participants emotions, relationships, and values that people associate with what is shown the image.

For shipbuilding, and specifically ship concept design, this could be a powerful method to create a discussion and ideas within the design team, or between the shipyard and shipowner when coming up with ideas, as both parties might have different views on the same thing. As for with the passengers, I don't belive this would be a method that could be applied for research.

- Observations to insights (mode 4)
  "Learning from what is observed in research by revealing nonobvious inner meanings"

In this method, the data collected through observations are analysed, and an insight that is as general as possible is made out of them. It's trying to understand the "inner nature" of the observed situation. The insight statements are then organized with the corresponding observations in a spreadsheet.

This a useful method for organization of data and can be easily attached to user observation spreadsheet.

- ERAF system Diagrams (mode 4)
  "Diagram and analyze Entities, Relations, Attributes, and Flows"

ERAF Systems Diagram is a method that creates high-level diagrams that presents a system. These systems can be formed for any projects, and they are formed from a set of entities, relations, attributes, and flow (hence the name ERAF).

Entities are the “nouns”, people, places, and things. They can also be conceptual entities, such as projects, problems, and goals. Relations describe the connection between the entities and are thought to be the “verbs” between the entities. Attributes describe the entities and the relations; thus, they are the “adjectives” of the system. Flows describe the direction of the relations between the entities. They are thought to be the “prepositions” of the system, an indicate the “to and from”, “before and after” or “in and out”. There are two types of flows; the temporal flows, which are linked to time, and process flows, which show the inputs and outputs.

There are two levels for ERAF System Diagrams, the synthetic that is based on information and data gathered through research and put together into a diagram, and analytical, which point existing, emerging, or potential problems, imbalances, missing entities, or other gabs by studying the diagram.

I belive this method has high potential and usage in early stages of ship concept design. It is a very useful method to analyse a space that is being designed, especially if the space has a new concept and hasn’t been built before. It can point out potential missing or problematic entities, relations, or flows that might not be obvious without this type of analysis. In addition, it can easily use to analyse already existing spaces to recognize the problems. The very important aspect of this method is that it can be carried out by the designer on his own and can be easily discussed by the team, as it’s very visual method. In its simplest form post-its can be implemented in this method.

- Venn diagramming (mode 4)
  “Diagramming to analyze clusters of entities that overlap”

In Venn Diagram, the methods are put into clusters, and by that it is made possible to analyse the overlaps of these clusters. Basically, by using Venn diagrams, it is possible to see which entities belong to multiple clusters, depending on the definition of each cluster.

In ship concept design, this method can be used in early stages to understand potential passengers, as they can be clustered into groups of who would be in which space at a given time. For example, the clusters could be restaurant, spa and kids play area and the entities could be family, couple and group of women friends. By having multiple definition of different passengers, they can be placed in the different clusters.

- Semantic profile (mode 4)
  “Making profile of entities based on a set of semantic scales and comparing those profiles”

Semantic profile compares the different attributes of the several entities at the same time. The entities could be different types of people (young vs. elderly) and the attributes could be of a mobile phone (price, quality, experience, etc.). By marking on the same diagram, the scores of each attribute for different entities, a fast overview is achieved.

This method can once again be applied when designing a new space. The entities could be for example a child, a family with a baby, a couple, a group of friends, and the attributes are related to the space requirements. It can also be used to understand the requirements of each space at different times for each attribute, thus it would increase the understanding of how the space can be used and aimed for different groups at different time.

- Compelling experience map (mode 4)
  "Mapping the entire user experience with five stages—attraction, entry, engagement, exit, and extension"

This method analysis an experience beyond just the main focus of the experience itself. It tries to understand what happens before, during, and after the experience itself. The framework divides the experience into five stages: Attraction, Entry, Engagement, Exit, and Extension. Each stage is analysed by six different attributes: Defined, Fresh, Immersive, Accessible, Significant, Transformative. By assessing each stage against each of the mentioned attributes, it can be understood how compelling an experience is.

This method can be valuable to use when trying to come up with new "WOW"-effects. By understanding the whole experience before it starts, the value of the experience can be analysed, and thus it could make it easier to recognise which experiences give the highest value.

- User journey map (mode 4)
  "Mapping the user's journey through the context"

In this method, a user is tracked throughout an entire experience and the journey is broken into parts to gain insights of possible problems or opportunities.

This method can be once again used to discover "WOW"-effects. The journey can be carried out in model of the experience (amusement park?) and thus it can be seen what the opportunities or problems can occur for this experience on a ship. On the other hand, this method can be carried out onboard a ship to figure out is a certain experience working as it should be or is there problems that in need attention.

- Design principles generation (mode 4)
  "Transforming insights from research into actionable, forward-looking statements to guide ideation"

In this method, the insights from the collected data are transformed into design principles. Design principles are "actionable, forward-looking prescriptive statements" and they have a verb in them.

This method is the end of the journey and transforms all the ideas into statements that have to be met by the design for them to be eligible based on the data. Thus, this method is very useful in any design discipline, Ship design being no exception.

- Analysis workshop (mode 4)
  "Conducting a work session to understand insights, find patterns, and make frameworks for ideation"

Analysis workshop is a workshop where different people bring their views on the insights through discussion. No matrices are used in this method. Basically, it's a workshop for exchanging ideas and understanding to come up with a set of Summary Frameworks as a result.

This is another method for analysing data that is collected. This method requires a larger number of people with different expertise to attend to get the most divers input.

- Principles to opportunities (mode 5)
  "Transitioning from analysis to synthesis: exploring opportunities based on defined design principles"

In "Principles to Opportunities" method the design principles achieved in method "Design Principles Generation" are explored from the point of view of possible opportunities. Basically, each principle is analysed from the point of view of individual, system, and strategy opportunities before any concepts are developed from them. The difference between an opportunity and a concept is the level of detail in them, an opportunity being a lot less detailed than a concept.

This method is useful in ship concept design when the design is based on any kind of input. The input can be as mentioned before data collected various ways or then again, the input can be a list of requirements given by the shipowner. When Each of these requirements is analysed as an opportunity rather than a requirement, the possibility for a wider more complicated ideas arise, and thus there is a better chance for a more suitable out of the box idea to fit the given requirement.

- Opportunity mind map (mode 5)
  "Organizing aspects of the project and mapping areas of opportunities for innovation"

In Opportunity Mind Map, the core topic is situated in the middle of the map with the main aspects for that core surrounding it in the sectors. Each principle is situated into the map to the corresponding aspect, and from each principle opportunities are mapped. The difference between this method and the previous is that the principles analysed are related to the core, thus by defining the core idea and the aspects according to what is needed from the outcome, it would make it easier to develop the principles into the opportunities in a direction wanted.

This method can be applied when wanting to develop a certain area on the ship based on the principles developed from the insights. For example, upper outdoor deck area is relatively thought to be expensive area, but then again it is an area, which activities depend on the weather. If the whole area is open deck, and the weather is bad, the shipowner loses possible revenue, and the space is a waste. Thus, by taking weather as a possible aspect when thinking about the opportunities, it will affect the ideas developed.

- Concept-generating matrix (mode 5)
  "Generating a comprehensive and well-grounded set of concepts based on research insights"

This method utilizes two sets of important factors achieved from previous analysis and creates from them a two-dimensional matrix. The concepts would be situated in the intersections of the factors. The factors in each set should have something in common between each other and thus they can't be found together in the same concept. They rule each other out. The sets, on the other hand, complement each other.

This method can be used in ship design when there are clear sets that need to be compared. As the designed concept is a space rather than a product used by individuals, the sets can be for example activities and different passenger profiles in a certain space. For example, the space is an indoor space with no sea view. Passenger profile can be kids, youth, families, elderly, couples, etc. and activities can be mingling, shopping, cinema, kids playing, youth playing, dancing, etc. Keeping in mind that the area does not have sunlight, it's most likely will be more ideal to put a space that wouldn't benefit from sun light, such as a cinema, shopping area, aquarium, youth game room, etc. Kids play area is not ideal, as there wouldn't be an ideal place for the adults to hang around while their kids are playing, and usually passengers want to have a direct connection to the sea specially if they are spending time while having a coffee.

- Morphological synthesis (mode 6)
  "Organizing concepts under user-centered categories and combining concepts to form solutions"

In Morphological Synthesis, the concepts are organised into set of categories. These categories that are selected are usually a set of activities, user needs, or design principles. By choosing a concept from each category and combining them into a new functional concept, the designed solution meets all the design criteria.

This method is really useful in ship design, as usually the space needs to fulfil multiple functions and criteria at the same time. Example of different categories that can be useful in ship design are different user groups and their activities and different time periods.

- Solution diagramming (mode 6)
  "Diagramming to think through solutions and to show how solutions work"

This method uses different types of diagrams to translate solutions into visual representations. The idea is that different diagrams give different type of information of the solution that can be utilized and based on it the solutions are easier to understand and develop further.

This is another method that is not connected to a certain industry or approach but is more of way of communicating and representing information, and thus can also be used in ship design if needed.

- Solution storyboard (mode 6)
  "Constructing narratives that explain how system solutions work"

In solution storyboards, a possible scenario is implemented into the solution and sketched out as story to understand how the different part and elements of the concept work out in different scenarios. By understanding the journey of the character that is sketched, possible problems can be noticed in the solution and improved on.

This method is useful when designing a new space. Understanding the possible different interactions that might occur can help out the design in early stages.

- Team formation plan (mode 7)
  "Planning initiatives based on innovation solutions and forming teams around them"

This method aims to form innovative teams depending on the project need. The aim is to choose the team members carefully based on their skills to form a versatile multidisciplinary team.

This is once again a method that cannot be applied for design work as such. IT would be thought interesting to see how it would work from the sense of forming a design team for a certain project based on given criteria, for example interest towards the project, and see if that would affect the end result of the work in terms of complexity or time used.

- Vision statement (mode 7)
  "Shoeing and telling what the offering will be as a comprehensive illustration"

The aim of vision statement method is to describe the result of an innovation project without any of the background research, analysis, and synthesis done. The goal of the method is to express the innovation intent in a short sentence or a title statement.

This method would be useful in any project as a wrap up method, to understand what the main goal of the project or the innovation is made in the project in a single sentence. As innovation project for ship design occur in the early phases of design, this method wraps up nicely the project in both cases if the project will continue or ends after current stage.

- Innovation brief (mode 7)
  "Making the vision for innovation offerings understandable for all stakeholders"

This method translates the innovation plans into understandable form for all different stakeholders. These forms can be messages and/or images. The method divides the communications into three different aspects: the message, the intended audience, and the medium through which the message is delivered. By taking all these three aspects into account, it makes the message delivery better for different groups as the message is directly aimed for them.

In early phase of ship design work, many different presentations and briefs are done in different stages of the project for different audience, thus even though this method aims to produce a message of the whole innovation of the project, it is important to realise that each stage of the project is in its own right a final version for that specific stage thus this method is important to keep in mind when doing different presentations at different stages of the project for different audience.

2.3.3 Project based external methods

- Trend expert interviews (mode 1)
  "Talking with trends experts to learn about latest developments and possible futures"

Trend expert interview is basically interviewing an expert in a certain field for further information.

This method is used already, an indirect way. First of all, the company designers are experts in their field and during shipyard-owner meeting, experts from a different point of views discuss the ship design. Thus, the discussion is happening. In addition to this, the company has meetings with experts from other companies that tell about their point of view of the future. What can be added is interviews with outside experts on a regular basis such as professors, hotel owners, etc.

- Interest groups discussions (mode 2)
  "Immerse with interest groups to learn about what is being discussed in a topic"

In this method, a group of people who share the same interest are analysed through their conversation. The group conversation is followed either in real life or then online and insights are picked. Based on the insights an idea might develop or a better understanding is achieved.

This method would be so useful when designing or coming up with new ideas for a specific target group, for example a play area for kids or teenagers hanging area onboard. Interview might be too intimidating in cases mentioned above, but a relaxed group discussion might trigger easiness and thus good ideas might emerge. On the other hand, this method can be used to collect data online from forums, but then again, the data wouldn't be reliable enough.

- Research planning surveys (mode 3)
  "Studying physical, cognitive, social, cultural, and emotional factors that drive overall user experience"

This method is a short survey that is given to participants for answering and the answers are analysed.

This method can be easily used for passenger/crew survey for rapid information. Based on the answers, a further survey can be made. This method can be widely used in any phase of the design, for example if there is a known problem in certain area design, giving surveys to passengers and/or crew concerning this area for feedback on the reasons why certain place works or doesn't work, we get valuable feedback directly from users.

- Five human factors (mode 3)
  "Studying physical, cognitive, social, cultural, and emotional factors that drive overall user experience"

The five human factors method divides the data observed from humans into five categories: physical, cognitive, social, cultural, and emotional.

By keeping into account, the five different categories while observing people, more detailed data can be collected and thus there is more information to analyse. For example, the reasons behind a certain act might be easier to explain when noticing and considering that the observed person is a mum with a crying baby.

This method is easy to do and carry out during any cruise visit. Question that might be easily answered by doing this type of observations are what people do while queuing for a restaurant.

- POEMS (mode 3)
  "Studying people, objects, environments, messages, and services in a context"

POEMS method is an observation method, where the observed elements are: People, Objects, Environment, Messages, and Services. The aim is to notice all five elements, and how they interact with each other.

This is another method can be easily applied and used in any cruise. Observing how passengers and crew act naturally is the best source of information and by taking into account all five elements, it is easier to notice the working and not working aspects and elements of the design.

- Field visit (mode 3)
  "Having conversations with people about their daily lives and contexts"

Field visit is an interactive observation method. The idea is that there are no formal interviews carried out, but an informal conversation is carried out. This method is best carried out by a group, as some members could record the observations using multiple forms, while other group members could take part in the activities carried out by the observed group and have a conversation with them. This method can be easily connected to the "five human factors" and "POEMS" methods from the observation point of view. The main point is that the participants carry out the conversation and the questions asked are open-ended ones.

This is another method that can give a lot of valuable data from passengers onboard. Places such as cafeteria, sundeck, children's play area are full of potential for development, and just observing might not give all the data that is available.

- Ethnographic interviews (mode 3)
  "Having conversations with people about their daily lives and contexts"

Ethnographic interview concentrates mainly on understanding the people's activity and experiences. The interviews are conducted in the actual location where the activity is carried out, thus the participants would feel more at ease in a familiar environment. In addition, it would be easier to understand the actions as the participants can show them directly.

This method would be useful when trying to understand the environment of work for operations rather than passengers. For example, in big galleys, this would be crucial. Understanding the place of the equipment as well as the people flow, would make it easier for designers to design the place. Another helpful area in the ship would be any kind of logistic work, for example linen and cleaning equipment. Following a crew member for one day, it would make it easier to understand the work and the logistics of movement and get the best inside information right there and then. This would help the development of new ideas. I see this method useful for understanding the environment of work area of the crew members.

- Field activity (mode 3)
  "Organizing and sharing observational data from different projects"

In this method, targeted users are taken into the field and are engaged to a selected activity in a specific situation in order to understand their behaviour. Afterwards they are interviewed about their experience.

This method can be used when designing a specific area for the crew members. Crew can be taken to the specific area, for example galley and asked to carry out their chores for a day, and an interview can be carried out afterwards. The galley could have a new layout design that needs to be verified that it actually works before utilizing it in the ship. As for passenger, it's once again hard to aske passengers to take part in this type of experiment.

- Value hypothesis (mode 5)
  "Generating a comprehensive and well-grounded set of concepts based on research insights"

In Value Hypothesis, the aim is to answer core questions to define the value for possible new offerings. This method set a define ground and understanding of what the concept needs to meet. The main questions that need to be answered (according to Geoffrey Moore's Value Proposition Statement) are the following:

1. Who are the target *users*?
2. What are their unmet or undeserved *needs*?
3. What are the new proposed *offerings*?
4. What are their *benefits* to the users?
5. Why will users choose these offerings over those of the *competition*?

As in shipbuilding industry there is multiple stakeholders that affect the ship design, it is very important that all stakeholders have common understanding of what is intended of the design developed. For example, by answering these questions concerning a certain area during a common meeting of all stakeholders in early stages of design, it would make it easier for all to develop further ideas and concepts when the common "rules" are the same for all. This method is very useful for shipyards as they have usually multiple customers and by defining the basics with each customer separately, it makes it easier for all stakeholders to work together towards a common goal.

- Synthesis workshop (mode 6)
  "Conduct short, intensive sessions to generate system solutions"

Synthesis workshop is a brainstorming session that has a clear structure. All the work done by the team during this is session is based on using defined design principles that guide the concept development.

This method is very useful once the design principles are developed. As usually most cases of workshops with external parties such as the brand and/or the shipowner, this type of method is useful in addition to just having a list of things that need to be covered. Once

there are the ground rules established as design principles, the work can be more efficient and moves faster as everyone understand what the aim and there is no time wasted.

2.4 Overview of other theories used in early phase of ship concept design

2.4.1 Traditional ship design spiral

In shipbuilding industry, the most common and almost always used design process is the ship design spiral, first introduced by Evans (1959) (Figure 8), which over time is better known in the form shown in Figure 9 (Vossen et al., 2013.)

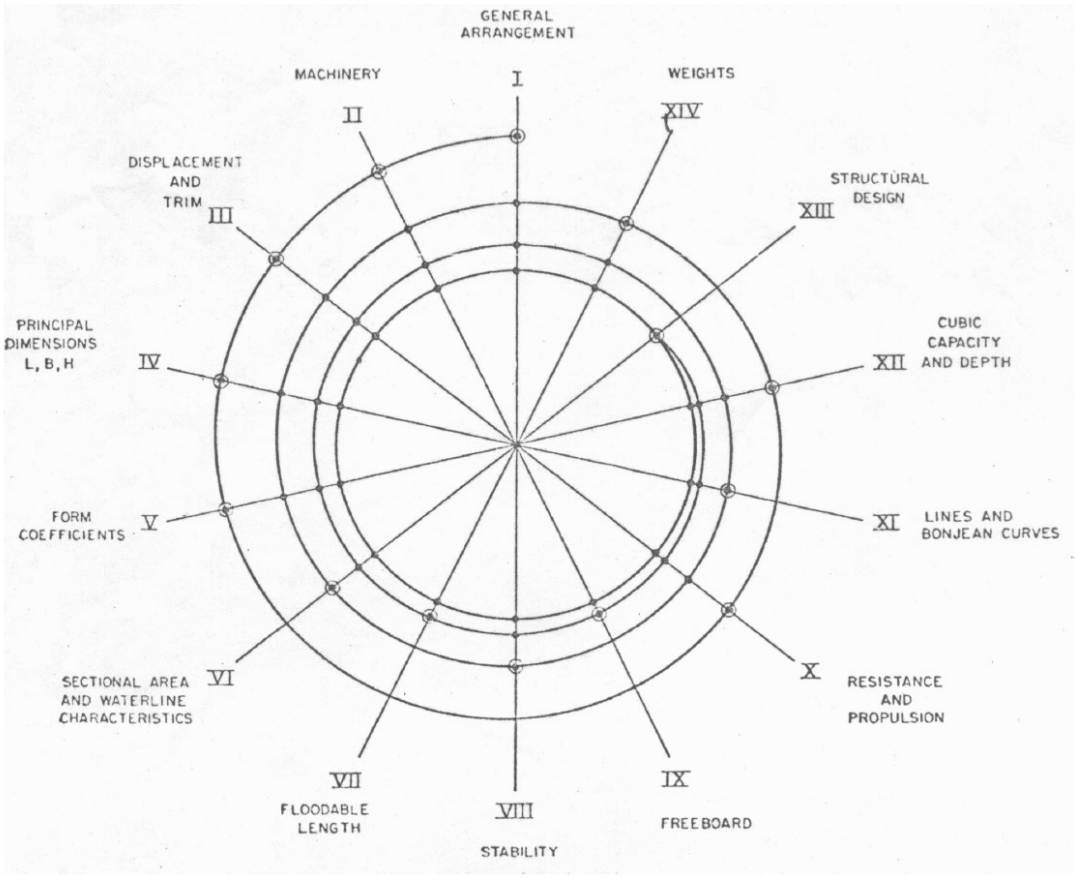

Figure 8. Ship design spiral according to Evans (1959).

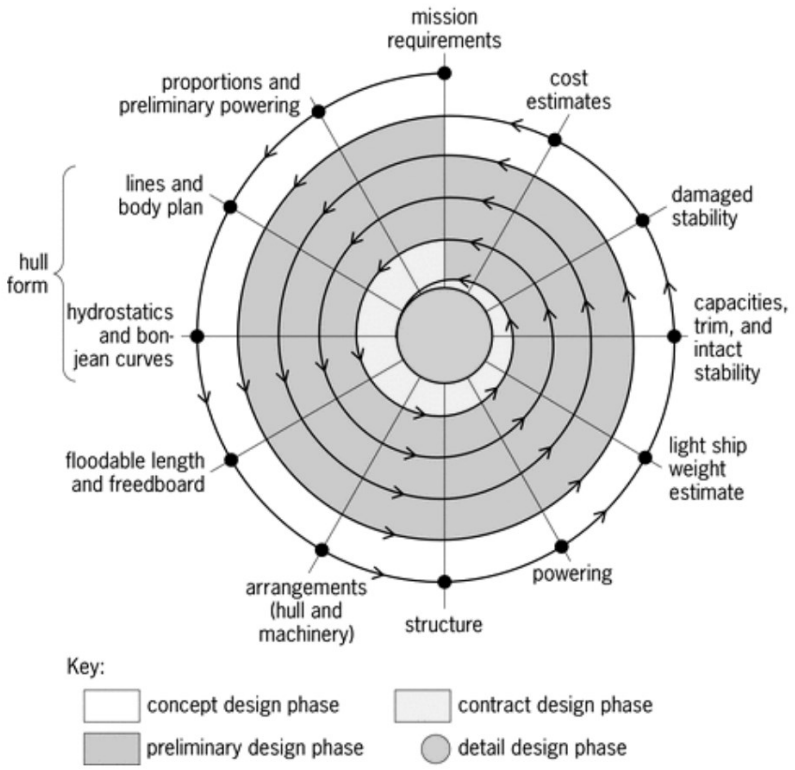

Figure 9. Newer version of ship design spiral (Vossen et al., 2013)

The spiral is thought to be a sequential process, and in an ideal situation the workflow would consist of studies of each design issue individually and the design would advance step by step. Each full round of the spiral iterates the design to become more accurate, and after each round the workloads increases as the amount of detail increases. A more modern approach to ship design is to consider all the different aspects of the spiral simultaneously. This is made possible by the usage of Computer Aided Engineering (CAE) as it makes it possible to do calculations and simulations faster and in larger quantities. (Papanikolaou *et al.*, 2011)

To understand why there is a need for a new, more modern design spiral, first it must be understood what in practice are the different stages of the spiral and how they differ from each other. As mentioned, the spiral consists of several rounds of design to produce the final design that is used to build a ship. The first iteration round is called the concept design, and the main aim of this phase is to develop a concept design that fits the requirements and gives an estimation of costs and risks. Based on this design, a mutual understanding between the owner and the shipyard is formed. (Eyres, 2007)

According to Pugh (1991), approximately 70 % of ship's lifecycle cost is defined during the concept design phase. This makes it easy to realise why it is important that already in as early stages as possible, there is as many easy and informative methods used to achieve wanted results, a cost-efficient ship that meets all the requirements. The main aim is that the wants and needs of the customer, the shipowner, are met by the shipyard. In case of cruise ships, the wants and needs in this specific case are the wants and needs of the end-user, the passenger. The earlier these are understood by both the shipowner and the shipyard, the faster and more efficient the development of the ship concept will be. The follow-

ing subchapters will introduce the latest models developed and used in the shipbuilding industry for concept development.

As can be noticed, both versions of the ship design spiral are very technical, done from purely engineering point of view, and thus missing the design point of view. The discussion concerning the work description of naval architects has been going on for long time (Andrews, 2018). Considering the design spiral and its stages, it is safe to say that the design spiral tends to describe the workload of a "hull engineer", mentioned by Andrews (2018). This makes one question where is the creative design part in the ship design spiral and are naval architects "hull engineers" or "designers".

2.4.2 Collaborative design process

The main idea behind collaborative design is the relationship between parties. Kvan (2000) defines collaboration relationship to be a full commitment to a common mission. When connecting this definition to design, it basically means that there is more than one party designing the product, which in the current era is the norm, as there is seldom anymore a complex product design fully by only one designer. This can be easily explained by the complexity of the different parts of the product that would require different specialists for their design. It must be noted that collaboration should not be confused with interaction, as interaction is defined as "formal, transactional communication link and is process related" (Kahn, 1996).

In an ideal collaborative design process, an outside observer is not able to distinguish or identify the contribution made by each participant to the design. This type of design is thought to be continuous close-coupled process (Figure 10), in which the participants work closely and intensely with each other, while understanding throughout the whole design process one another's reasoning and intentions. (Kvan, 2000)

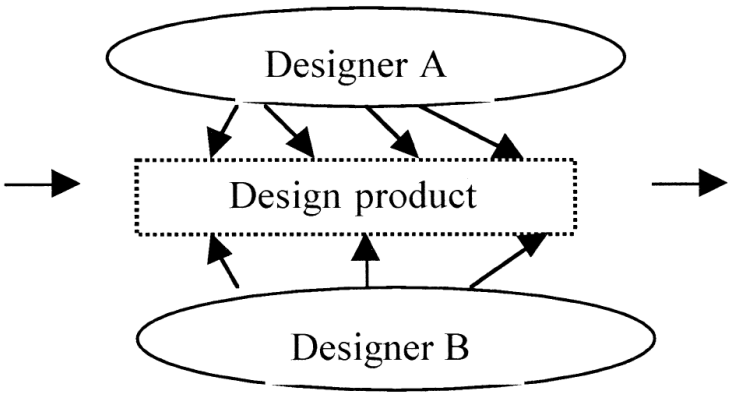

Figure 10. Continuous close-coupled design process (Kvan, 2000)

In practice, it can be noticed that this is not the case, as seldom all the designers are able to work together throughout the whole design process. A more practical form of collaborative design is formed called loosely coupled design process (Figure 11), in which the participants work individually on their domain of expertise and contribute their knowledge to the design process when needed. In this process, it is easier for an observer to recognize each step of the design and in addition, they are able to tell what happened in each one of them. (Kvan, 2000)

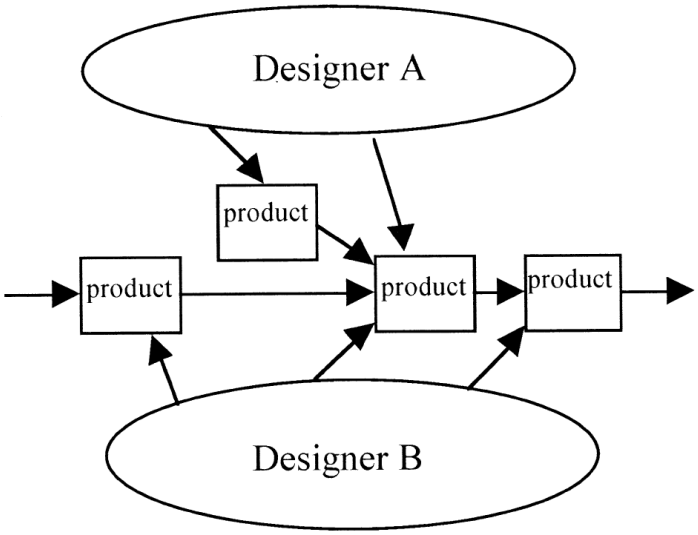

Figure 11. Loosely coupled design process (Kvan, 2000)

This method is widely used within design companies, and shipyards are no exception. Actually, it can be easy to connect the loosely coupled design process with the traditional ship design spiral, as each participant is an expert in their own field contributing at the correct moment their part of the design into the whole product design. In practice these participants are, for example, naval architects, theory engineers, fire safety engineers, and designers.

In addition of finding collaborative design process within the company, this approach is becoming more common between the companies. In case of designing ship concept, this could mean a collaborative design relationship between the shipowner and the shipyard. Each company provides different knowledge into the design process, such as the shipowner's knowledge of the passengers and their feedback, while shipyard provides the engineering expertise in building the ship.

2.4.3 The double spiral model

The double spiral model (Figure 12) is a combination of the traditional ship design spiral and another spiral, which main aim is to develop the ship's concept along side the technical development. According to Keiramo et al. (2018) the process of the spiral is carried out by several small multidisciplinary teams as a joint effort, where the aim is "doing more by smarter and more agile approach". The teams consist of technical specialists, architects and designers, futurists, suppliers, and other partners, and because of the large variety of different point of views and knowledge, the concept can evolve and develop at the same time as the technical part. When the teams of specialist work simultaneously in a transparent collaboration, this enables swift information change between architectural design and naval architectural design. Due to this the first-time-right principle and fit-for-purpose design is easier to achieve. This is very important, because the aim of this type of process is to reduce hours, redesign work, and cost.

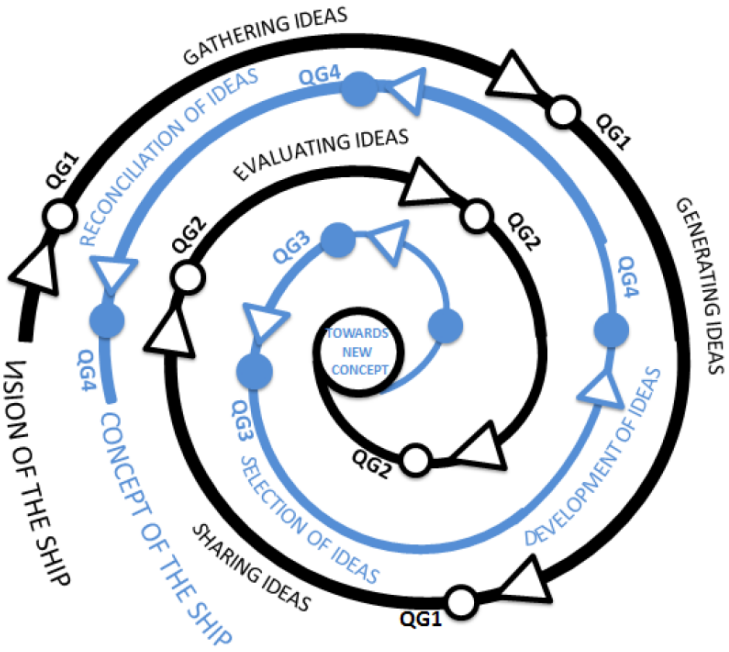

Figure 12. The double spiral ship design model (Keiramo et al., 2018)

The double spiral allows layering the work streams such as architectural and technical design, safety, financial, risk, quality and resource related management streams, unlike the traditional ship design spiral, which is linear "straight path" design process, where any changes cause the round of the spiral to restart. (Keiramo *et al.*, 2018)

The aim of a new design method is to ultimately ensure that there is no time and money waisted on multiple not needed design rounds that could be ignored if the design method right from the beginning is good. By involving multidisciplinary teams in a transparent collaboration and letting them work by using a layered process that is able to adjust to changes, a more profitable and better-quality concepts are achieved faster.

3 Suggestion of Developed process for early stages of ship concept design

Until now design thinking and naval architecture design models are seen as two separate processes. The aim of this chapter is two combine design thinking methods and the double spiral model to form a whole entity that can be used by the members of Meyer Sales and Design team. Not all methods are included, as the usage of them really depends on the need and the project in hand, but the purpose is to include such methods that I see necessary to be part of any ship concept design project. This chapter does not as such include the methods that are not related to a project, as those methods should be active all the time, but it mainly concentrates on the methods defined in Chapters 2.3.2 and 2.3.3.

First of all, before even starting to work on the different stages of the double spiral, it is important for all participants of the project to have a common understanding of the goals of the project. Thus, the method "intent statement" should be carried out as the first part of the project. This enables a mutual common understanding of what is wanted from this project to all participants and stakeholders. It is also important that during the design process, if the intent stamen changes, the change reaches every participant and stakeholder. By ensuring this, the possibility of misunderstanding decreases and everyone stays on the same page concerning the stage of the project.

Secondly, also before starting he actual spiral, if the project concept is new, and the ship built is a prototype or the shipowner is new to the shipyard, it is an important step for the shipyard to collect data if it is not provided. I recommend that even if data is provided by the ship owner or the ship brand that the shipyard does its own background data collection. By this it ensures it has a wide range of data available. The data can be collected by using such methods as different types of interviews, trend analysis, observations during field visits, including POEMS and five human factors as observations ways, popular media search. Some of these methods are external, but they provide rich data that can be further analysed and used in different ways and manners for even different projects.

After collecting data from a variety of sources, it is important to analyse it in a proper way, so that it is possible to form rich insights. Such analysis methods are trend matrix, initial opportunity map, observations to insights, principles to opportunities and Venn diagramming. The observations to insights method is very good method for observed data, as it forms from long qualitative data short and main to the point type of statements or insights. In addition to analysing methods, the analysis itself could be carried out during an analysis workshop. This would give a better structure to the workshop. If the data is provided by the ship owner or the ship brand, I think it would still be important to have a common analysis workshop, where the data provided is went through and maybe reanalysed or explained to so that it is sure that everyone understand it in the same way.

Another very important method, that becomes even more important when considering double spiral model, is team formation plan. To make the most efficient teams, but at the same time not keeping the teams as constant from project to another, using a team formation plan as a method during each project to forms the teams is important.

Now during the spiral design itself, when developing new ideas into concepts, the methods that can be used are for example analogous models, ERAF system diagramming, compelling experience map, etc. These are methods that increase understanding off the concept

developed by using them to analyse the possible scenarios of the concept. In addition to this type of methods, one also can use methods that compare different entities of the concept to one another or compare different concepts to one another. Such methods are asymmetric clustering matrix, semantic profile, and concept-generating matrix. It must be remembered that these are only example, and specially in this stage, any type of concept development or trial method can be used and reused depending on the stage of the design. When wanting more assurance on the solution chosen, solution storyboard could be a useful method to apply. Thus, at this stage it come down to the teams needs rather than anything else.

Finally, after each stage is conducted and/or a major decision is made that affect the rest of the design teams, a vision statement has to be done. This would first of all give an explanation of the concept developed to the rest of the team, and if in the future the concept is once again altered and this design specifically is not needed anymore, it is easier to save the design in a spreadsheet with a short vision statement alongside the concept. This makes it easier to reuse the concept as the vision behind it is explained. In addition to vision statement, innovation brief method would also be useful for explaining the concept to others briefly.

4 Evaluating the usability of some Design Thinking methods by applying them to ship design

The aim of this chapter is to evaluate the usability of some design thinking methods introduced in Chapter 2.3. To evaluate them, they were used to answer the following question: "What are the wants and needs of the passengers in the future and does the shipyard need a better understanding of them?"

4.1 Background

This chapter will provide some evaluation of the usage of some suggested methods mentioned in Chapter 2. I implemented some of the methods in the shipbuilding industry to find out what type of data is obtainable using the Design Thinking methods and is the data useful in the early phases of ship design. The main question I tried to answer is "What cruise ship passengers want in the future cruise ships and how can the designers from the shipyard form a better understanding of the passenger's needs."

To solve the problem, several different methods were used, and data was collected internally within the company, externally by visiting different sites and collecting observations (ferry cruise, a cruise harbour, design meeting with shipowner and ship brand), by carrying out interviews with all 4 main stakeholders of cruise ship industry (passenger, brand, ship owner, and shipyard), and by collecting data online from passenger reviews.

4.2 Passenger observations done during field visits

I visited two different fields to collect observations using mainly the POEMS method. The two different fields I visited where a ro-pax ferry in the Baltic sea and a cruise ship harbour in the Canary Islands both during 1st quarter of 2019.

It must be pointed out right from the beginning that the voyage on the ro-pax ferry was carried out from the experience base to learn how to collect sufficient data, and back at the time it was not thought to be one of the main data sources for this thesis. Nevertheless, the data collect is suitable for this analysis and the observation was carried out as efficiently and precisely as it would have been carried out in any other ship.

When collecting the data from the ro-pax ferry, I concentrated on the passengers, what were they doing, who they were interacting with and so on, thus there is little data on other people in the areas such as crew members and other personnel. Similarly, at the harbour, I concentrated only on the passengers when leaving and returning to the cruise ship, rather than what were they doing after that. The passengers were from a midsize, mid-priced cruise ship embarked and disembarked the ship between 11am and 1pm. The ship had arrived at the port at 8 am, thus the main disembarkation had already occurred when I arrived at the port.

As background information concerning the passenger segments analysed, in the ro-pax ferry, the passenger segment consisted of mainly over 55 years old passenger (based on observation percentage of passenger being over 55 years old was around 80%). There was just few families and few couples. As for the cruise ship at the harbour, the passengers were from all age groups, but the main connection was that the ship was aimed for the German market, thus the passengers were mainly German speaking.

The first main observation occurred right when boarding the ship. I boarded on to elevator and stairways lobby of a cabin deck. This lobby is connected to 6 cabin corridors each which had a sign above it stating the cabins that can be found along that specific corridor. Two of these corridors were closed due to still ongoing cabin cleaning. Due to that, some passengers were queueing in front of the glass door leading to those corridors. In the same lobby by the elevators there was on the wall a vertical deck plan of the whole ship and a horizontal deck plan of the current deck. It could be noticed that some of the passengers, mainly younger passengers or passengers travelling with young children, were observing the deck plan and then taking a corridor that was available. Following two groups (both families with young children) that took an available corridor, first group's cabin was along the chosen corridor, while the second group had their cabin along a corridor which main entrance from the lobby was closed at that moment. What this group noticed from the deck plan (Figure 13) was that all corridors (marked with yellow) on the same side are connected at the end forming a U-turn back along the corridor, which entrance was still closed. By doing this small observation from the deck plan, this group did not have to queue and wait until all the cabins of that corridor were cleaned, but they were able to enter their cabin right away. I walked that corridor until the main entrance and noticed that there was just one cleaner left, but the glass door towards the corridor was still closed and there were still passengers waiting.

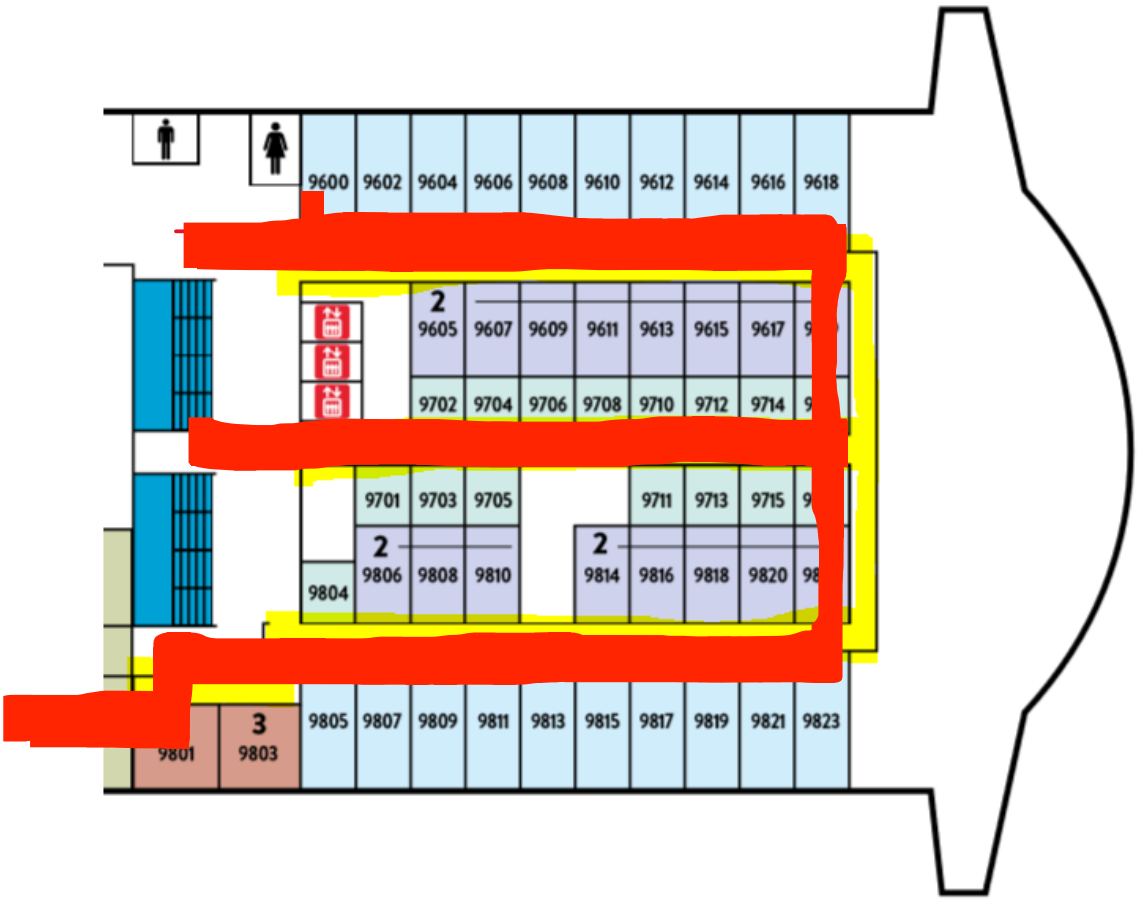

Figure 13. Example of cabin area in a ro-pax ferry (Viking Line n.d)

The second main observation occurred between the 10 pm and midnight, the ship was nearly empty except for three main spaces: "*Sweet & Salty Café*", "*Rockmore Bar*", and "*Club Vogue*" (Figure 14). Each space had specific passenger segment there, and it was easy to notice that the division was made by music. The "*Sweet & Salty Café*" did not play any music at all and as the children's play area was already closed, the space was in comparison with the rest of the space very quiet. The passengers occupying this space where from the older group segment, age over 70, sitting in couples or groups of three enjoying a cup of coffee or glass of beer and chatting. There were only 4 tables occupied in the whole space.

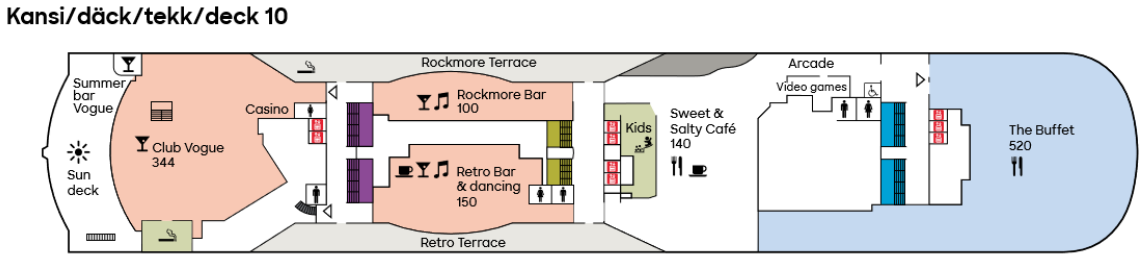

Figure 14. GA of the main public space deck (Viking Line n.d)

As can be noticed from the deck plan of deck 10, the "*Rockmore Bar*" and "*Club Vogue*" are right next to each other, but each space had very different passenger segment in them. The "*Rockmore Bar*" had the younger passenger segment (shown in Figure 15 as purple dots), passengers up to the age of about 55, and it was playing the latest radio hits, while in "*Club Vogue*" the music played was old Finnish dance music ("*lavatanssi*"), and the passengers in that space were clearly the older passenger, age over 55 (shown in Figure 15 as blue dots). The second floor of "*Club Vogue*" was closed, as well as the other public areas.

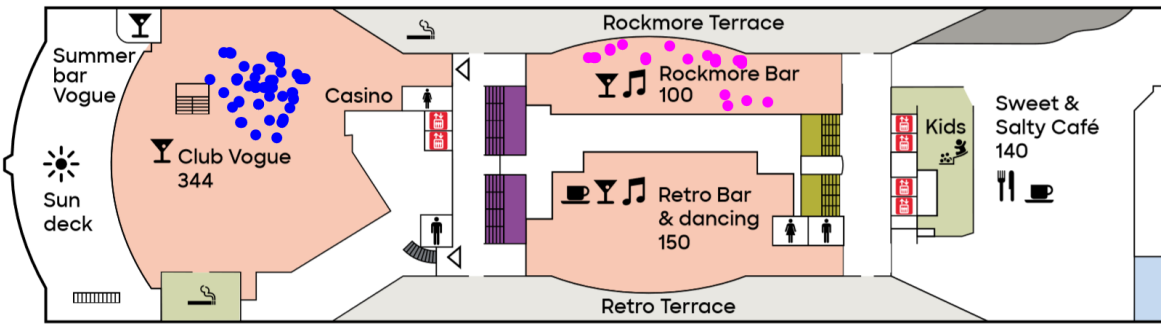

Figure 15. Passenger segment division (Viking Line n.d)

What was interesting in the previous observation was how easily the division was carried out by the cruise ship based on the passenger data the ship operator had (age, citizenship). Solely by the music, the spaces were transferred into different separate areas dedicated to certain passenger segment, concentrating on their wants and needs. Both spaces had their own bars and both bars provided the same beverages, but because the number of passengers preferring old Finnish dance music was larger than the number of passengers preferring newer radio music, the music was divided accordingly. "*Club Vogue*" had around 100 passengers during the observation period, while "*Rockmore Bar*" had only 13 passengers. "*Club Vogue*" had a live band playing music and there was at peaks around 40 passengers

dancing, while in "*Rockmore Bar*" there was a DJ playing for 1 hour and the rest of the time the music came from an automatic music list, but at no point was there any dancing passengers. The passengers in both spaces were chatting and drinking throughout the whole observation period.

The next main observation occurred during lunch time in the lobby in front of "*The Buffet*". Just by the entrance of "*The Buffet*" there is a sign stating that lunch servings are at 12:00 pm and 12:15 pm. To enter "*The Buffet*", one must pay either in advance and thus reserve a table get a ticket with the reserved table number or pay by the door and get an empty table. The lobby itself does not have any seats for waiting and it can be seen from the deck plan of deck 10 that the lobby is not designed to be a waiting area, but just to be a lobby connecting other areas to each other. From 11:45 am onwards, passengers started waiting and queueing for "*The Buffet*". Some passengers came from the seating areas of the "*Sweet & Salty Café*" and "*Arcade*" right next to the lobby to queue, even though they could have waited in their sitting places, and just before the first serving there was around 60 passengers queuing. Around 90% of the people who queued had a reservation made before hand, and just walked into the restaurant after showing their ticket. Just after midday and after the first serving was done, a second queue was formed in the lobby, also consisting of about 60 passengers, but this time nearly all of them bought their lunch ticket at the door. The information sign did not state that the first serving at 12:00 pm would be for pre-reserved passengers and the second serving at 12:15 pm would be for passengers buying their lunch ticket at the door, but based on the actions of the passengers, one would think that would have been the case.

I, myself, did not attend the lunch serving in "*The Buffet*", but I attended the dinner serving at 2:45 pm. Dinner serving was not as busy at the lunch serving as the whole dinner time there was around only 60 passengers dining, while during lunch it was around 150 passengers. The most interesting observation I made during in "*The Buffet*" when I attended was how the passengers continued the queuing inside the restaurant also. The buffet is "W"-shaped, so that both sides have the same food (Figure 16). The outside of the "W" had the salads and starters and the inside of the "W" had the main dishes. There was 2 separate points for beverages, bread, and dessert. The passengers first entered the restaurant and looked for their table. Then nearly all went to queue for the starters and either returned to their seat and left their plate and went then to the bread and beverages point or went to the bread and beverage points with their plates. Out of the passenger attending this serving, only 7 first went to either beverage or bread point before getting their starters. Rest of the passengers were happy queuing for their food, even though the food points were attended by the stuff throughout the serving. All the different points were clearly signed, and all the points were close to each other, thus the behaviour of the passengers was not due to bad designing, but rather due to cultural tendencies. The passengers were happy queuing and going through the points in the "correct" order rather than the faster order. In addition, it could be noticed that people from the same seating tended to queue together and chat during the queuing rather than wait in their seat or move alone. One of the seven passengers, who took the food in different order than most, was a father of 2 children and a baby travelling with his wife. He went with the children to the children's food point, came back with them, then went and bought bread and drinks for the whole family, before he went and got food for himself, after which he took the baby from his wife, and she went to get food for herself. In this case, it was obvious that this family chose the serving with less people at-

tending, and they chose the most efficient way to collect the food as they had children with them.

Figure 16. "The Buffet" (TRAVEL AGENCY INGVES & SVANBÄCK n.d.)

The main observation from the harbour was concerning how the passengers embarked and disembarked the ship. When I arrived, there was passengers disembarking and just about to start their tour in the city, while there was on the other passengers who already were already boarding the ship back. The passengers carried an identity card that they had to show to the security by the entrance of the dock and just before boarding the ship. This is as far as security check is seen outside of this specific ship. The passengers have the freedom of leaving and boarding the ship whenever it is suitable for them, while she is anchored in the harbour. Due to this freedom, for the 2 hours I was observing by the port, there was not at any time a queue either way. Also, during those 2 hours, I did not see an excursion carried out by the cruise ship starting, but rather that the passengers where leaving to their own excursions. There is a possibility that the excursion carried out by the cruise ship started before I arrived or is scheduled to after I left.

Based on the observations done on the ro-pax ferry, it can be concluded that even on a small ferry cruise that is not fully booked, there is certain behavioural patterns done by the passengers that can be observed and analysed. In addition, it can be noticed that the ship owners also utilize different methods to meet the needs of the passengers depending on the situation at hand, as the example mentioned of the music. Different spaces were easily divided and distinguished by changing the music played. Understanding the behaviour of the passenger when going to "*The Buffet*", made the crew work more efficiently and made it so that there was no terrible long queue formed in the food points as the passengers came slowly in. These types of observations and knowledge of how the crew and passenger in-

teract on board is useful in the designing face, as it would make it easier to notice spaces that would not work or are missing, for example based on the above observations, the lobby in front of the restaurant is essential, because even though passengers have booked their tables, they still want to queue and make sure they won't miss their serving. At the same time, it is essential that the lobby is a lobby, open space, rather than just a corridor connecting to the restaurant as the queue would have formed in the corridor and blocked the rest of passenger flow. At the same time, it must be pointed out that this specific lobby cannot have any extra seats or chairs as it is the lobby connected directly to the fire safe stairway, and thus based on The International Convention for the Safety of Life at Sea (SOLAS), any fire hazard material must not be placed this type of area. I believe that by observing larger cruise ships with more passengers on board and for a longer period, a better understanding of passengers' behavioural patterns is formed and thus it would be easier to understand what is actually wanted by the passenger to be found on board a ship.

Based on the information obtained from the ship's website and the observation done by the port, I noticed that the passengers looked relaxed from the sense that they did not have a tight schedule to follow. They were able to decide when to leave the ship and when to return according to what they wanted to do.

The main points of the observations done from both field visits and their conclusions are the shown in Table 3.

Table 3. Main observations and their conclusions

Observation no.	Who and where?	Observation	Conclusion
1	Passengers at a ro-pax ferry	Passengers were happy queuing and waiting for the cabins to be cleaned rather than finding another route. It could be seen that most passengers who weren't in a hurry were happy waiting, while for example passengers with younger kids searched for an alternative route and didn't wait.	Different passengers act differently based on their needs, so by taking all those different needs into account in early phases make a difference.
2	Passengers at a ro-pax ferry	Different type of music in different bars determined how the passengers were divided into the spaces	With such an easy change, the passengers were divided into 2 groups and were directed according to where the crew wished them to be
3	Passengers at a ro-pax ferry	Passengers queued for the food in a certain order, even though there were no queues for bread and beverages points. People with no children were happy queuing, while parents tried to find the shortest alternative	Different passengers act differently based on their needs, so by taking all those different needs into account in early phases make a difference.
4	Passengers leaving and boarding a cruise ship	The passengers have the freedom of leaving and boarding the ship whenever it is suitable for them	The passengers looked relaxed from the sense that they did not have a tight schedule to follow

It can be concluded from all observations above that human behaviour is predictable. When the passengers are not stressed out or in a hurry, they are more than happy to queue and wait and spend their time chatting. This is supported by both observations done on the ro-pax ferry and at the harbour. Connecting this conclusion to ship concept design, considering that passengers are willing to queue and wait for their turn, areas where queuing can occur need to have enough space for it. This information can be applied specially to new spaces that have not been built before. When developing the concept and using for example ERAF system diagram or user journey map, the queuing period need to be taken into account and thus an area for possible waiting need to be added when and where needed.

4.3 Interview methods

I carried out four different types of interviews. Each interview type was tried with one of the main stakeholders of the cruise ship industry, i.e. the passenger, the shipyard designer, the ship brand, and the ship owner. The interview methods were chosen to achieve the best possible results in regard to time and availability.

The method chosen for passengers' interviews was open ended questions. I had a list of questions (see Appendix 1), which were aimed to give answers that were not a single word or yes/no answers. In addition, I tried to ask for further information based on the answers they gave me. It must be noticed that the passengers were leaving from the harbour area for their excursion in the city, thus they did not want to spend a lot of time on the interviews. Due to that the interviews had to be short and efficient. Three interviews were conducted in the harbour area.

The shipyard designer interview was carried out as an open discussion. There was no list of questions, but the questions emerged during the discussion itself. The topic of the discussion was "does the shipyard need more knowledge on the future wants and needs of the passengers". As we had a lot of time to carry out the interview, the topic was widely covered, and the point of view of the shipyard become clearer concerning the topic.

The interview with the ship owner was similar to the interview with the shipyard designer, as this one also was closer to a discussion rather than an interview. The main difference was that there were leading questions (see Appendix 2) that guided the discussion and lead for more questions. This interview had also a lot of time to be carried out, thus the topic was widely covered.

As for the ship brand interview, it was the only interview that was not carried out face to face with the interviewee, but it was carried out via emails. Thus, the interview had a structure of question and answer, and due to that did not provide the possibility of having further detailed discussion based on the answered received. The whole interview, the questions and answers are attached in Appendix 3.

As can be noticed, each stakeholder gave different answer to the same question. The passengers themselves were not able to point out development points, but then on the other hand all the points that were made concerning the cruise were emotional based points that could not be approach through ship design.

Shipyard designer gave examples of how observations on board has increased the knowledge of the shipyard. The example given by the designer concerned an inclination on one of the decks of a cruise ship. The height difference is due to different type of spaces on both ends of the ship, and height of each type of space is defined in SOLAS. Thus, while meeting the minimum regulations it caused an inclination on one of the decks. During the design, the shipyard assumed that this would be thought as a false by the passengers, but when getting on board and interviewing the passenger, the shipyard found out that the passengers thought of the inclinations as a design feature, i.e. it received positive feedback, rather than what was assumed to be negative feedback.

The ship owner belies in the feedback of the passengers, but they do not share it as it is with the shipyard. They do their own analysis on it and they share only the results that they see fit. This in a way is fine, but at the same time the shipyard does not get some of the valuable input as data. There is always some information lost.

As for the ship brand, it has a strong marketing sense and believes that the passengers are happy because of what the brand provides them, and that the passengers themselves do not know what they want in the future. The brand has a strong sense of knowing their passengers now, and what has worked until now will work in the future, but as to include the pas-

sengers more as source of inspiration for new concepts is not thought be a useful idea/method.

Table 4 presents the main points of all 4 types of interviews.

Table 4. Main points of the interviews and their conclusions

Who	Type of interview	Main points of the interviews	Conclusion
Cruise ship passenger	Open ended questions	None of the interviewed passengers were able to come up with suggestion of improvements. The passengers were satisfied with the ship they are travelling with. A repeated positive point for this brand is the informality and easiness of the ship. Also, the entertainment received positive feedback	The points the passenger made were all concerning emotional based feedback. The feedback as such did not concern the design of the ship, but on the activities provided and the atmosphere.
Shipyard designer	Open discussion, no leading questions	Shipyard has some experience with interviewing the passengers and observing them on board and based on those experiences the shipyards knowledge has increased.	The shipyard believes that it is beneficial for them and for the whole project to know the passengers themselves and not only via the information provided to them.
Ship owner	Open discussion with leading questions	Ship owner collect the data from the passenger through different channels and methods, analyse them and shares the results	The ship owner believes the data they've collected and the way they analyse it is sufficient enough to understand what the passengers wants in the future. Whatever the shipyard needs they provide them, i.e. the shipyard doesn't need more information
Ship brand	Email interview	The brand knows best how it needs to develop based on its image and what it is known for. The brand is the main developer of the new concepts. The passengers themselves do not know what they want in the future.	The brand believes because it knows their passengers the best, and what already works doesn't need to be changed, they alone are the best providers for information and ideas.

As a conclusion, based on the data received from the interviews, the shipyard designer believes more data collected directly from the field (the cruise ship) and interviews would increase the shipyards knowledge on the future wants and needs of the passengers. This is supported by the ship owner as they also do wide range of data collection that they use for their own analysis. This type of data is also needed by the shipyard. The only exception to this belief is the ship brand, as they belive that only the brand knows what the passengers wants.

4.4 Data from online reviews

In addition to interviews with the passengers, I collected online reviews written by passengers. The reviews were collected from Tripadvisor.com and CruiseCritic.co.uk. The first constraint for choosing a review as source of information is that it had some type of complaint or suggestion concerning a space or a structure. This constraint was chosen, because

based on these types of feedback the designer is able to improve the structural space design of a ship in early phases of ship design.

At first, I read all the reviews about a ship trying to find a review that met the first constraint. After reading about 150 reviews, I realised that on a scale of 1 to 5 stars given y the reviewer, the reviews that had 4 or 5 stars were all positive, and they concentrated on how nice the cruise was, how beautiful the ship is (without pointing put specific aspect though), and how helpful the crew was. In the end of the review they would nearly always recommend the cruise. On the other hand, the reviews that had 3 stars or less usually contained some complaints. Most of the complaints were about the crew or the food or the excursions provided by the cruise ship, but some of them were also about spaces and structures. This type of reviews was easier to find in reviews that had 3 or less stars and based on that I added another constraint on my search and how I chose the review. I started reading reviews that had only 3 stars or less and that had a complaint or a suggestion concerning design of the space or structure of the ship.

Table 5 presents the main points of the reviews picked concerning design of the space or structure of the ship.

Table 5. The main points of the passengers' online reviews

Passengers' online reviews	The main point of the review
Pvbgirl – Cruise-Critics: Silver Muse, Baltic sea	The main negative has been discussed over and over, that being the lack of a main dining room.
john m. reed - CruiseCritics: Silver Muse, Baltic Sea	No computer room
Thomas B - TripAdvisor: Jewel of the Seas, United States	The glass-roof covered solarium was more a cold room most of the time
Hilrecommends – TripAdvisor: Azura, Caribbean	The ship is very large and there are thousands on board. This causes problems to find somewhere to lie out when you have an at sea day. There were no quiet places on deck.
Cath W - TripAdvisor: Britannia P&O, Mediterranean	If you sit on the very top deck (nearly the funnels) you get covered in black soot but because nobody goes round taking towels of beds, you can not find two together after 9am, on sea days. Another thing that lets the ship down is, it's the biggest ship we've been on but it doesn't have a walk round deck and there seems to be the same footprint that the Ventura has but Ventura holds 3,192 passengers and Britannia holds 3,647
sbrabbs - TripAdvisor: Norwegian Epic, Eastern Caribbean	With my father using a walker, it was espacially hard to navigate many of the public areas, and even getting in/out of out stateroom was challenging as he couldn't fit the walker through the doorway especially well. Deck 15, home of the pools and buffer, was ridiculously crowded and using the pools/finding a chair/walking leisurely about the deck was just about impossible.

Spysmum	On exploration we found to our surprise that there was no traditional, walk around promenade deck, but it was possible to walk right round the highest deck. Unfortunately access to that pleasant spot would have been difficult for many, as it involved climbing 2 outside stairways. The top deck had comfortable lounge chairs with soft cushions .
Flamenco98 - CruiseCritic: Saga Pearl II, Southern Caribbean	The main sunbathing deck was under the funnel which sometimes beiched out filthy black smoke, depositing soot particles on the sunbed cushions below.
Kenneth b – TripAdvisor: Celebrity Edge, Caribbean	Infinite veranda. This is their version of a new balcony that is enclosed. It has retractable upper window and a full blind instead of a curtain. Our feelings were mixed on the concept. The room is narrower and the balcony is smaller (you literally have to move the chairs to close the doors).
David K - TripAdvisor: Celebrity Edge, Caribbean	No room to congregate with friends, no library or game room. Most chairs aren't seat worthy. Dead ends in many places. Surprised it isn't a safety hazard.
tom_m_65_65_65 - TripAdvisor: Celebrity Edge, Caribbean	Infinite balcony Stateroom: The room was nice except the "balcony" was useless. This should have been called an ocean view with opening window. We liked the extra space but was not a balcony. When the window was open, the room instantly filled with humidity and the air conditioning turned off. There were times in port when the window would not open. When sleeping at night, other cabins close by would open or close the windows made so much noise it would wake you up. The fake doors to the balcony would barely close, get in the way and did nothing to stop the room overheating. The pool are:The design of the hot tubs were ridiculous. These were located in full sun two stories up from the pool deck. In order to get to these, you had to walk up two flights of stairs or go to the forward elevators. Once of the two sets of stairs was through the smoking area. Retreat Area:One of the most annoying things about the ship was the Retreat area. All front views out of the ship were cut off unless you were in a suite. You cannot take the forward elevators up to deck 15 or 16. You must get off at 14 and walk up the stairs. On other Celebrity ships, this area is a lounge open to all. Ironically, we spoke to many Suite guests who complained of no shade in the retreat area as well. I get the need for additional revenue but to cut off over half of decks 15 and 16 is a bit much.
Cruisestitcher - TripAdvisor: Celebrity Edge, Caribbean	Don't believe the hype -- infinite verandah is just a room with a window that opens -- not a verandah. The verandah-less verandahs are only the tip of the iceberg. The verandah rooms front and back have miniscule balconies, but at least they are real, not imaginary like the "infinite verandahs". The ship has many other deficiencies. Not enough inside bars, no sky lounge, no place to play cards, no library, no way to access pools if you need steps rather than a ladder, a handicapped elevator that is too small for a scooter to use
LessWork M - TripAdvisor: Celebrity Edge, Caribbean	The ship is confusing and no "wow" moments, all compartmentalized spaces. The ship is confusing and no "wow" moments, all compartmentalized spaces. Too many ways to get lost

RCM - TripAdvisor: Celebrity Reflection, Caribbean	We have done a number of cruises on a few different lines. The two latest were on Celebrity Reflection and Equinox, both in the Solstice class. These have the most splendid public areas, but quite the smallest and least well appointed cabins we have ever seen. Even in Concierge and Aqua class the cabins were only 8 feet 5and a half inches wide, (2.53m), long and narrow, and with so little storage that we had to live out of our luggage. I weigh only 72 kg/160 lbs but I had to squeeze sideways around the end of the bed. Older smaller ships only for us on this line, thankyou

As can be noticed from the reviews, there are passengers who can be very precise as to what needs improving and what does not work. It is this type of feedback that all stakeholders want and need more. And by knowing that the passengers know how to give constructive criticism, it is now down to the stakeholders to know how to get this type of feedback even face to face, because then more and better understanding is achieved. This is where the design thinking methods would be extremely useful.

5 Conclusion

As Chapter2 provided, the design thinking is a process that can be approached and used differently depending on the user and need, There are multiple processes and methods, but in the end they all produce the same results. Design thinking can be used to try and solve any type of problem, the main aim of the whole approach is to actually understand what the true problem is and define it properly. It is only after that stage when ideas are even considered.

Combining design thinking process and method with naval architecture design models requires an understanding of both approaches. A working experience in a ship design team gave me the hand-on knowledge and experience needed to notice that there is a need for new methods at work. In addition, it gave me the knowledge to be able to divide the methods. When considering this thesis, there is three major points that are discussed in this work, which rely on hand-on knowledge and work experience.

First, based on personal work experience and observation of other projects carried out by Meyer Sales and Design team, the design thinking methods where chosen to give more value and at the same time ease the workload concerning concept development. For each chosen method, an example of how the method can be applied in early phase of ship concept design is given with a short description of the method. In addition to this, the methods are also divided into three groups based on how they are thought to be used. The groups are not project related internally used methods, project related internally used methods, and project related externally used method. The division is chosen to be as this because each project is different. There are projects that are done within the company, sometimes even alone, and for those situations there needs to be methods to help the designer. The totally opposite situations are when the project is big and requires internal and external data and work force. In this type of situations external methods are useful. The data collected and analysed by using external methods give high input into the project. In addition to different project related methods, there is situations that there just needs to be a systematic method to keep up with all the data, inspirations, and ideas there is. That when non-project related methods are needed.

Second, understanding the current design process used by the Meyer Sales and Design team during early phase of ship concept development with addition of literature overview made the connection between the design thinking methods chosen and the process mentioned more valuable. To be able to connect and explain how and when the methods can and should be used, gave a concreate example of a possible design thinking – ship spiral – process.

Third, the evaluation of usability of the chosen methods showed that the methods do provide different type of data that can be valuable. The methods chosen in this thesis were to answer the question “What are the wants and needs of the passengers in the future and does the shipyard need a better understanding of them?” I belive that this question was answered and covered from all the main stakeholders point of views and thus a wide understanding of the question is achieved. Even though none of the stakeholders gave a similar answer to the main question, based on the other data collected using other methods, it is safe to say that the shipyard would benefit from having a better understanding of the future wants and needs of the passengers and actually take more into account the feedback provided by them in design phase.

The next step on the mentioned thee points to improve them would be a new division on the design thinking methods for example into individually and group usage. This division is also important to have, as earlier mentioned there is sometimes projects that must be carried out alone, thus workshop type of method would not be useful. The next step for he suggested process would be applying in it into a new project and see which methods are useful and which are less useful. This would be an iteration stage that would develop the process further into more useful form, and hopefully someday this process would be a common way of working.

So overall, in conclusion some design thinking method provide valuable data and an efficient way of working that it is important to add those methods to everyday working environment. The old ship design spiral does not meet all the requirements anymore and thus a new better version with the design method is better. Based on the data collected, the method used in this thesis provided information that can be used more. It is important that the shipyard has some type of data from the passengers, let it be interviews, observations, or online reviews, because there is always the possibility that not all information is provided by the ship owner or the ship brand, or that they haven't noticed something.

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List of appendices

Attached are the questions asked for the passengers. The aim of the questions is that they are short and straight to the point but provide answers that are not single words or yes/no answers.

1. Have you taken a cruise trip before or is this your first time?
2. If this is not your first time, on which ship(s) you have been on before?
3. What you think about this cruise and the ship?
4. Would you like to travel again on a cruise ship? If yes to where?
5. Do you mind travelling on a English speaking ship?
6. With whom are you travelling?
7. Do you travel a lot? If yes, then by what means?
8. What is the best on this ship?
9. Do you have any suggestions how to improve this ship? Or if there is something missing?

Attached are the leading questions used in the shipowner interview.

1. What are the future trends in the cruise ship market and based on what?
2. How Royal Caribbean takes the future changes in the market into account when developing a new ship concept?
3. How much margin of change is kept during design phase?
4. How does Royal Caribbean take into account the passengers and their wants and needs in new concept development?
5. How are information and data collected from passengers? How about potential passengers who haven't yet been on cruises?
6. How are information and data forwarded to the design company/shipyard?
7. How much affect and saying does the design company have on the ship concept?
8. Can you give me a concrete example of implementing an idea that is originally from passengers?
9. How does Royal Caribbean know what are the wants and needs of the passengers in the future?
10. How is the market segment taken into account during the concept design?

I met during a Silversea project workshop with Mrs. Barbara Muckermann, Chief Marketing Officer of Silversea Cruises. I was suppose to interview her concerning the passengers' wants and needs in the future cruise ships and how that knowledge should be used by the shipyard, but unfortunately due to her busy schedule, the interview was not able to be carried out there and then, but was done via email later on. The email interview is attached below:

1. In the very early stages of developing a ship concept, what is considered and noticed from the architect point of view?

- From the Brand point of view the main thing is to understand which is the role of this new ship in the portfolio of the cruise line: who are the guests, which will be the destinations and which will be the innovations that this ship will bring forward, all of this coherent with the brand positioning of course

2. What inspires the concept?

- The brand always :)

3. How trend analyses, such as CLIA trend analysis, are considered?

- In general, we compile research from a large number of sources, CLIA is one but also the industry reports and in general demographic and wealth reports

4. What part the passengers play in the design phase?

- Not too much.. as Henry Ford said: if you would have asked my first customers what was the transportation of the future they would have said "faster horses""… in general guests are great to give feedback in front of something existing but it is very difficult to get them to give judgement while imagining a future they have not seen first

5. Is the brand ever in direct discussion with the passengers concerning feedback? If yes, then how their point of views and ideas are taken into account?

- All the time, we do individual interviews, focus groups, quantitative research and co-design sessions for web development

6. How often do you contact with the customers?

- Very often, they write to us all the time and we read the comment forms at the end of each cruise :)

7. How the wants and needs of the passengers are known?

- They are very vocal :) you cannot miss these

8. In the meeting discussion the brand identity was the main decision maker. What about future passengers and the possibility that they want a newer brand identity?

- We do run research all the time also on prospective customers. When we evolved our brand positioning, we tested this with the prospects as well as with the existing customers

9. It was mentioned that the venue needs to have customer experience to make sense. How you define customer experience?

- The first rule of good design is really to have a purpose, the biggest mistake we can do for a brand in our segment is building a feature for the sake of design forgetting that design exists to be customer centric and give the best experience to the guests

10. What about future customers? How do you think you could attract them and understand their interest?

- We do run research on them all the time and also, we follow consumer trends using companies like Stylus or Future Brands

11. How you come up with the new ideas (e.g. colosseum)

- Any good idea comes out from a customer insight

12. Who are your current passengers and who are your future passengers? How these two groups differ?

- Today the demographic of our customers is: 20% silent, 60% boomers, 20% X Gen (approx.) in the next 10 years we will have mostly boomers and X Gens and the silent will have stopped cruising for old age

13. How do you see the passengers segment develop and how you intend to make them regular customers?

- Boomers are approaching retirement and they are the heavy cruisers of tomorrow, we know we need to get them to "repeat" a minimum of 21 days, after 21 days they typically stick with the brand of choice we are thus concentrating a lot of activities on the repeat purchase

14. What is more important brand identity or customer feedback? How you make both work together?

- Brand identity and customer feedback always have to go hand in hand, the trick is to understand when you are faced with one opinion which is not statistically sound, and you need to be disciplined and never take important decisions on a set of one

15. Based on your experience with the shipyard, do you believe that the shipyard needs more knowledge on the passengers and their wants and needs?

- Not necessarily, I think Meyer in particular is very good at listening :) and everyone has its role in building great ships