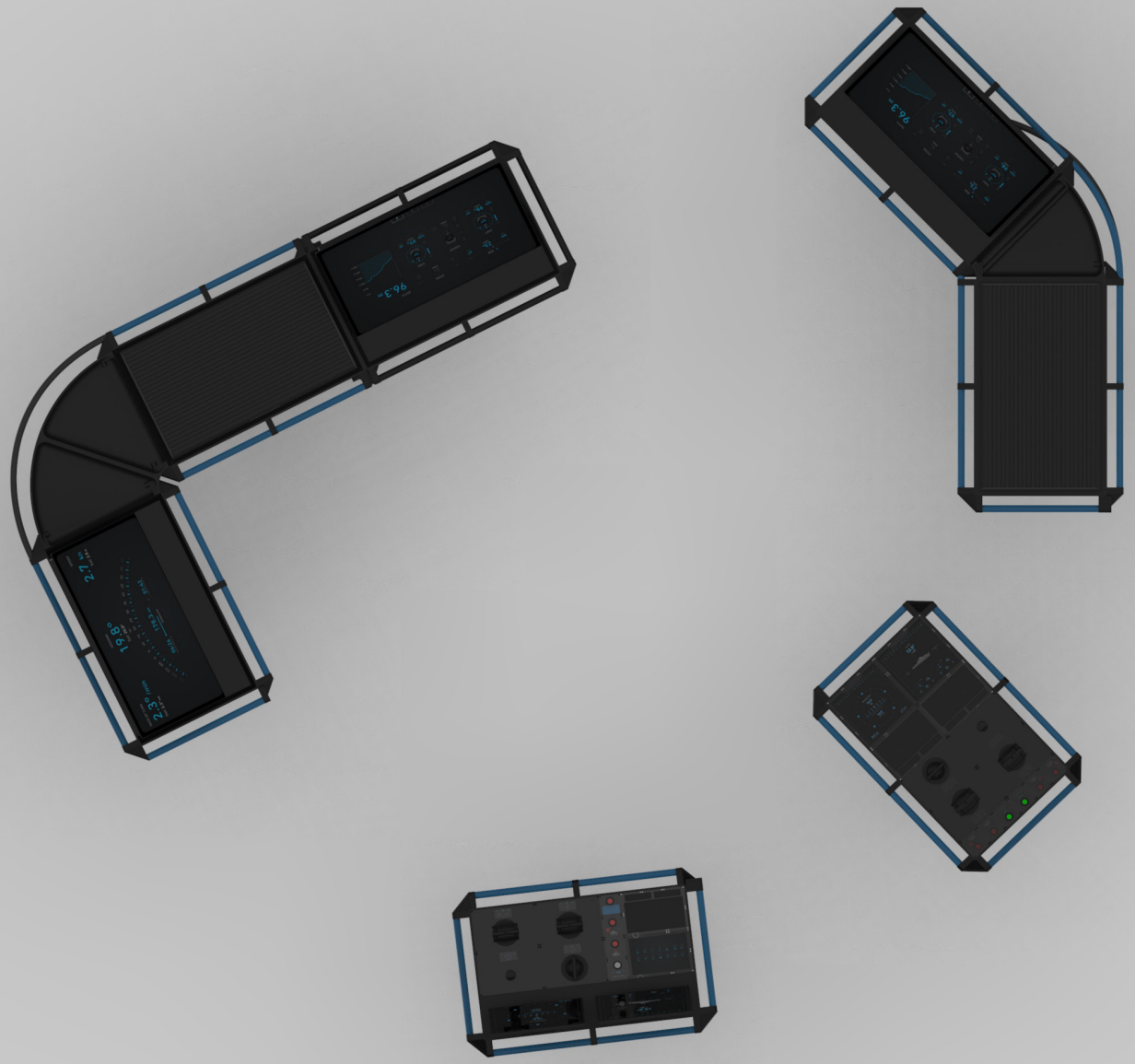


BOREALIS

The arctic modular bridge

By Lasse Thomasgård

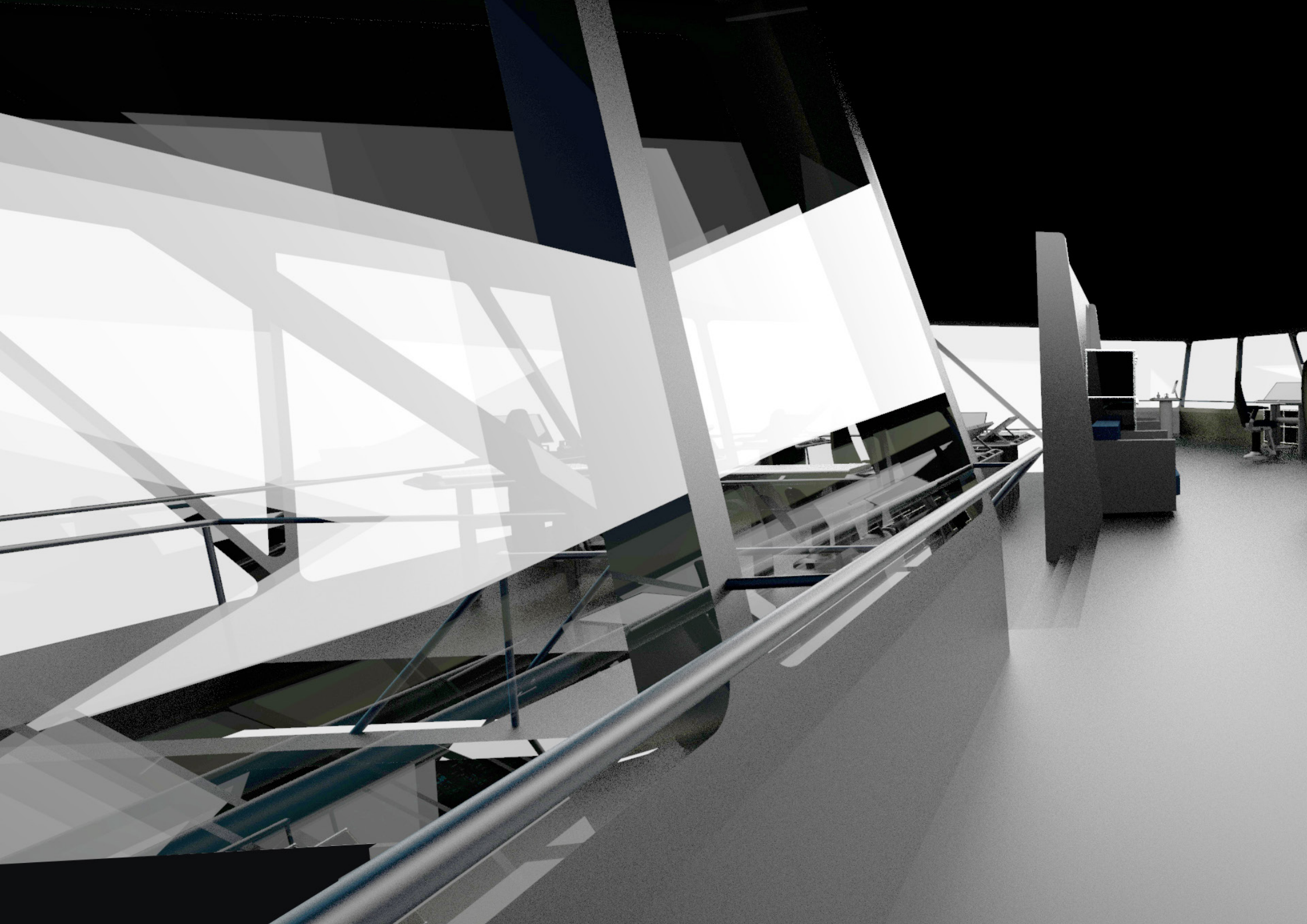
Abstract

This report is the direct result of my industrial design diploma at the Oslo School of Architecture and Design. In cooperation with VARD, a future concept for a modular ship bridge system was developed.

The goal for this project was to explore the future of ship bridge design and challenge the way bridge consoles are being designed and used today.

The result is a concept of a new modular bridge console with a special focus on the Norwegian coast guard vessels.

I hope that the result will trigger new ideas for my collaboration partner.




19.8°
MAGNETIC
19.8°
5 10 15 20 25 30 35
19.8°
GYRO 2
19.8° min
RATE OF TURN
-1.1° min
DEVIATION

Content

Development 32

Delivery 94

Foto: Tom A. Østrem

Foto: Marius Villanger

summary

Context and goal

The goal for the project was to explore the future of the ship bridge and the challenge the way the maritime industry designs and use them. The result is a concept of a new ship bridge intented for the Norwegian coast guard vessels. The project explores design opportunities to increase efficiency, safety and comfort for the people working on the bridge.

I hope that the result will trigger new ideas for our collaboration partner, and create discussions within the maritime field of Norway.

Process and method

In such a complex and non relatable context like the maritime sector I quickly understood the need for getting access to both the industry and ships. To get this access I wanted to have a partner who I could discuss concepts with and hopefully visit and experience how they work with design and make innovative products.

My method has been to experience as much as possible in the right context during this semester, and because this approach I haven`t had as much time for iterating and sketching as I normally would have during a project.

Result

Borealis is a modular bridge console designed to fit any kind of ship. The intention is to create cleaner and safer ship bridge where change and update is easy. The modular system makes it easy to switch around equipment which can be helpful if equipment is outdated or damaged. Modular components means that it`s easier to experiment and find better layouts and solutions.

Result

The arctic poles are melting and a rise in traffic has already begun. The Norwegian coast guard has a duty watching over the arctic waters, which means they will have more to watch over in the future. Because of this the Norwegian government has ordered new coast guard vessels which are to be finished in 2022.

The result of my diploma is a bridge concept for the next generation coast guard vessels.

About me

Lasse Thomasgård

lasse-roev@hotmail.com
+47 48 155 680

www.thomasgard.com

My goals

My goal is to design a realistic and inspiring concept which can create discussions and challenge todays industry.

I want to create a solution which is user oriented with intention of creating a better workplace at sea.

My motivation

Being born by the fjords and mountains of Molde, I have always been inspired and challenged by the maritime industry.

My motivation is to use my skills as a designer to challenge the industry to design better solutions and products for the people working on ship bridges.


0200/17

People

Field studies

To get a better understanding of the industry and learn how things look and feel I have tried to go on as many field trips as possible.

This ambition has resulted in four field trips to different actors in the maritime sector of Norway. Visiting a shipbuilder, a simulator center, a school for naval officers and lastly spending thirteen days on a ship has been both time consuming and crucial for my project.

Experts

After deciding to do a project within the maritime field, I wanted to have a partner to discuss concepts and thoughts througout the project.

Due to their position within the maritime industry, their innovative design solutions and their welcoming approach, VARD was on top of my list of collaboration partners.

They wanted to be a part of my project and my contact Andreas Hjellbakk has been great througout the semester.

Supervisors

This project had never existed without Kjetil Nordby. He has been my main supervisor througout this project and assisted me with everything from planning to industrial design. Stein Rokseth has been my second supervisor with focus on industrial design, and Adrian Paulsen has helped me with system thinking and keeping a bigger picture on the project.

Users

Going to field studies gave me the opportunity to talk and observe users in the right context.

After spending 13 days at sea on a expedition to greenland on the coast guard vessel "KV Svalbard" I got to experience how people live on a ship isolated from the rest of the world for thirteen days. Here I got to do interviews, casual talks and observations.

Supervisors

Kjetil Nordby
Main supervisor

Stein Rokseth
Secondary supervisor

Adrian Paulsen
External supervisor

Experts

Andreas Hjellbakk
Senior System Development Engineer

Collaborators

Physical workspace

Working with a project within the maritime context requires a lot of information from professional users and experts within the field. My partner for this diploma is "Vard".

After visiting VARD I got the impression that the next step within maritime design is an open source collaboration not unlike «the open bridge» project at AHO. My project is therefor a part of this research project as well.

The "open bridge" project aims to create open source concepts for the maritime industry where different companies can exchange ideas and discuss future solutions. My diploma will be an open source deliverance where all information can be assesed and discussed further.

My last contributor to my diploma is "Sedna":

SEDNA project receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no.723526

("Safe maritime operations under extreme conditions: the Arctic case") is a research project that is developing an innovative and integrated risk-based approach to safe Arctic navigation, ship design and operation.
Sedna offers a big party of researchers and experts within the field, and being a part of the SEDNA project helps me open doors and get good feedback and experts.

SEDNA also gave me the oppurtunity to spend 13 days doing research on the 100m icebreaker "KV Svalbard" from the Norwegian Navy.

VARD

OPEN

EU funded SEDNA

Research

Development

Delivery

In this chapter I will present the most important findings from the initial research phase.

The project started out with desktop research before I early on started planning fieldstudies throughout the semester. After reading earlier diploma projects and research documents regarding the maritime industry I quickly learnt how important field studies are in this context When I got the opportunity to join an expedition to Greenland onboard the coast guard vessel "KV Svalbard" I therefore quickly said yes before thinking about the consequences a trip like that has on the project.

This chapter will look into how the maritime industry is focused on the arctic and how different industries are adapting for arctic travel, cargo transportation and oil extraction.

I will also look into what state of the art ship bridges look like and make my own aestethics profile to use whn going into development of my concept for a future bridge vision.

Research ethics

Documentation and publication restrictions

This project has been approved by the Norwegian Centre for Research Data.

These were the guidelines the project had to follow during the trip to Svalbard

• No directly identifiable data (name, personal number or photo with face) of people could be collected during the interviews or field observation.

• Only indirectly indentifiable data could be collected: age, gender, profession.

• The data has to be kept at a secure server and locked physical location

• Written approval has to be given for any identifiable data in publication, otherwise the data has to be anonymized.

Any photos/videos with faces shown in the project are therefore reenacted and staged for communication purposes .

NSD

Synne G. Frydenberg
Postboks 6768 St. Olavs plass
0130 OSLO

Vår dato: 18.04.2018 Vår ref: 59679 / 3 / PEG Deres dato: Deres ref:

Vurdering fra NSD Personvernombudet for forskning § 31

Personvernombudet for forskning viser til meldeskjema mottatt 07.03.2018 for prosjektet:

59679	*Arbeidsplass på forskningsskip og andre arktisk gående fartøy*
Behandlingsansvarlig	*Arkitektur- og designhøgskolen i Oslo, ved institusjonens øverste leder*
Daglig ansvarlig	*Synne G. Frydenberg*
Student	*Lasse Thomasgård*

Vurdering
Etter gjennomgang av opplysningene i meldeskjemaet og øvrig dokumentasjon finner vi at prosjektet er meldepliktig og at personopplysningene som blir samlet inn i dette prosjektet er regulert av personopplysningsloven § 31. På den neste siden er vår vurdering av prosjektopplegget slik det er meldt til oss. Du kan nå gå i gang med å behandle personopplysninger.

Vilkår for vår anbefaling
Vår anbefaling forutsetter at du gjennomfører prosjektet i tråd med:
• opplysningene gitt i meldeskjemaet og øvrig dokumentasjon
• vår prosjektvurdering, se side 2
• eventuell korrespondanse med oss

Vi forutsetter at du ikke innhenter sensitive personopplysninger.

Meld fra hvis du gjør vesentlige endringer i prosjektet
Dersom prosjektet endrer seg, kan det være nødvendig å sende inn endringsmelding. På våre nettsider finner du svar på hvilke endringer du må melde, samt endringsskjema.

Opplysninger om prosjektet blir lagt ut på våre nettsider og i Meldingsarkivet
Vi har lagt ut opplysninger om prosjektet på nettsidene våre. Alle våre institusjoner har også tilgang til egne prosjekter i Meldingsarkivet.

Vi tar kontakt om status for behandling av personopplysninger ved prosjektslutt
Ved prosjektslutt 27.03.2018 vil vi ta kontakt for å avklare status for behandlingen av

Systems oriented product design

External supervisor:
Adrian Paulsen

The complexity of the maritime industry guided me into working not only with industrial design but also some systems oriented design.

I therefore asked Adrian if he would want to be my external supervisor to challenge me and help me have an overlook of the industry and the context where my product is being placed. Throughout the semester we have had very interesting discussions regarding the maritime industry and it`s been important to me having these conversations regarding the project.

As an industrial designer I tend to scope my self into working with only the details or the technicalities of the product, and it`s therefore been really nice to have Adrian poking me now and then and challenging my thoughts and concepts.

Project background

Motivation

Ever since I was a child the maritime industry has been a big inspiration to me. I have dreamt of doing something related to this traditional, yet innovative industry for some time, and after learning about the research being done by the school on this field I decided to do a project designing a conceptual pilots chair for the arctic context last semester.

Last semester was a big eyeopener for me and I was both shocked and motivated by the complexity of this field. The semester was mostly about getting an understanding of the context, and I wasn`t overly happy with my final design. I therefore wanted to use the knowledge I got last semester and build on it to do a better job in my diploma.

Partner

Having a partner has meant a lot in this project. My main motivation for having a partner was to get good insight into the industry and have discussions both during research and development phase of the project.

I wanted to have VARD as a partner on this project because my initial research made it clear that VARD was one of the most design oriented companies in the maritime sector and therefore a an excellent diploma partner. Through Kjetil Nordby we reached out to them and questioned a possible collaboration. They were interested and I quickly planned a meeting with them.

In the research phase it was helpful having the possibility to visit VARD and get some insight into how the state of the art within ship bridge design is today. Throughout the semester I have had one visit at Vard, a midterm skype meeting and at last a final conceptual walkthrough before I started the finalizing phase.

Foto: VARD

Project theme

Ship bridge

The bridge is the nerve centre of a ship. Its where everything from navigation to operations are being controlled and commanded.

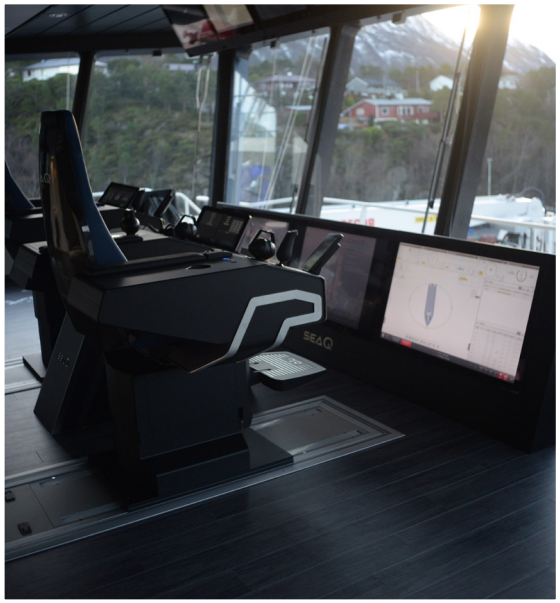
The ship bridge is placed on top of the ship with maximum visibility around the vessel. To the right you can see a future concept vessel made by the design firm "Montaag" for VARD in 2015 called "A step forward". You can easily spot the bridge on top with its large windows and 360 degrees visibility.

Everything from navigation, planning and daily operations of the ship is being controlled from the bridge. My research showed me how the ship bridge has a main purpouse of handling navigation and planning of operations, but that it`s also used for more specific operational tasks being executed around or on the ship for f.ex. offshore missions or rescue missions.

The reason why the bridge is used for more than just it`s main purpouse of handling navigation is because it has a great overview around the ship , and since ships are being hired for operations it`s crucial that the task it is being hired to handle is being done in the best way possible.

The two pictures down to the right is from two state of the art vessels built by Vard the last years with the concept bridge from "A step forward".

Foto: VARD



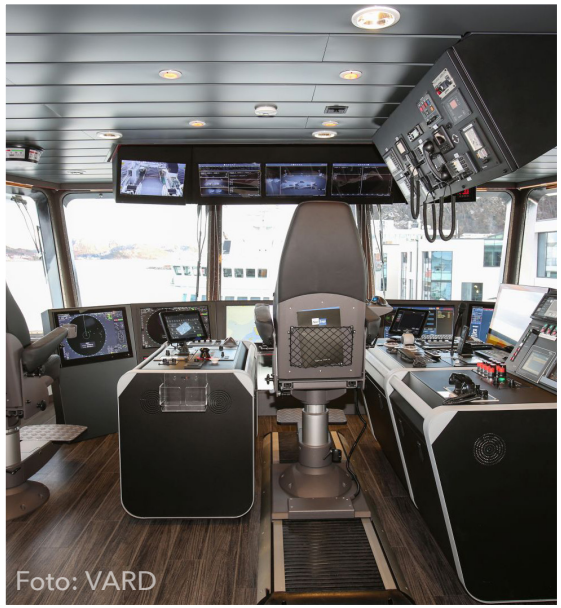
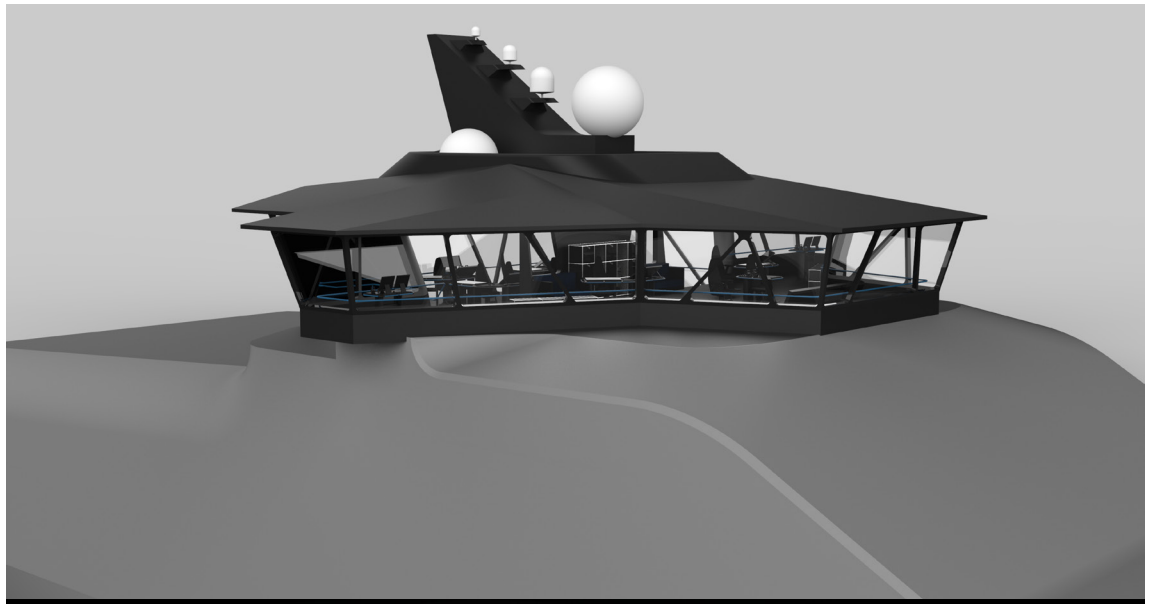


Foto: VARD

What is a ship bridge?

Navigation

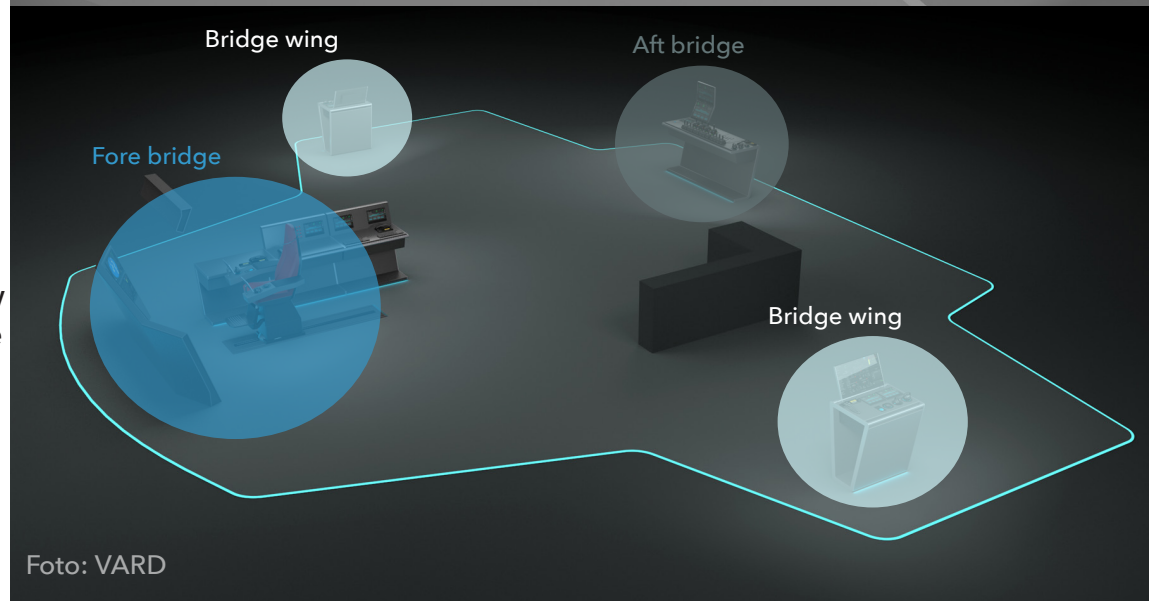
The ship bridge is made for navigational purpouses and the whole structure is covered in glass. Modern bridges have big windows expanding from the floor up to the roof, but the layout and the basics are the same as it has been the last 50 years.



Layout

A ship bridge is divided into four main parts. The fore bridge, The aft bridge and the bridge wings- One port and one Starbord.

The picture to the right shows a very simple illustration of how the consoles are arranged on the bridge. You can see how the fore console is much bigger than the rest because of all the equipment needed for planning and emergencies.



Different ships

Ships made for traveling

Cruiseliners and passenger vessels are specially designed for one purpouse: Going from A to B in safe waters. Passenger ships are therefore built with a "simple" bridge made for travelling long distances in mind.

Foto: Hurtigruten

Foto: cruiseastute.com 2012

Ships made for positioning

The big trend since oil became the most sought after product in the ocean has the last 30 years been supply vessels or construction vessels designed to handle offshore operations. These ships are built with a "advanced" bridge with precision navigation and positioning in mind.

Foto: VARD

Foto: VARD

Specialized vessels

Specialized vessels made with very specific contexts or operations in mind are complex and expensive vessels often with the best equipment available installed. Examples are research vessels and military vessels where state of the art equipment is necessary to be able to do the operations in mind.

Foto: http://rosellinisfour-10.no/

Foto: VARD

Project theme

Console

A console on a ship bridge is the physical part where all the equipment is being mounted and operated from. A ship bridge have several consoles placed on different places around the bridge.

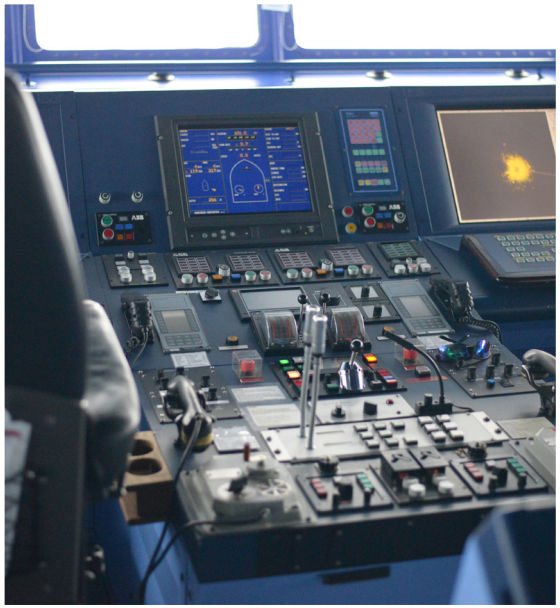
My research has shown me different consoles and different ways of both placing and using them. I realized that almost every new console is made with offshore missions and dynamic operation in mind, and I therefore saw a big opportunity working with navigation and other operations for my diploma.

How can a ship bridge console be used for more than just navigation? Can one design be used to fullfill both the operational crew and the navigational crew`s wishes, or will this be too much to ask of this kind of product?

These were some of the questions I had into this diploma project that I wanted to explore and design a concept for.

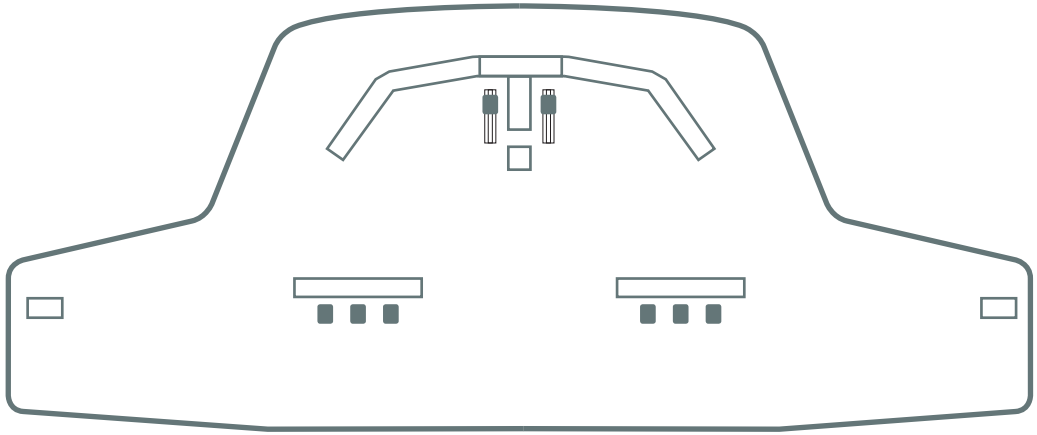
The pictures to the right is from the coast guard vessel "KV Svalbard" where bad ergonomics and old equipment is found everywhere.

Technology is a big factor within the maritime industry, but even though technology can make slimmer and better consoles, ergonomics will always be a factor to design for.



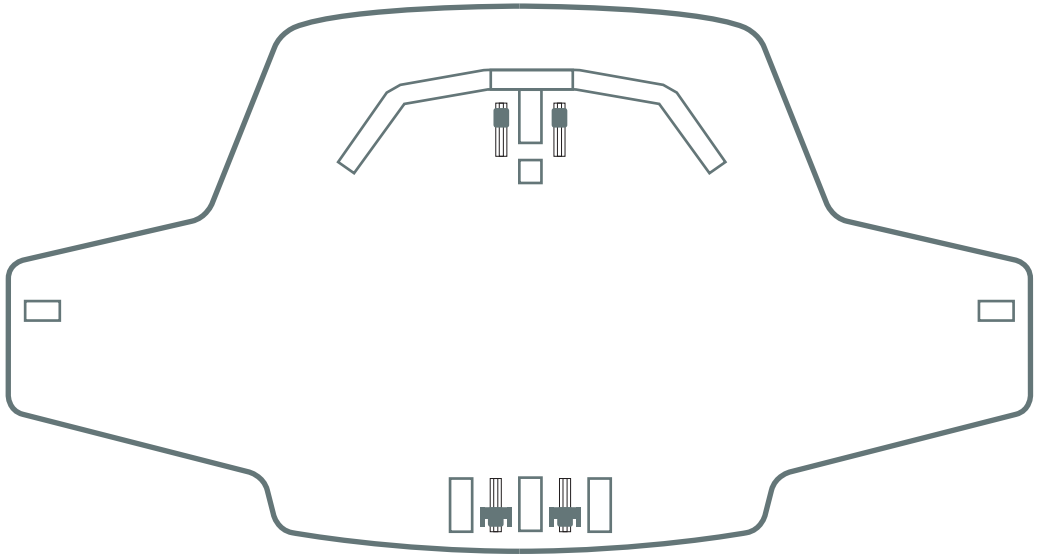
Navigational bridge

A navigational bridge is the most common type of bridge found on commercial vessels. These bridges are made for long travel and require less equipment. The illustration to the right shows a typical layout of equipment of a navigational bridge with a horseshoe in front with all the necessary equipment needed for navigation. The desk further back is being used for planning and operation of the ship. The bridge wings are used when entering and leaving docks.



Dynamic positioning

A bridge made with positioning and work being done either on the aftdeck or in the close area around the ship are built with a bridge facing both fore and aft. Technology and the need for a system which can hold a ship in perfect position during offshore missions have brought forward a system called DP (dynamic positioning). DP is a computer controlled system which can hold a vessels position automatically by using it`s own thrusters and propellers. A DP station is found on almost every new ship being built, and it`s often placed in the aft bridge as seen on the illustration to the right.



Project theme

Arctic context

Arctic travel

It`s no big mystery that the arctic ice is melting. One way of observing how fast the ice is melting is how many passenger ships that are being built with arctic travel and exploration in mind today. The ship to the right "Roald Amundsen" is being built for "Hurtigruten", a Norwegian travel agent with arctic travel in mind. This is only one of many examples of cruise ships being built for the arctic climate.

Foto: Hurtigrufen

Luxury travel

It`s not only big passenger cruise vessels that are aiming to travel up north to explore the arctic climate. The mega yacht in the picture to the right will be the first yacht with P6 polar class designation meaning it can handle thick ice.

After they started building this megayacht in 2016 more yachts with arctic exploration in mind has reached the planning stage and we can only wait for a rise in traffic in the arctic in the following years.

Crystal Endeavor

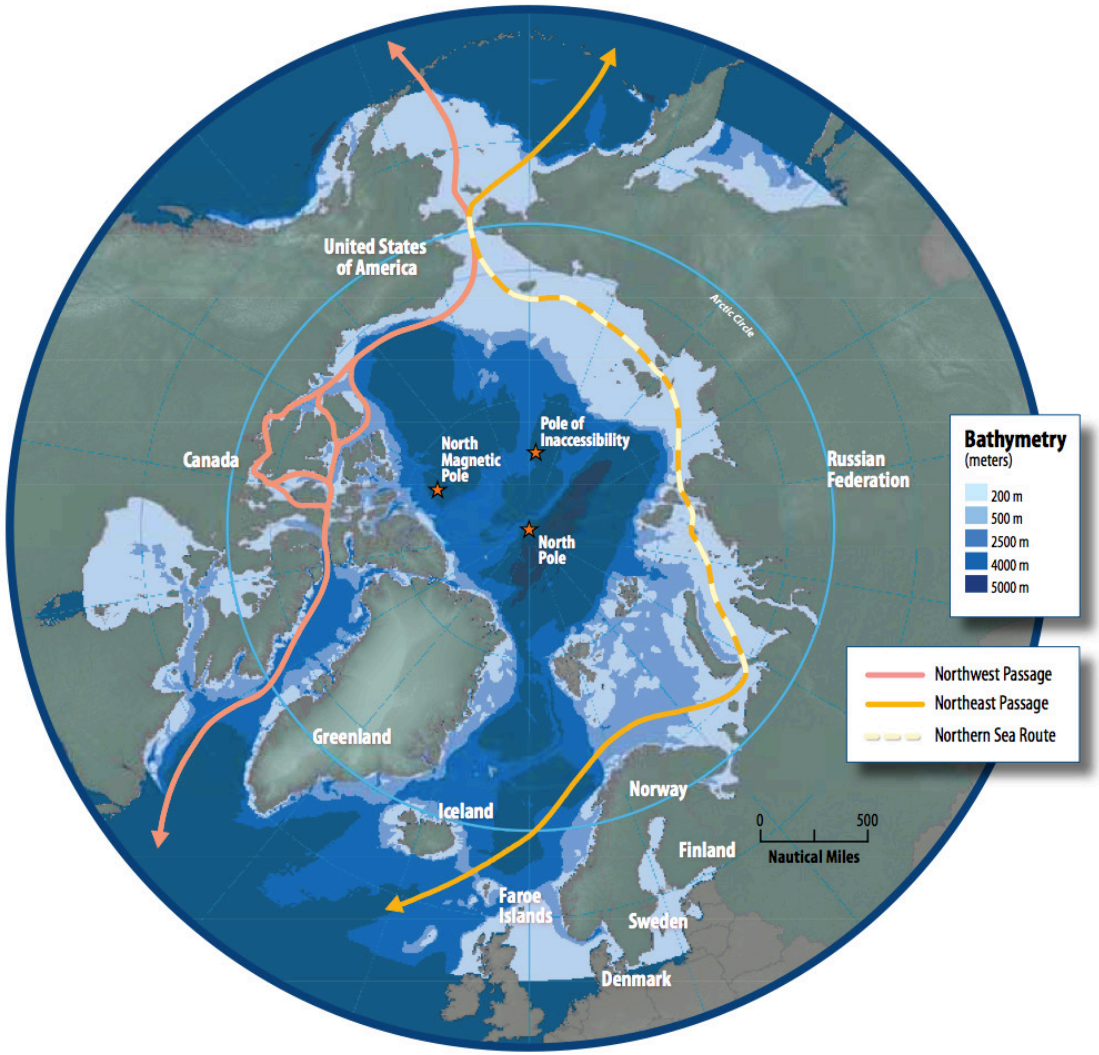
Arctic maritime routes

"The security policy situation in the High North has led the Armed Forces to spend around 100 million more annually in increased preparedness in Finnmark than originally budgeted with,"

- Chief of defense Haakon Bruun-Hansen

Because of a rise in activity up north the Norwegian coast guard needs to be prepared for whats happening. More ships will sail through the Norwegian sea and more ships will travel to the arctic. The Norwegian coast guards role in the Norwegian sea and the arctic ocean is to patrole and keep the oceans safe.

New coast guard vessels are already been ordered by the Norwegian government and they need to be delivered soon to be able to meet the rise in traffic.

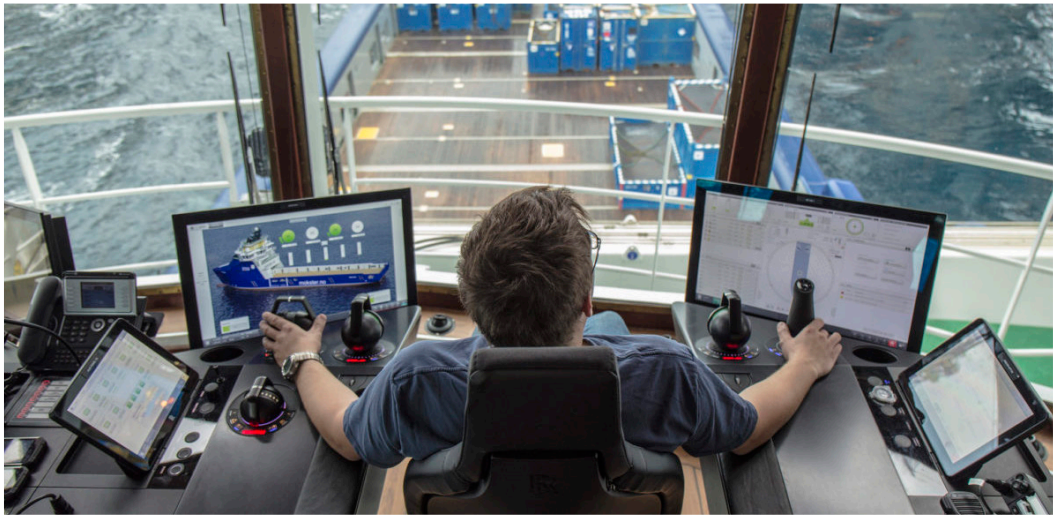


State of the art

Rolls Royce unified bridge

The "Rolls Royce unified bridge " has been the industry's most human centered and innovative bridge console seen the last years. It aims to have all systems and screen inputs integrated in the system so the design is both unified and easy to use.

The bridge console is designed with dynamic positioning in mind and all the equipment is within reach when sitting both aft and fore. It offers big touch screens where all the systems can be operated from. The unified system makes it possible to put every function into one system where you can handle everything from alarms to thruster controllers. Rolls royce delivers everything from ship design to thrusters and propellers, so the unified bridge is therefore a complete solution with every part of the ship integrated.



Vard Seaq

After Montaag made the concept ship "A step forward", Vard has moved on with the vision made for the bridge console and designed a solution called "SeaQ". Vard doesn`t offer thrusters and propellers, and they have therefore decided to create a bridge console which can be fitted with equipment from external producers like "Rolls royce", "Brunvoll" or "ABB".

"SeaQ" offers touch screens where all of functions and adjustments can be made, and since the system is html based producers can easily connect equipment by making a html friendly interface.

Modularity

” Modularity is a general systems concept: it is a continuum describing the degree to which a system's components can be separated and recombined”

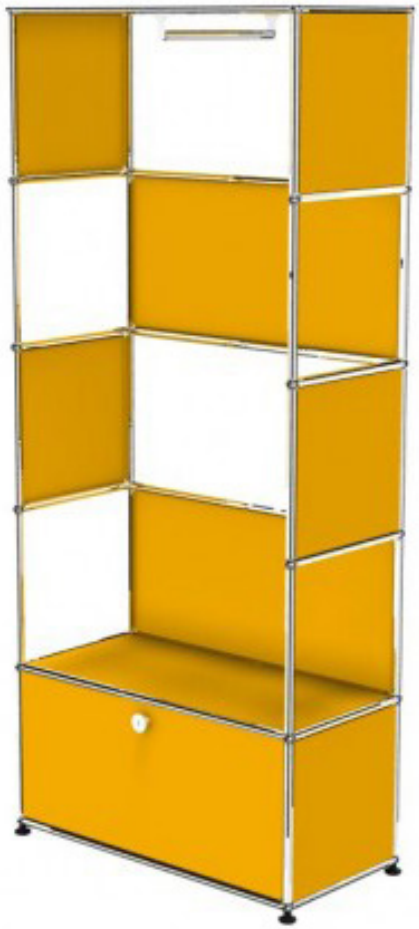
(Schilling, 2000)

Modularity in its most abstract level is about the degree a systems components can be separated and recombined. Few systems have components that are inseperable and in most cases they can be recombined.

With my project I want to see how modularity can create new layouts and start discussions on how a bridge layout should be.

Modular pieces can be moved around and my goal is to create a console which can be used for different kind of workstations with different equipment.

A perfect example of how modularity can be mastered is the ”USM Haller” system created by Fritz Haller.



Aestethics & identity

The design language and detailing of my concept will help with the credibility and make the project easier to communicate. I wanted to look into which design language Vard is expressing and build onto their feel when making a future concept.

Vard expresses a fierce look with a high focus on tight clear lines. The concept vessel made by "Montaag" expresses a futuristic but realistic design with strong lines and a functionalistic expression.

My project isn`t supposed to go into Vards portfolio of todays products but rather challenge and inspire future discussions at Vard. I have therefore created two directions on the next page showing the kind of feeling I want my project to express.

I want to design a console which can help people working at sea, and the expression I`m aiming for is an honest, simple and functional expression.

Vard

Avoid

Styling just for appearence
Show off
unnecessary elements

Aim

Honest
Simple
Functional

Research

Development

Delivery

In the development chapter I will go through the different field studies I have done throughout this semester and show some findings from the different trips.

The biggest part of this chapter is the expedition onboard KV Svalbard where most of my findings and insights have been made.

The expedition to Svalbard turned out to be an experience I never will forget. I got to spend 13 days with the most fantastic people experiencing nature and wildlife on it`s best way possible. When combined with the fact that I got to do great observations and do as many interviews and take as many photos as I could, it`s not hard concluding that the trip was a success.

The development chapter ends with a bridge layout excercise and concept sketche.

Field studies

A big part of my project has been to go out in the field and experiencing the context for my self. I started planning field studies right away after the diploma start in January and throughout the semester I`ve been to four field studies experiencing the maritime sector in four very different ways.

It all started out with a visit to Vard where I got to experience the company and got to look into their newest bridge: "SeaQ". After visiting Vard I went to the offshore simulator senter in Ålesund where I got to take part in a training course in the simulator where I was observing the whole operation. The next visit was to the University college of Southeast Norway where I looked at simulators and got to see a lot of Kongsberg equipment.

The last and biggest field study was a 13 days expedition onboard the coast guard vessel KvSvalbard.

VARD Electro 01.02.2018

Offshore simulator senter 01.02. 2018

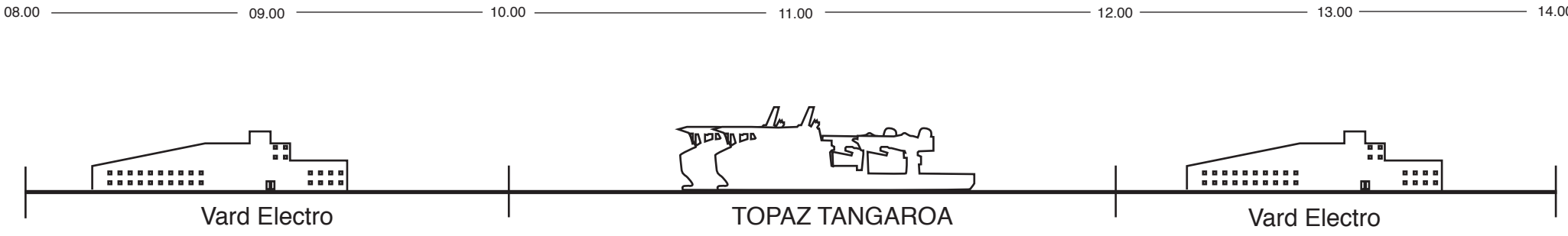
University college of Southeast Norway 02.02.2018

SVALBARD 14.03.2018-27.03.2018

VARD Electro

February 2th we went from Molde to Tennfjord. The small trip of one and a half hour showed us no less than 3 ferries crossing Moldefjorden, 4 different shipyards and 11 different vessels at sea. It was almost as the region of Møre and Romsdal knew we were coming. Our destination was Vard Electro, and at 08.00 we had a meeting with Andreas Hjellbakk.

After two hours together with Andreas at Vard Electro we went to Brattvåg to experience the state of the art in bridge design.



Discussing diploma collaboration, the business and the future

My biggest goal when visiting Vard was to discuss my diploma and get into some interesting talks about concepts and possible directions.

I learnt that the new SEAQ bridge has made it`s way into the industry, and we got to see two different examples of it installed. The two different ships where SEAQ bridge has been installed is 2 small construction vessels and a modern fishing vessel.

We discussed the future and how small changes is more important than changing the system of how ships are being built and used. Autonomy is a big factor, but the dream of having a unmanned vessel is rather a dream than a wish.

Noise, stress and culture

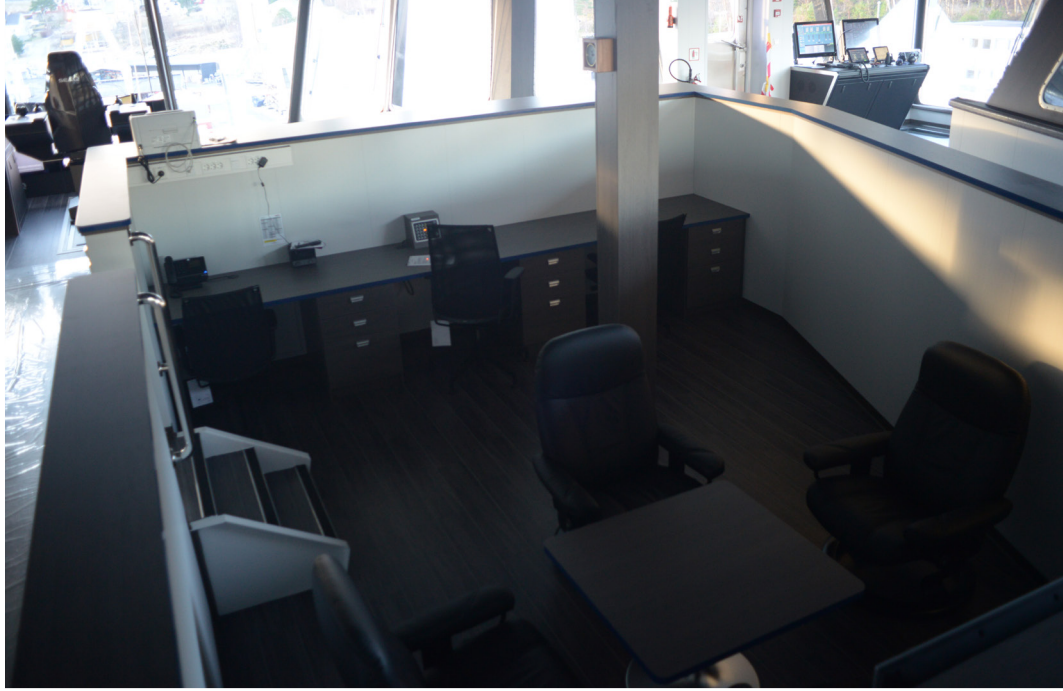
There is seldom only navigators walking around and working on a bridge. In most missions you have some kind of operator, researcher or expert on the bridge doing work from a station on the bridge. This can be a winch operator doing winch specific work or a researcher doing echo sound mapping.

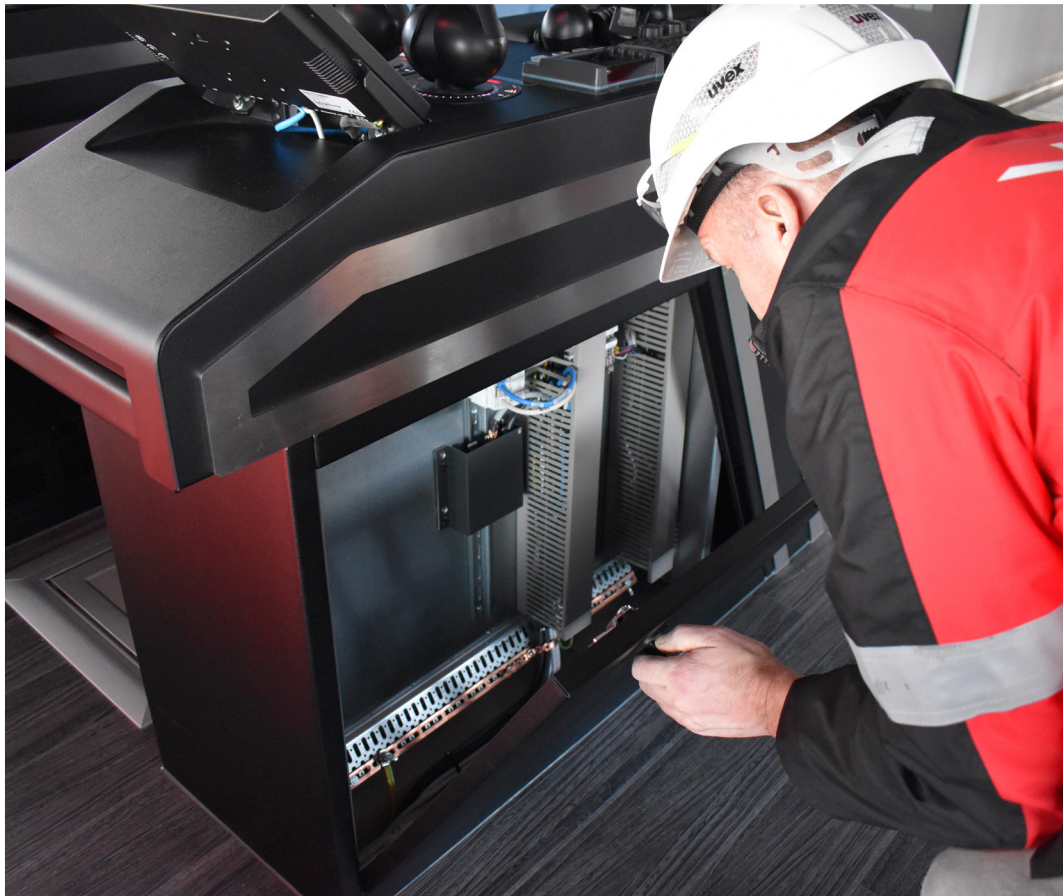
They are often placed on the same floor as the navigators, and the result is different people doing different jobs on a very tight space where noise and light can be irritating and stressfull. The two pictures below shows how VARD has solved this problem on the ship: "TOPAZ", where the meeting area and expert station is dropped into the floor.

Cables and electronics

The SEAQ bridge on the TOPAZ ships have a external "computer/electronics" room where all of the gyros, computers, servers and cables have been placed. This is to releave the bridge of computers and electronics to free up space for the navigation stations.

The picture above shows a SEAQ console opened up where you can see the cables being pulled straight through the floor.




uvex

SEAQ

After visiting Vard Electro in Tennfjord, Andreas brought us to Brattvåg where two newly built ships are waiting for missions.

Topaz "Tangaroa" and Topaz "Tiamat" have both been built with all the new designs from Vard where we got to experience their newest bridge concept, SEAQ bridge.

The picture to the right shows the aft facing bridge setup with 2 DP stations. The stations have been inspired by the concept bridge from Montaags delivery "A step forward", and the aluminium cut out on the chair is a element brought into the design from "A step forward".

Star of the show

The new bridge concept SEAQ has been made with a touch screen at every station, which is used for every adjustment, change of placement and communication on both the bridge and the ship.

This touchscreen can for example adjust the chair, turn on window wipers, communicate with engineers or toggle between cctv surveillance cameras around the ship.

One of the main functions is to change which display you want to have on the big screens ahead of the 1st officers or captain.

Rolls Royce

The new bridge concept SEAQ is made so a selected amount of physical controllers can be mounted from external producers. Vard has made a choice of not making their own physical controllers, simply because it`s better for Rolls Royce, Kongsberg or Brunvoll to deliver their thrusters or propulsion systems with their own controllers.

To the right you can see Rolls Royce`s thruster controllers mounted in the SEAQ bridge console. The SEAQ console is made in sheet metal which require holes to be cut for fitting of controllers, buttons and other equipment like screens.

Offshore Simulator senter in Ålesund

We got an invitation to visit the "Offshore simulator senter" in Ålesund and join a course in crane
operations on a offshore platform.

The senter has fullsize bridge simulators which are placed within domes to create a 360 degrees view during simulation.

The physical bridge was the "Rolls Royce unified bridge" which was equipped for DP operations and

My goal for the trip was to observe the equipment in use and discuss different thoughts and ideas with qualified people at the senter.

My biggest finding was to get feedback with my research that modularity and being able to update outdated equipment or change the original workspace layout could help people working on the ship.

Thruster overload

Here you can see how up to 7 thrusters can be mounted underneath a ship which makes positioning easier and manual control harder.

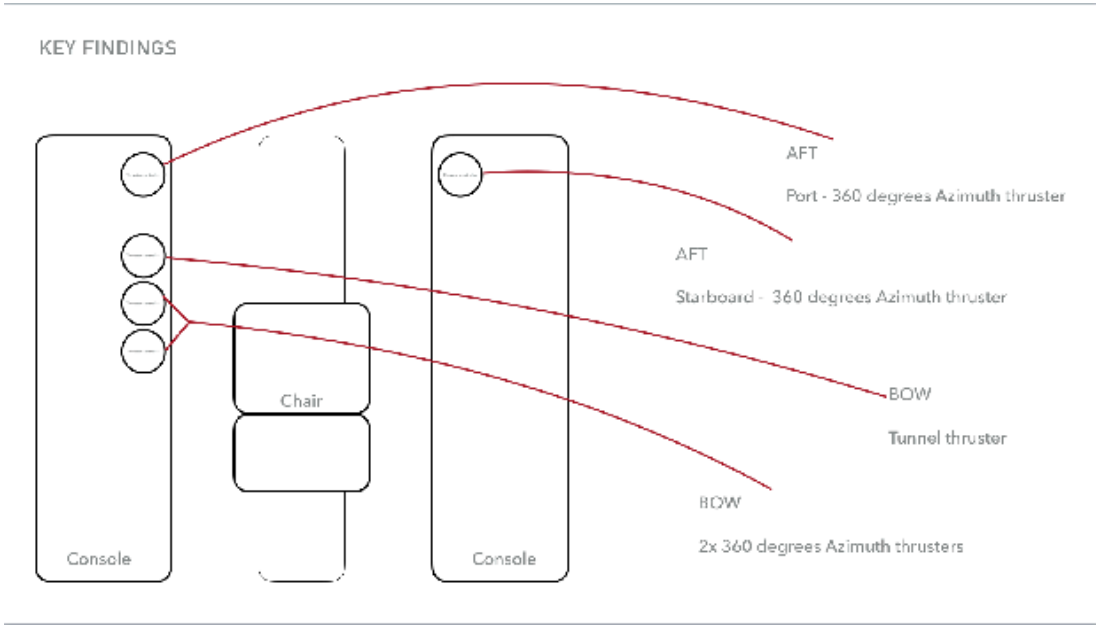
Manual control

Ships are being built to be controlled by a autopilot system, and the Dynamic positioning stations are designed to be controlled both manually and autonomously.

The picture to the left shows how a typical setup of 5 different thruster controls are placed on a bridge consol or DP station. This setup is no problem to a pilot whenever the system controls itself, and the ship is functioning like a fully autonomous system.

But in a dangerous situation or in big waves, the pilot may have to take control and position the ship manually. This is hard enough with 2 or 3 thruster controls at hand, so when a ship with 7 or 9 thrusters have to rapidly be manually controlled system overload happens

A modular system which allows change of design after testing could be a reasonable solution where placement of controllers could be tested and adjusted.



Vestfold university college

The Kongsberg bridge is made from sheet metal and the main structure of the bridge is built up by modules in different size and configuration.

The picture to the right shows a typical layout with many specialized buttons, a rollerball and a big dimmer switch. The guys working at the school gave me feedback on the layout of several consoles just like this one. The rollerball is placed on the middle with the dimmer to the left. This forces operators to stand a little to the left of the rollerball.

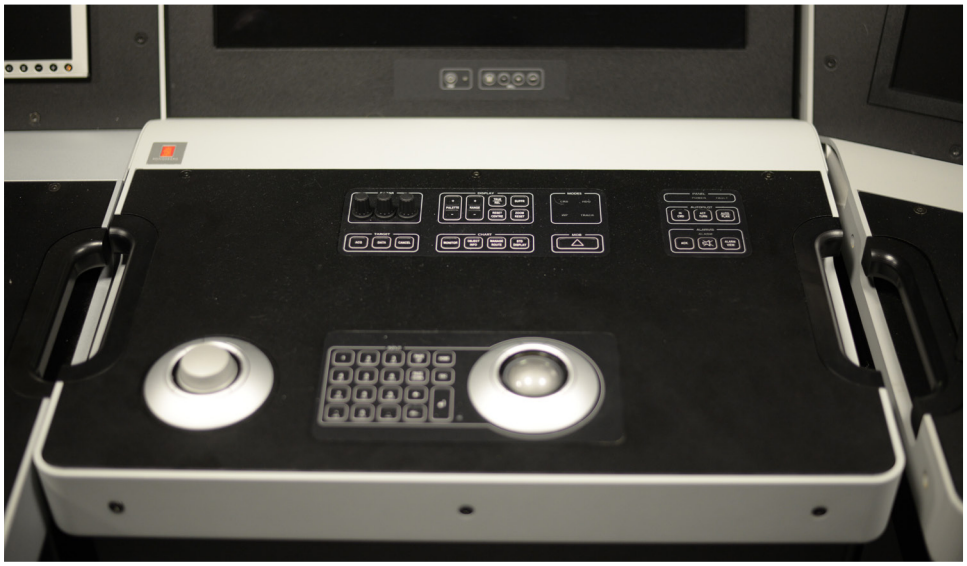
If the structure of the console was modular the rollerball and dimmer could be moved to the right creating a better workflow.

The sheet metal doesn`t enable upgrades to the system, and the only way to include new gear requires cutting or drilling.

Modularity

The navigational controllers and equipment of the Kongsberg system is mounted on
metal plates which are bolted to the top of the console.

This makes it possible to switch around and alter the original layout of the physical
console. This was a pleaser to me considering my research has shown me all the possibilities a modular system can have.



SVALBARD

In January Synne Frydenberg came to me wondering if it was interesting to go on a fieldstudy to the arctic with the coastguard vessel KV Svalbard. My reaction was a instant YES before thinking about the consequences a trip like this would have on my process and project.

The details about the trip came piece by piece, and after some weeks we knew both the length of the trip and where it was intended. The trip would last 13 days and it was arranged by ”Havforskningsinstituttet” who were going with the intention of counting seals. At the start of February we received confirmation that we were on the list of researchers attending the expedition to the arctic.

Going on a fieldstudy for thirteen days require lots of planning and I`ve experienced how much time and effort one need to invest when going on a trip like this.

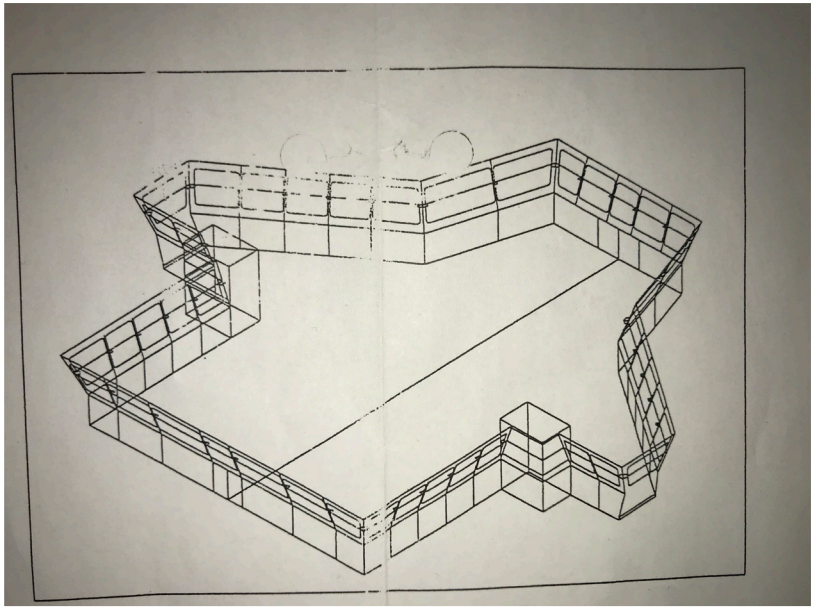
The picture to the right shows our route from ”Tromsø” to ”vesterisen” between Jan Mayen and Greenland before heading back to harbour in ”Harstad”.

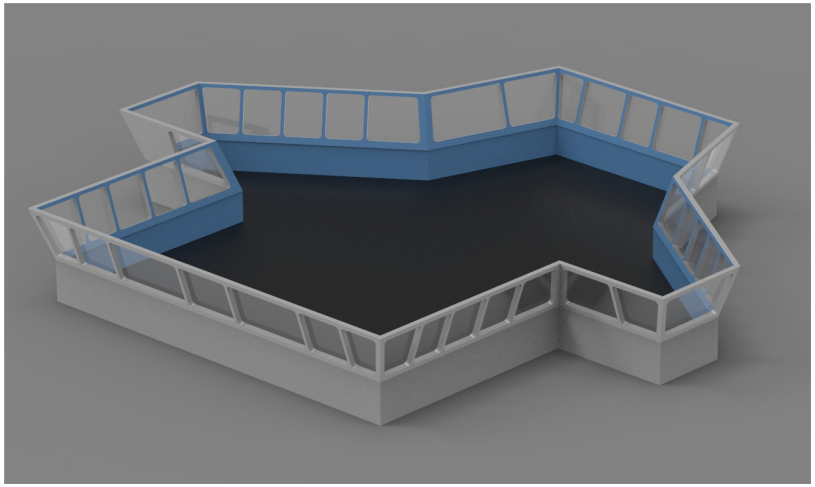
Planning for Svalbard

After getting confirmation from the Norwegian Navy regarding the expedition onboard the coast guard vessel "KV Svalbard", we quickly started planning and preparation for the thirteen day field study.

My goal during this trip would be to do observations, interviews and discuss concepts and findings from the earlier research phase with the crew onboard. My ambition was to make sketches and paper prototypes during the trip and discuss these with the crew. If possible I wanted to push the sketches into cad models and make realistic renders to discuss before leaving this fantastisc possibility.

We got some pictures and details of the ship some weeks before the expedition, and based on the planned drawing of the bridge seen to the upper right I made a cad model of the ship bridge to use when preparing for the trip. This cad model was used frequently to discuss how we assumed things would be and operated on the bridge.





Norwegian centre for research data

Because we were going to collect personal data we had to fill out and send in a notification form that needed to be approved by the Norwegian centre for research data before going on the trip.

Personal data is information that can identify a person either directly or indirectly. This can be through personal ID numbers or other identification.

Sea sick & polar bears

Staying on the ship for thirteen days ment many opportunities for research and relevant activities to my project.

The first days were all about getting known to the ship, the crew and life at sea. Especially the last part about getting known to life at sea took both time and effort. I thought it was very interesting to see how quickly the crew got known to us and treated us like we had been there for weeks.

Nothing surprised them about our clumsy way of walking or how ”little” sea that was perceived as ”much” sea by us. The biggest difference between us and the crew was the fact that during big waves and a lot of motion in the ship, we could go to our room and lie down while they had to work and be on duty.


KYSTVAKT


W303

Researching 24/7

Research and project relevant actitivites could be done at any minute anywhere on the ship. This was both a big opportunity but also a very exhausting fact during the whole trip.

I went for breakfast at 07:30 every day and quickly after finishing the meal I was ready for a new day with interviews, observations and research on the bridge. We tried to have meetings every day discussing findings and made preparations for the next day, but we often experienced that long days with research was so exhausting that we rather just went to sleep.

The days before getting into the ice was very exhausting because of waves and all the motion in the ship. It was very hard doing interviews during all the motion and big waves became synonymously with the bed and just lying down trying not to be sea sick.

Before entering ice the crew was mostly planning and discussing the operations and activities to be done when entering ice. The ship was mostly steaming on autopilot and the crew on bridge were doing observations and watching over the systems.

After entering ice everything was changed on the ship. The ice made the ship steady and when the ship was just laying still in the ice there were no motion and it felt just like walking around in a high facility building. This was very releaving for us since we now had more time and energy concentrated on the work to be done.

During the trip and especially after navigating through we started mapping out components and workflows on the bridge. I spent two or three days taking picture of every component on the bridge and made a map containing every console with detailed descriptions of what component that are being placed where on the bridge. This mapping resulted in a cardsorting excercise together with the captain where we discussed which equipment that are needed where on the bridge at any time, and which equipment that could be moved or removed completely.

I also got to spend time doing one of my favourite hobbies, taking photos and capture movies. I brought with me my drone and after some test flight in minus 20 degrees I got to take som very interesting ice shots aerial shots of the ship.

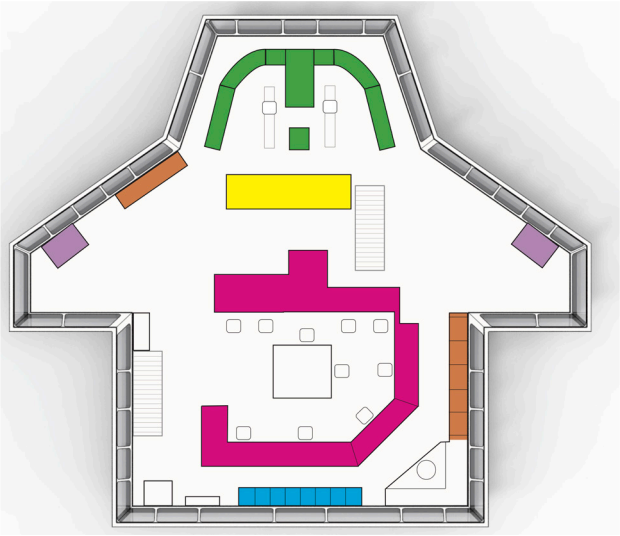
Mapping out components

Putting the bridge in a system

I didn`t spend much time before realizing a good method would be to map out all of the systems on the bridge and make a workshop together with a navigational officer to discuss and redesign the layout of the components.

I started out by making a digital top view of the bridge as seen below and splitting the different parts into different segments.

Green is the fore bridge.
Purple is the bridge wings
Pink is the operational part/room
Blue is the aft bridge
Orange is all the shelfs and storage compartments
Yellow is for emergency and planning station.



Putting the bridge in a system

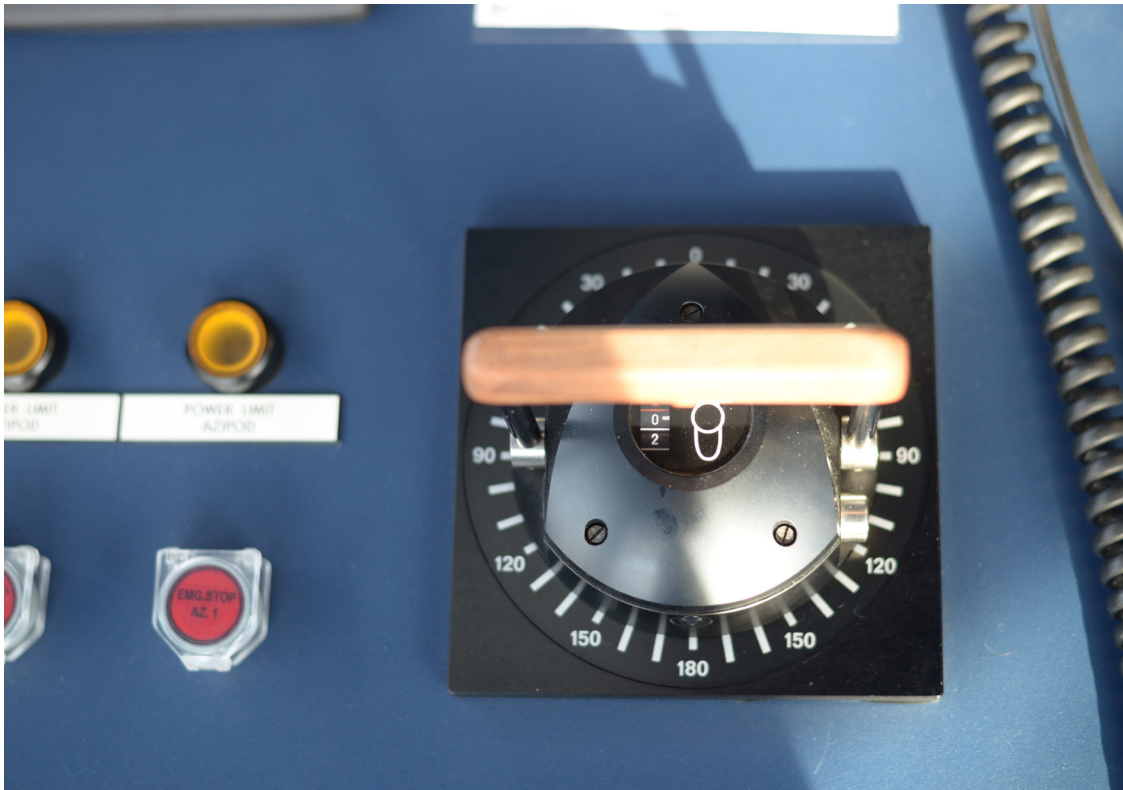
After taking pictures of every component on the bridge, I started drawing all the consoles with detailed lines separating the different components before filling in the pictures. After doing this I walked around the bridge together with a navigational officer and discussed every little part. While discussing it I filled in the description and possible comments into a document in the same way as the pictures.

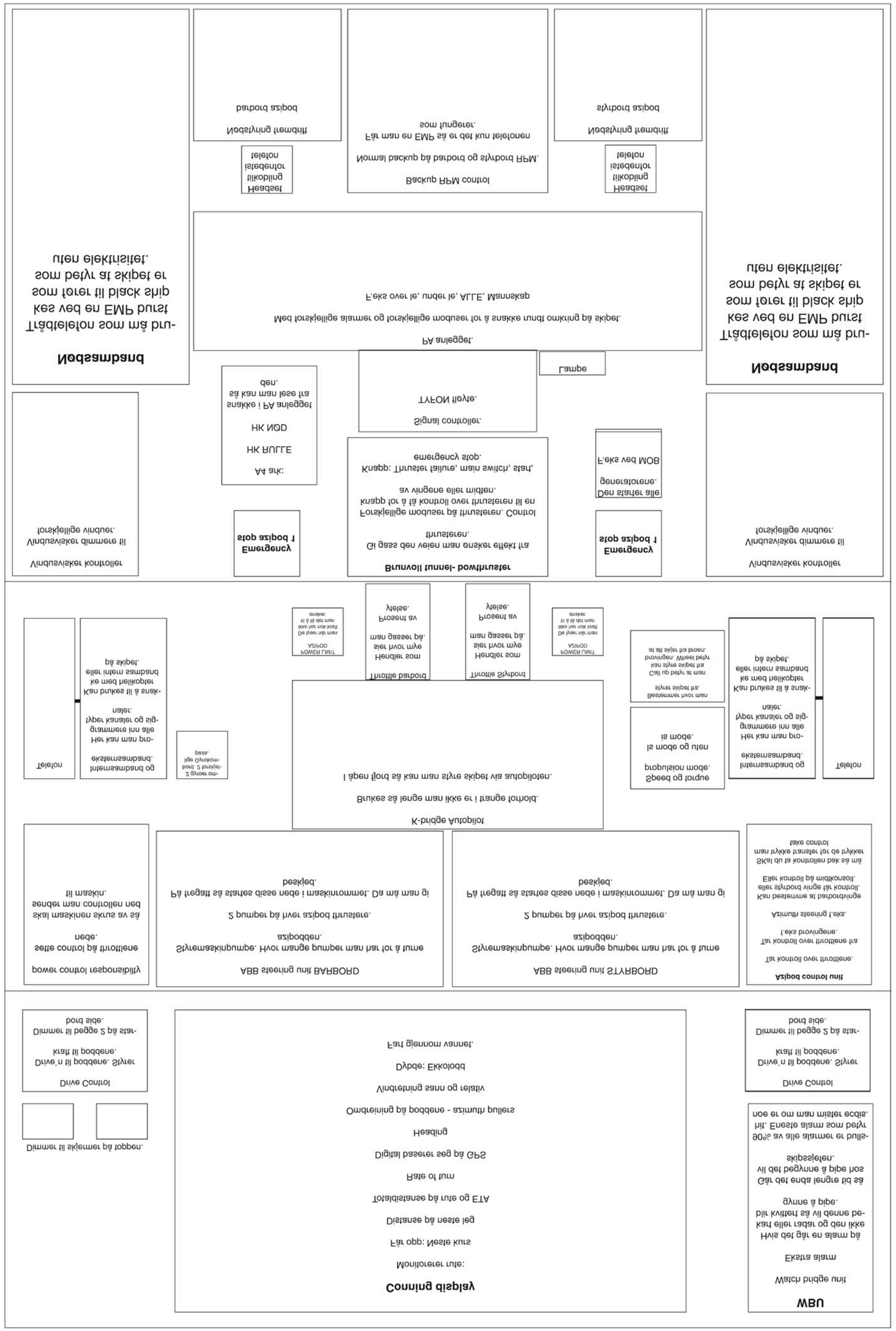
This job took a long time but it turned out to be a perfect conversation starter with all the navigational officers and the captain. We quickly learnt how many of the components that was never used and it was very interesting to learn how many of the navigational officers that were wondering the same things as we did. Luckily some of the officers have been stationed at this ship since it was built in 2001 and they had all the answers.

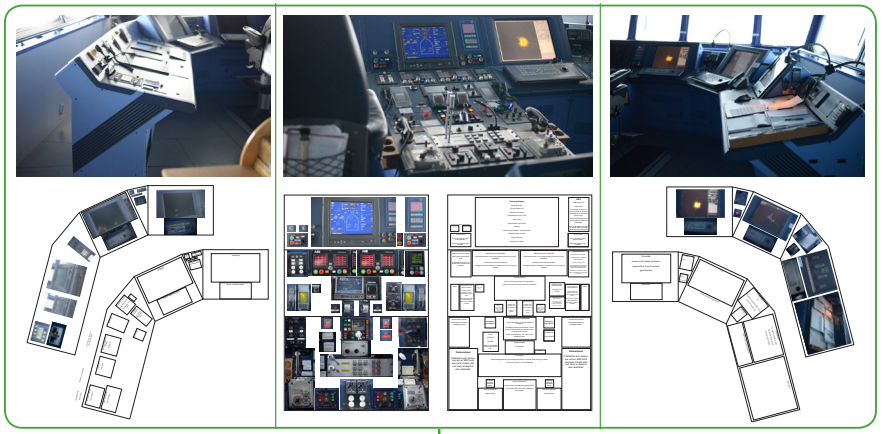
On the two pages following this spread you can see how we took photos of every component before writing what they were and which function they had on the bridge.

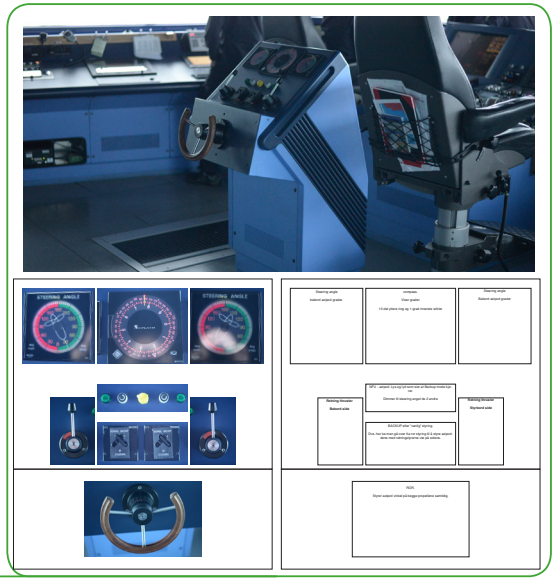
You can also see the final map showing every part of the bridge been mapped. We ended up with mapping around 150-200 components on the bridge, and just that number was a finding we got from this exercise.

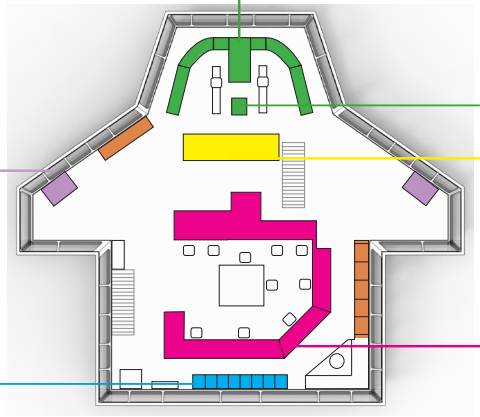

OCEAN
STEERING ANGLE

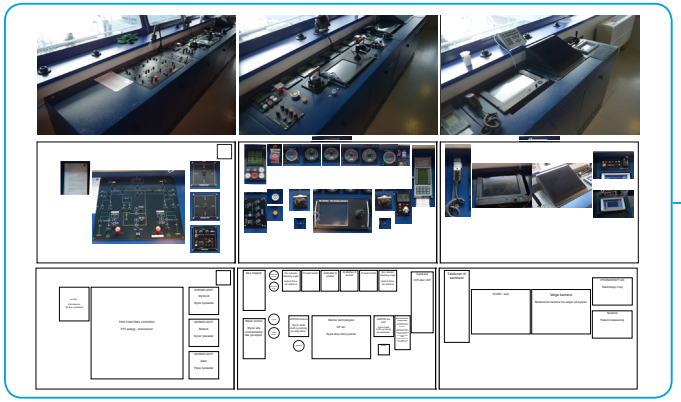

POWER LIMIT
AZIPOD
EMG.STOP
AZ. 1
90
120
150
180
150
120
90
30
30

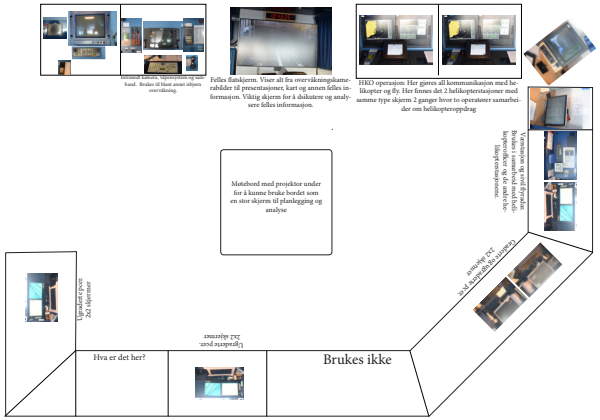

Nødsamband
Trådtelefon som må bru-kes ved en EMP burst som fører til black ship som betyr at skipet er uten elektrisitet.
Headset tilkobling telefon
Nødstyring fremdrift babord azipod
Backup RPM control
Normal backup på babord og styrbord RPM.
Får man en EMP så er det kun telefonen som fungerer.
Headset tilkobling telefon
Nødstyring fremdrift styrbord azipod
Nødsamband
Trådtelefon som må bru-kes ved en EMP burst som fører til black ship som betyr at skipet er uten elektrisitet.
PA anlegget.
Med forskjellige alarmer og forskjellige moduser for å snakke rundt omkring på skipet.
F.eks over le, under le, ALLE, Mannskap
Lampe
AI ark:
HK RULLE
HK NØD
snakke i PA anlegget så kan man lese fra den.
Signal controller.
TYFON fløyte.
Brunvoll tunnel- bowthruster
Gi gass der man ønsker effekt fra thrusteren.
Forskjellige moduser på thrusteren. Control knapp for å få kontroll over thrusteren til en av vingene eller midten.
Knapp: Thruster failure, main switch, start, emergency stop.
Den starter alle generatorene. F.eks ved MOB
Emergency stop azipod
Emergency stop azipod
Vinduesvisker kontroller
Vinduesvisker dimmere til forskjellige vinduer.
Vinduesvisker kontroller
Vinduesvisker dimmere til forskjellige vinduer.
Throttle babord
Henvler som sier hvor mye man gasser på. Prosent av ytelse.
Throttle Styrbord
Henvler som sier hvor mye man gasser på. Prosent av ytelse.
K-bridge Autopilot
Brukes så lenge man ikke er i trange forhold.
I åpen fjord så kan man styre skipet via autopiloten.
Telefon
Internsamband og eksternsamband. Her kan man pro-grammere inn alle typer kanaler og sig-naler. Kan brukes til å snak-ke med helikopter eller internt samband på skipet.
Speed og torque propulsion mode. Ia mode og uten Ia mode.
Telefon
Internsamband og eksternsamband. Her kan man pro-grammere inn alle typer kanaler og sig-naler. Kan brukes til å snak-ke med helikopter eller internt samband på skipet.
Power control responsibility
sette control på throttlene nede.
skal maskinen skrus av så sender man controllen ned til maskin.
ABB steering unit BARBORD
Styremaskinpumpe. Hvor mange pumper man har for å turne azipodden.
2 pumper på hver azipod thruster.
På fregatt så startes disse nede i maskinrommet. Da må man gi beskjed.
ABB steering unit STYRBORD
Styremaskinpumpe. Hvor mange pumper man har for å turne azipodden.
2 pumper på hver azipod thruster.
På fregatt så startes disse nede i maskinrommet. Da må man gi beskjed.
Azipod control unit
Tar kontroll over throttlene.
Tar kontroll over throttlene fra f.eks brovingene.
Azimuth steering f.eks.
Kan bestemme at babordvinge eller styrbord vinge tar kontroll. Eller kontroll på midtkonsoll.
Skal du ta kontrollen bak så må man trykke transfer for og trykke take control
Drive Control
Drive'n til boddene. Styrer kraft til boddene.
Dimmer til begge 2 på star-bord side.
Dimmer til skjermer på toppen.
Conning display
Monitorerer rute:
Får opp: Neste kurs
Distanse på neste leg
Totaldistanse på rute og ETA
Rate of turn
Digital basert seg på GPS
Heading
Omdreining på boddene - azimuth pullers
Vindretning sann og relativ
Dybde: Ekkolodd
Fart gjennom vannet.
Drive Control
Drive'n til boddene. Styrer kraft til boddene.
Dimmer til begge 2 på star-bord side.
WBU
Watch bridge unit
Ekstra alarm
Hvis det går en alarm på kart eller radar og den ikke blir kvittert så vil denne be-gynne å pipe.
Går det enda lengre tid så vil det begynne å pipe hos skipssjefen.
90% av alle alarmer er bulls-hit. Eneste alarm som betyr noe er om man mister ecdis.










Møtebord med projektor under for å kunne bruke bordet som en stor skjerm til planlegging og analyse
Hva er det her?
Brukes ikke

Cardsorting exercise

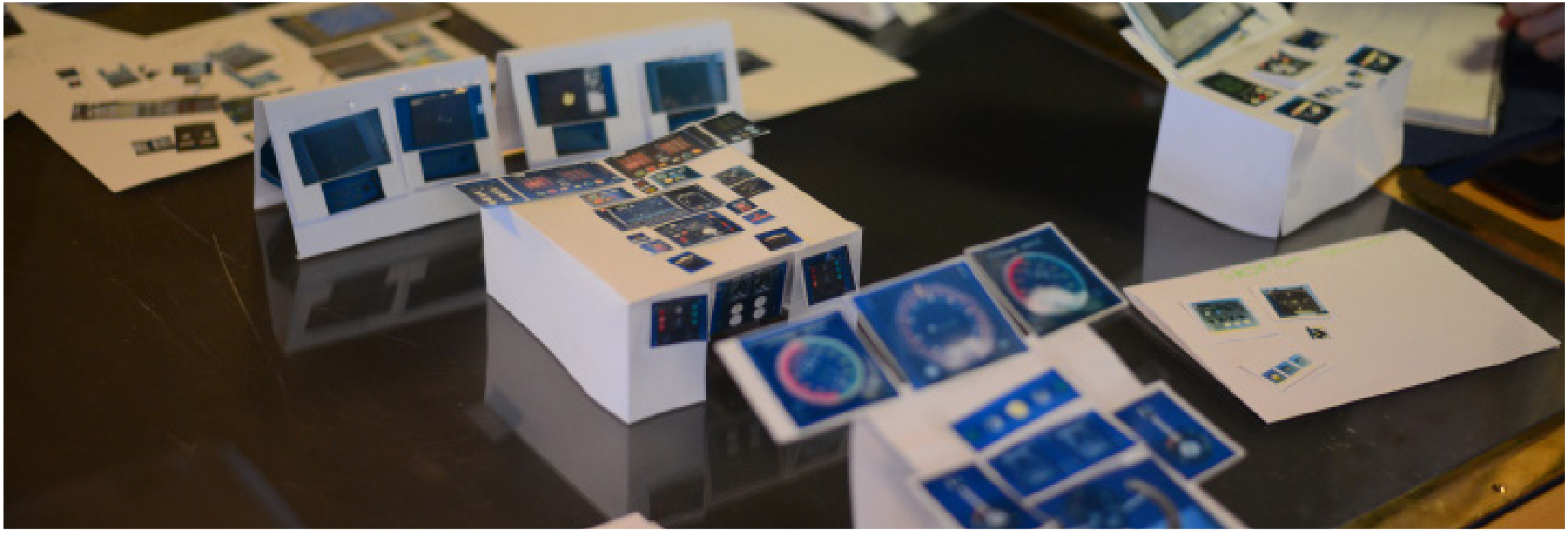
By facilitating the workshop within the bridge of the ship, we got the opportunity to walk around and discuss findings and solutions at the right situation or space. The pre cut and sorted out images of all components found on the bridge was throroughly discussed and the captain got to sort out and design his prefered layout.

State of the art bridge design was presented by showing pictures and we discussed if some of the features found in newer designs had relevance for arctic going vessels. It`s interesting to see how important the physical components on new design are, and how less important functions are being combined in touch screens.

The workshop started out with over 150 different screens, switches, panels and controllers. We then sorted out the most important functions and made categories for a new design proposal. From state of the art bridge designs we made a category for components that could be combined in a touch screen.

Our design proposal aimed to make the bridge cleaner and place components in a ergonomical way. By using paper-prototyping tools we made a concept for both console design, layout of the consoles and placement of components on the different consoles.


G.M.LEINEBØ



Reflections and results from the cardsorting exercise

The cardsorting exercise turned out to be a really good way to open up for discussions, conversations and interesting observations. I wanted to know which equipment that was placed around the bridge and how it was used. The interesting part was to discuss with the people using it every day, and get information on how they used the same components during different missions and operations. Some of the equipment was very specialized, but we would also find components that were used during almost every mission or operation every day.

The cardsorting exercise turned out to be a great way of discussing a lot of the things we had talked about earlier, and by printing and clip out the different components we could easily switch around and discuss different layouts and arrangements with the captain and others at the bridge.

By using paper and folding it into small boxes we quickly made a concept bridge together with the crew, and these small boxes were perfect starting points to design further when I came back to school.

I think it`s very interesting to see how these activities can start discussions where the crew want to take part and give insight into how life on the bridge is. For my future fieldstudies I want to make good preparations for these kind of exercises where as little as paper and a scissor is needed to design a need concept bridge.

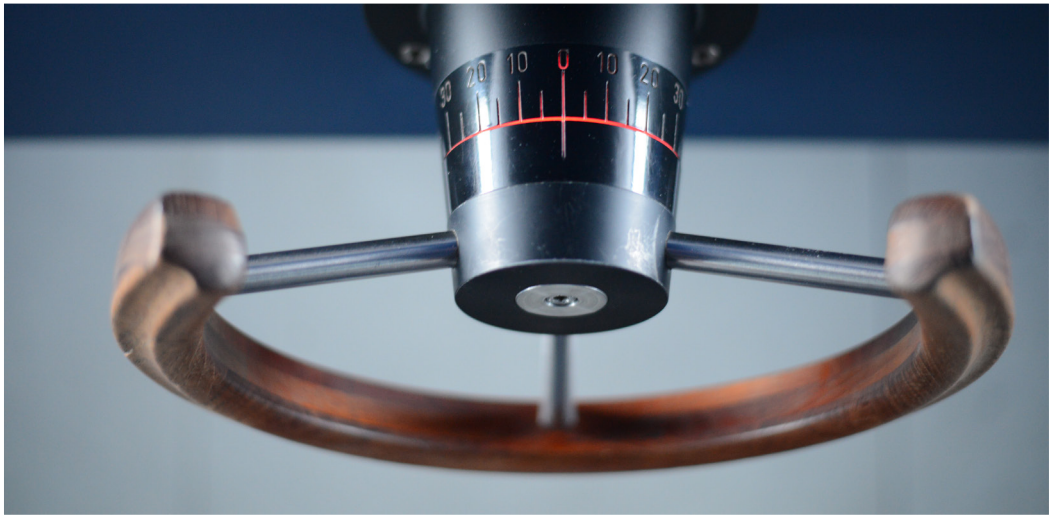
Findings and observations

Old but still doing the job

Most of the equipment of KV Svalbard hasn't been upgraded since it was built in 2001. This doesn't mean it isn't still doing its job and it was very interesting to see how high quality materials like wood, steel and aluminium is being used on highly used components to make them solid.

Other equipment like plastic keyboards andn ewer telephones had all big wear marks and often you could find taped plastic equipment.

This finding is a big inspiration and motiovation to me as a industrial designer showing just how important it is to use quality materials and consider the use and the context when designing products.



Ergonomics

The focus on human factors and ergonomics has changed a lot the last 17 years, and it`s very interesting to see how people either learn or adapts to use the equipment around them.

KV Svalbard had everything from low consoles without the ability to height adjust to roof mounted consoles so low that you had to bend down to look out of the window.

The picture to the right shows how low console makes the navigation officer operate the thruster controller on a very different way then intented when designing the controller.

Low consoles

Low consoles make it very difficult for higherr users to operate and steer the ship as intended. The consoles on KV Svalbard seems to be designed for people under 170cm high and as you can see on the picture to the right very tall people need to find ways of handling this issue to be able to steer the ship as intended.

The picture shows how one of the tallest navigational officers need to lift out a floor tile to be able to look out of the windows while steering the ship from one of the bridge wings.

Equipment obstructing sight

Roof mounted equipment can offer great visibility of screens and different instruments, but if they are mounted too low tall people won`t be able to see out of the windows without bending down. This results in the bridge not being used as intended, and it was very interesting to see how people had to adjust these design flaws and find creative solutions to handle these problems.

Operational room

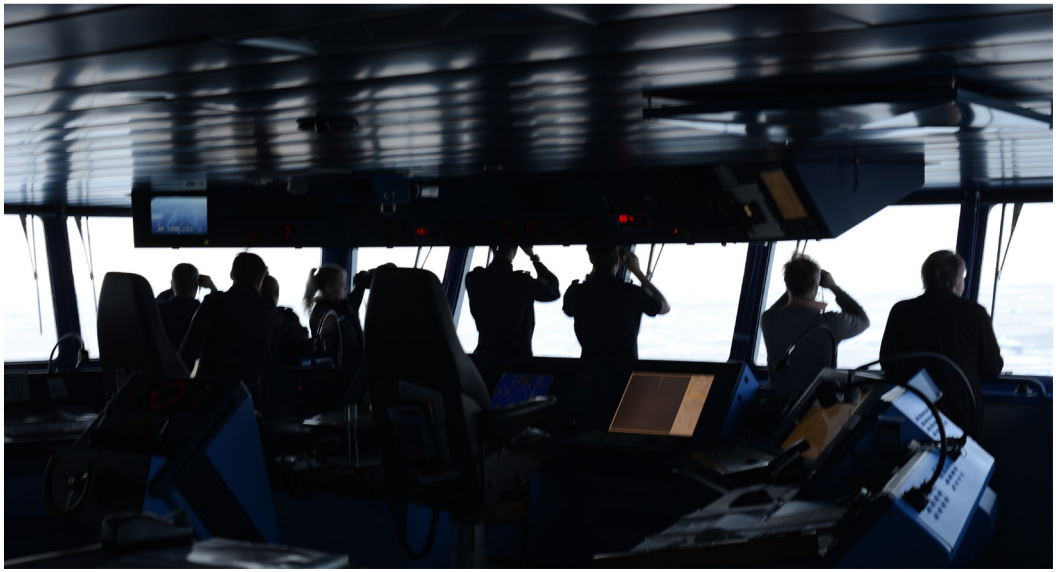
The operational room was used for everything from meetings, planning, debrief, brief and critical tasks like helicopter takeoff and landing.
The main purpose of the operational room is to have all of the officers stationed during missions and and f.ex. during a rescue mission this room is used to plan and execute the mission.

The room had a very bad layout which resulted in everyone sitting with the back towards eachother while they really wanted to discuss and have conversations during missions.

Bad room flow

On a exciting mission to Greenland with lots of exotic nature and possibility to observe a polar bear, the bridge was always full of people. This was seldom a problem for the officers navigating and steering the ship, but if there were a sudden issue and people had to get out of the way consoles were poorly placed which resulted in people not getting out of the way fast enough.

This could be solved by having smaler consoles several places instead of one big horseshoe shaped console which leaves no espace route if you need to move around quickly.



Labeling and instructions

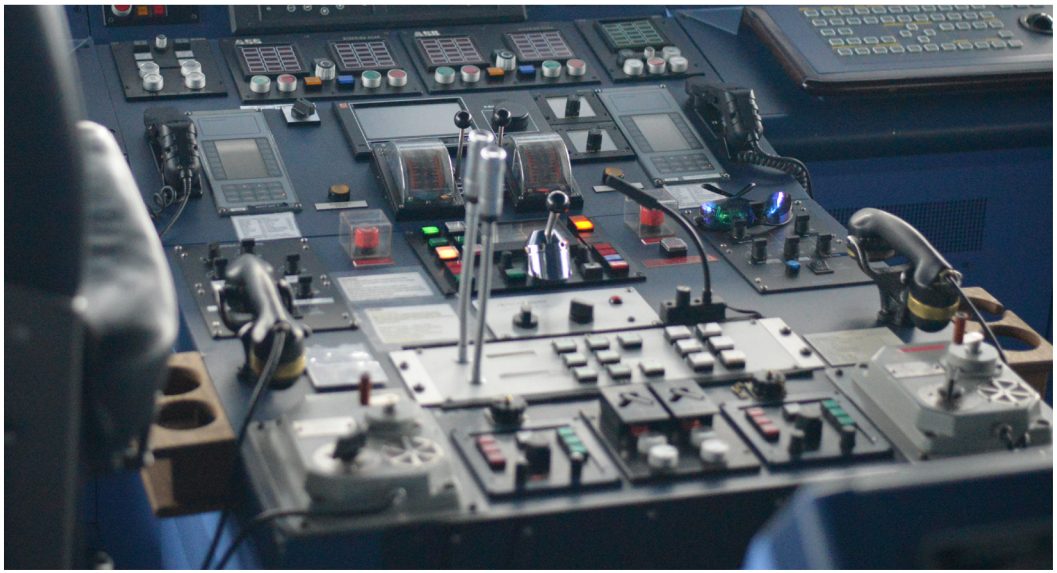
All the equipment is labeled and there are often instructions to be found on different equipment. This could be detailed instructions on not to use the equipment or it could be guidelines for how it should be operated in f.ex. bad weater.

A solution to this could be to have some kind of screen or a better system where text and information can be written and explained. Maybe you also could add the possibility to change the text and information for different modes or missions?

Several design = mess

Several producers delivering different switches and equipment results in a big mess of difference in design, size and color. This leaves a big mess on the consoles making it harder to reach for the right equipment at crucial moments.

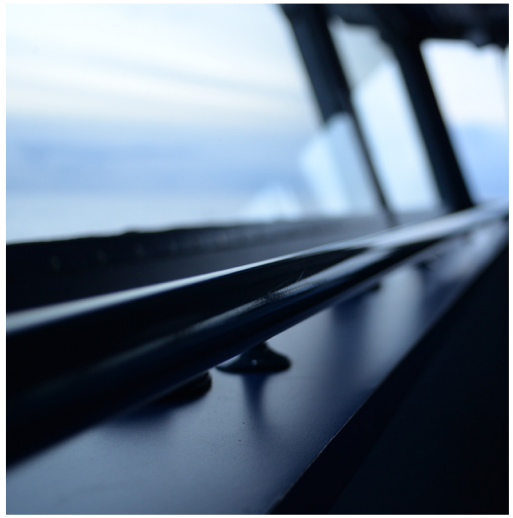
Could you have one design which every producer can follow, or is it possible to make a modular system where different producers can follow design rules to be a part of the system?

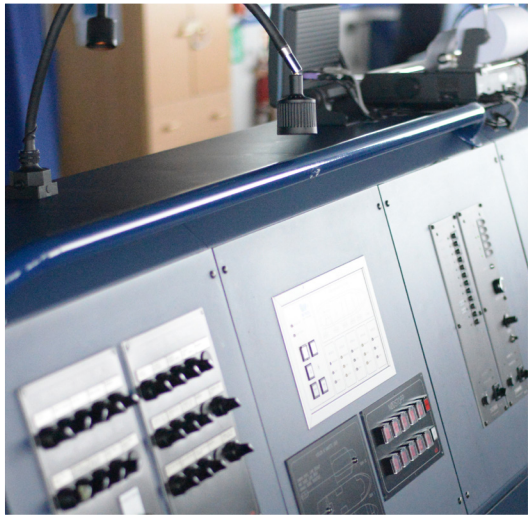


Handrails

I got to experience full storm and massive waves while going on the expedition onboard KVSvalbard. The picture on the right page shows how much the ship rolled during the storm. The picture is taken with a gyrostabilized camera perfect in level while the ship is rolling 30 degrees,

A solid handrail was my best friend during this experience and I now understand how important it is to have a solid and trustworthy handrail by your side.





Motion

Ships are never standing still and constant motion of the ship means you need to have precautions for storing and handling equipment.

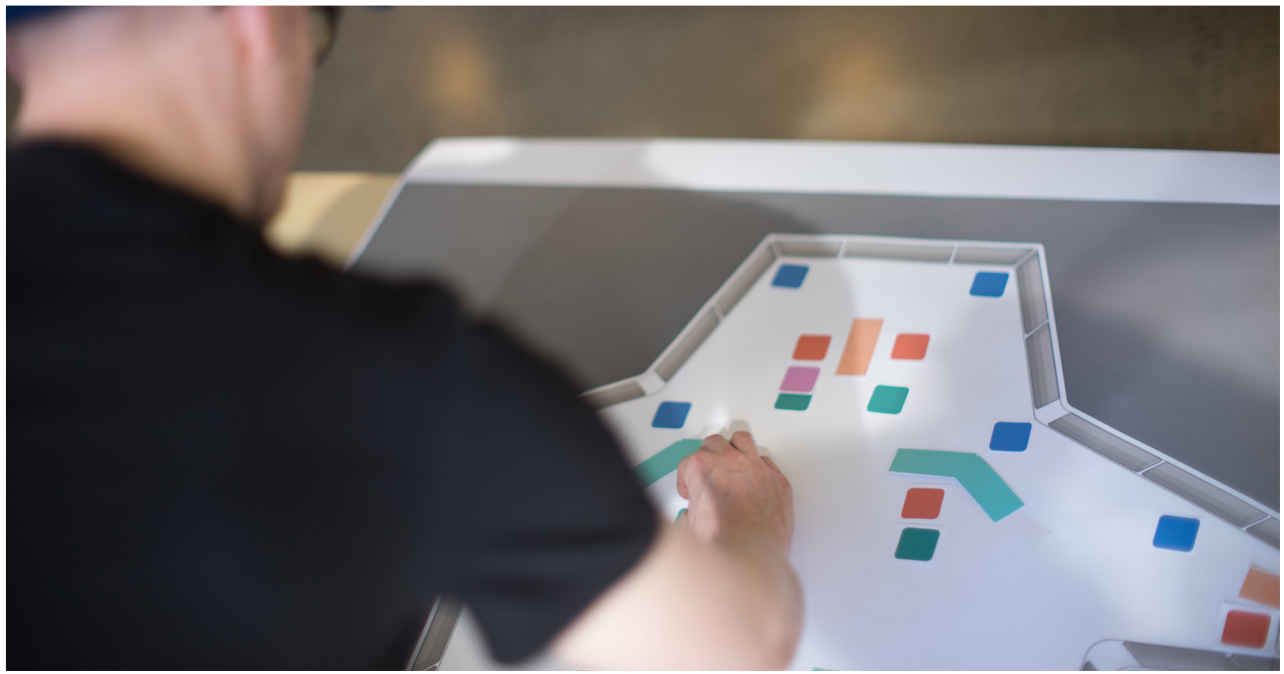
The picture to the right shows have the crew has made a wooden lock to keep the dresser locked during sailing.

Foto: Tom A. Østrem

Bridge layout

In order to aim for a better workflow and efficiency on the bridge, I had to look at the arrangement of consoles and seating. In order to work with this task I used the method quantitative structural analysis with physical objects. By moving and placing consoles and workstations around a printed floor plan of the bridge I could imagine how people would react and behave to the different setups. The result and arguments for the different findings are featured on following pages.

All photos: Gard Hagen



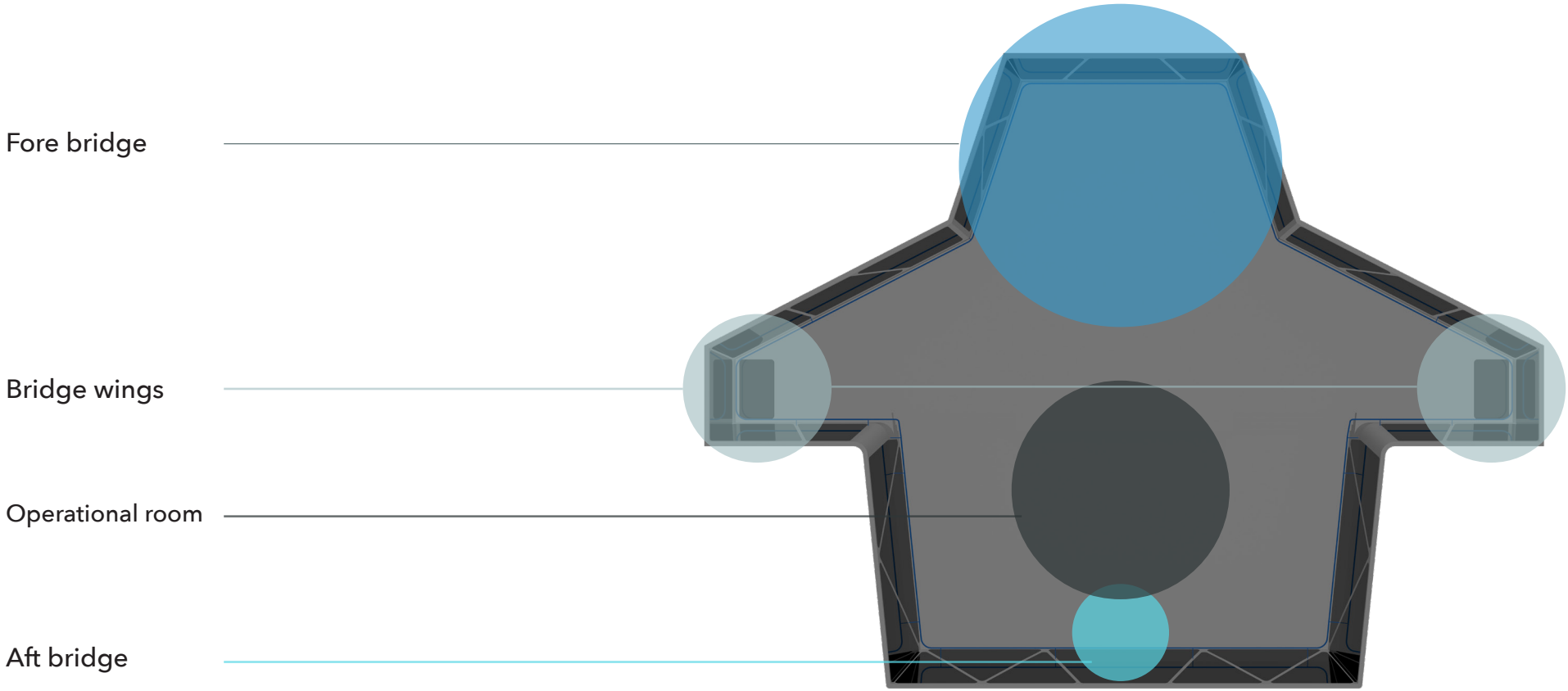
Bridge layout

The basics

The bridge is the nerve centre of a ship where everything from navigation and steering to operating and management of the ship is done. It is divided into 3 areas where steering of the ship can be done. ”Fore bridge”, ”bridge wings” and ”aft bridge”

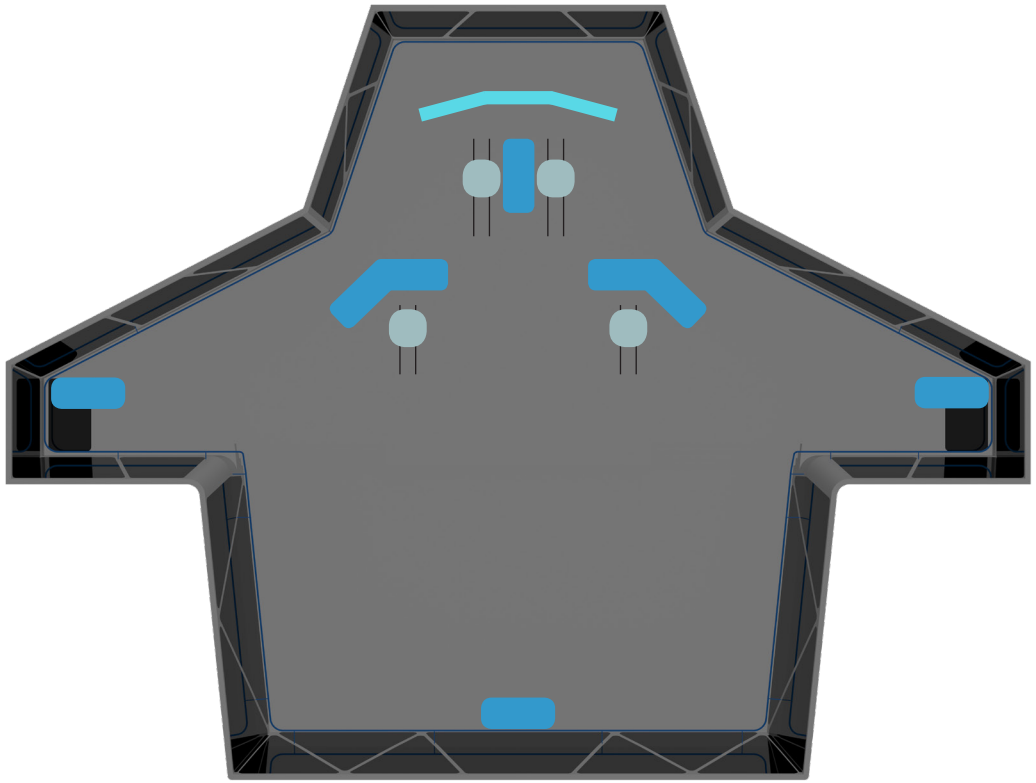
Operational room

Every ship has some kind of operational room where missions or operations are being handled. A coast guard vessel has a large operational room where everything from rescue missions, helicopter missions, oil spill and military related jobs are being controlled



Basic layout

The bridge layout below shows how a typical bridge is outfitted today. Everything related to navigation and planning is located in the fore bridge. The bridge wings are mostly used when docking and leaving harbour.



= Floormounted screens

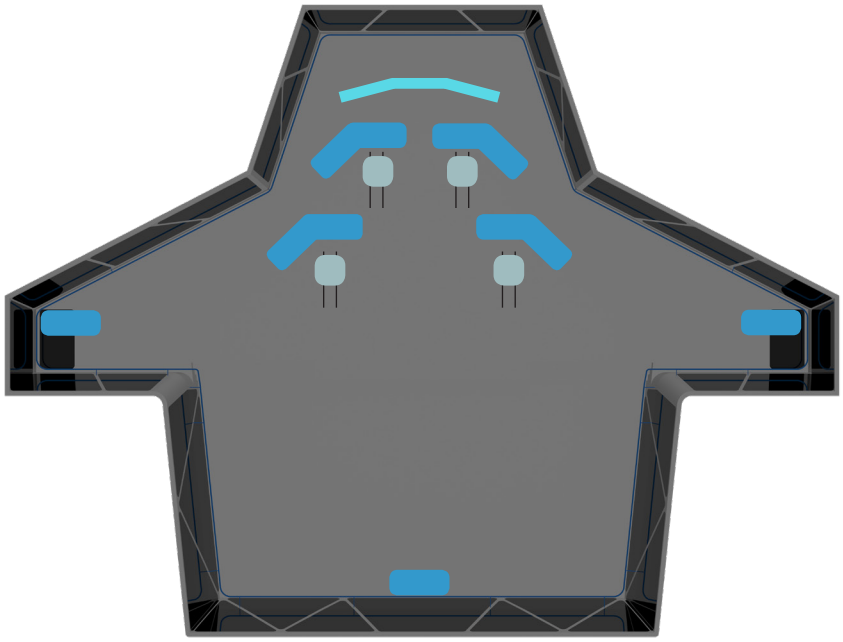
= console

= +

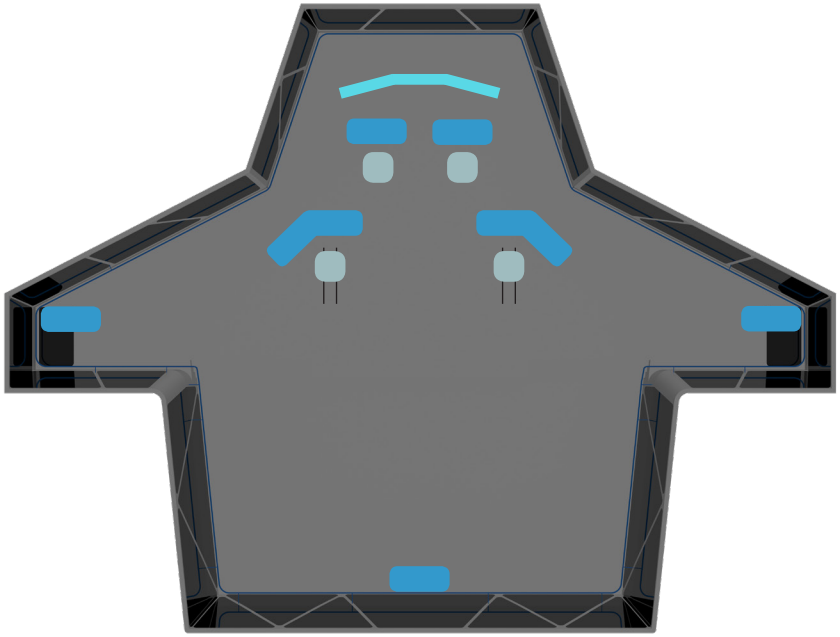
= chair with rail

= chair

Front bridge setup
ABB thruster system
Lots of switches



Front bridge setup
Kongsberg thruster system
Many switches need extra space



Components

Modular pieces

Modularity can be a fantastic feature, but it can also result in a weak construction or simply bad user experience.

For the components of the console I wanted to make a modular system where different components could be installed in different ways and by time easily be replaced with a updated piece.

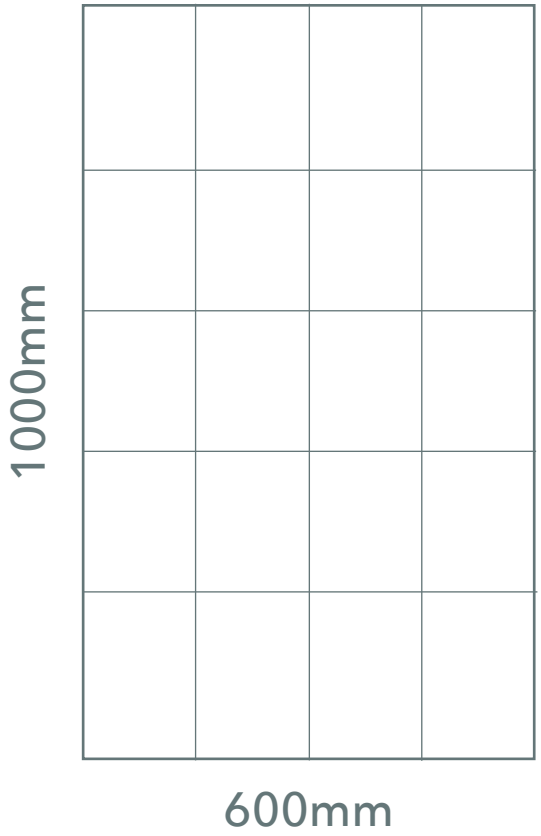
When making a modular top on the console where different tiles containing different equipment could be mounted and moved around, I had to start with looking into which equipment that needed space and what kind of space did they need?

The most necessary

The cardsorting exercise from KV Svalbard in combination with a mapping of the equipment being mounted on new ships today gave me a list of the most necessary equipment needed to navigate and steer a ship.

I made some digital mockups with realistic size to see how big the baseplate of the modular console would need to be to fit all of necessary equipment needed to steer and navigate a ship.

I checked the size of the VARD SeaQ systems consoles and ended up with having a baseplate of 100cm x 60cm. This would be enough to mount a basic layout of equipment.



2x touchscreens

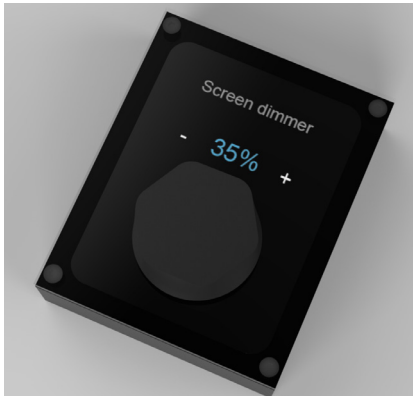
2x touchpads or roller-ball mouse to control floor standing screens

2x azipod thruster control-lers
1 for portside
1 for Starboard

1x tunnelthruster

1 x DP joystick

4x emergency STOP switches
2 for azipod thrusters
1 for tunnel thruster
1 for all engine stop



1 master dimmer switch for all screens

Fore bridge layout

Different needs

A state of the art system with every component and system integrated into a unified system where a touch screen can be used to change or adjust functions is a very user friendly and space consuming solution, but some producers and systems require space for specialized switches or components.

These two different needs, one requiring a touch screen and the other requiring space is the two kind of needs I have worked with in this project.

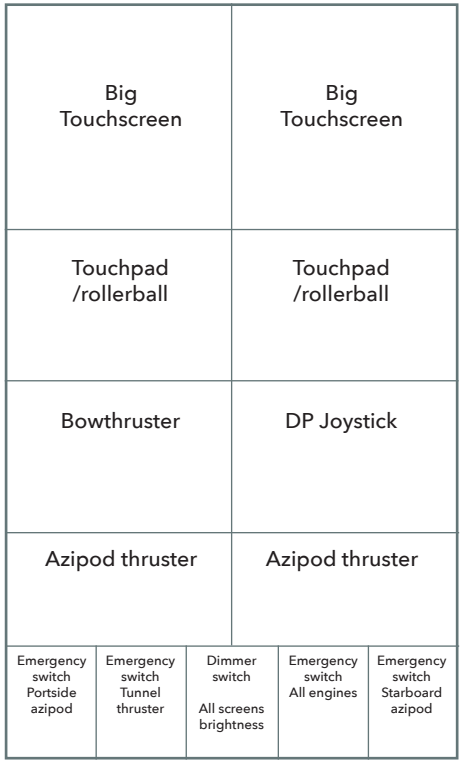
Change arrangement or add console

Different producers and ship types have different needs when it comes to both space and amount of modules.

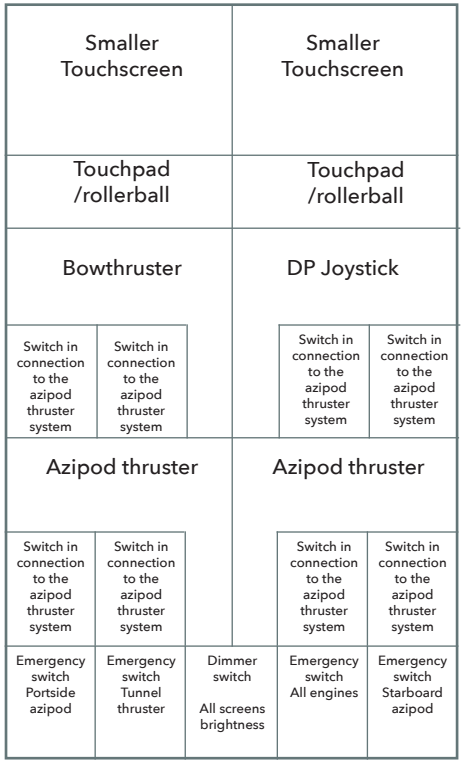
In a modular system, both arrangement of components within the console and adding a console if needed is possible.

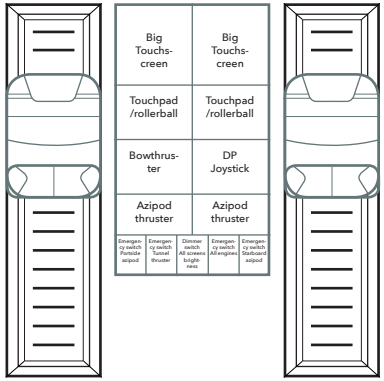
The illustrations on the next page shows how the system can be adapted to different needs and systems.

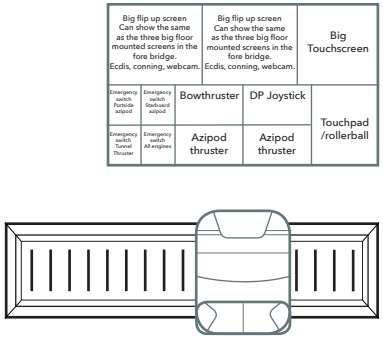
Setup with a thruster systems switches and levers implemented in the touchscreen

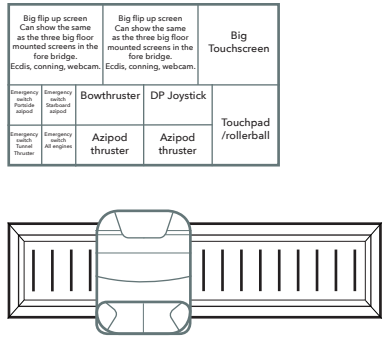


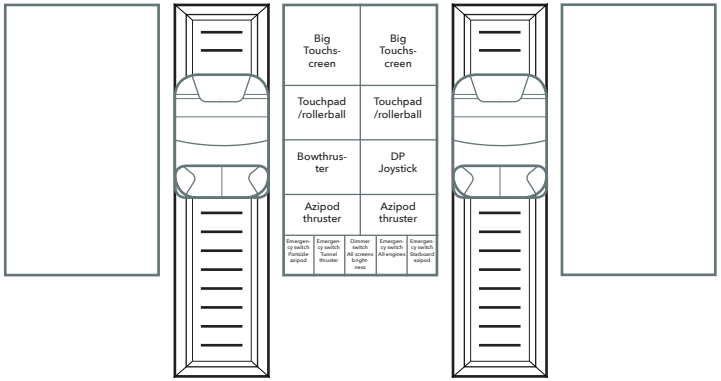
Setup with a thruster system not integrated in the touchscreen and extra space is needed on the console to fit more switches.

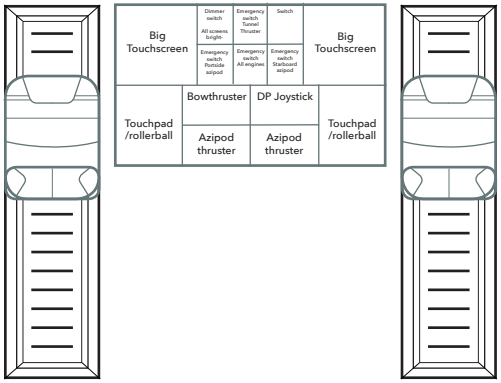



Big Touchs-creen
Big Touchs-creen
Touchpad /rollerball
Touchpad /rollerball
Bowthrus-ter
DP Joystick
Azipod thruster
Azipod thruster
Emergen-cy switch Portside azipod
Emergen-cy switch Tunnel thruster
Dimmer switch All screens bright-ness
Emergen-cy switch All engines
Emergen-cy switch Starboard azipod


Big flip up screen Can show the same as the three big floor mounted screens in the fore bridge. Ecdis, conning, webcam.
Big flip up screen Can show the same as the three big floor mounted screens in the fore bridge. Ecdis, conning, webcam.
Big Touchscreen
Emergency switch Portside azipod
Emergency switch Starboard azipod
Bowthruster
DP Joystick
Touchpad /rollerball
Emergency switch Tunnel Thruster
Emergency switch All engines
Azipod thruster
Azipod thruster


Big flip up screen Can show the same as the three big floor mounted screens in the fore bridge. Ecdis, conning, webcam.
Big flip up screen Can show the same as the three big floor mounted screens in the fore bridge. Ecdis, conning, webcam.
Big Touchscreen
Emergency switch Portside azipod
Emergency switch Starboard azipod
Bowthruster
DP Joystick
Touchpad /rollerball
Emergency switch Tunnel Thruster
Emergency switch All engines
Azipod thruster
Azipod thruster


Big Touchs-creen
Big Touchs-creen
Touchpad /rollerball
Touchpad /rollerball
Bowthrus-ter
DP Joystick
Azipod thruster
Azipod thruster
Emergen-cy switch Portside azipod
Emergen-cy switch Tunnel thruster
Dimmer switch All screens bright-ness
Emergen-cy switch All engines
Emergen-cy switch Starboard azipod


Big Touchscreen
Dimmer switch All screens bright-
Emergency switch Tunnel Thruster
Switch
Emergency switch Portside azipod
Emergency switch All engines
Emergency switch Starboard azipod
Big Touchscreen
Touchpad /rollerball
Bowthruster
DP Joystick
Azipod thruster
Azipod thruster
Touchpad /rollerball

One console layout

Modularity and placement testing

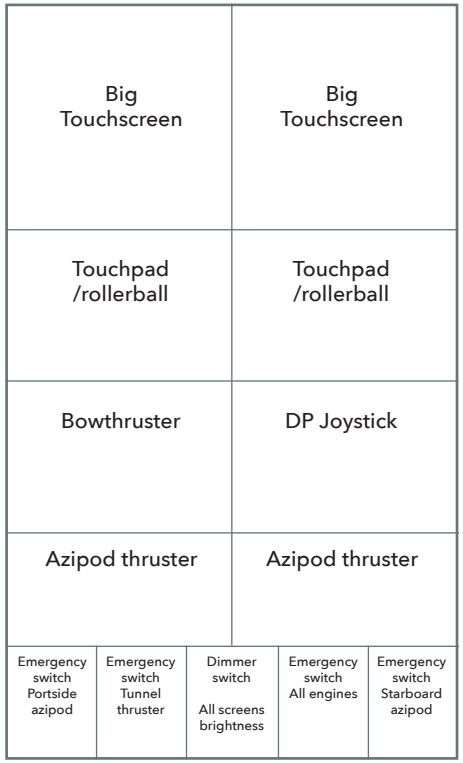
The idea of having just one console in the front is a thought I have been intrigued by ever since I started this project. It was therefore important to make mockups and do fast tests to see wether it was possible or not to have one single console in the fore bridge.

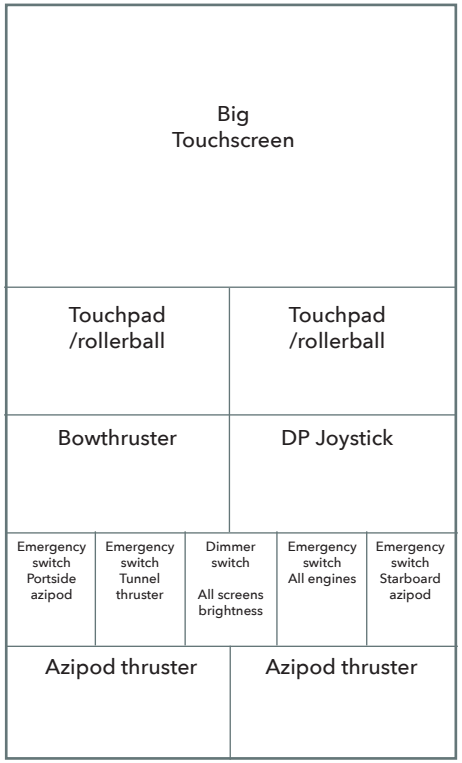
Today bridges have a double set of consoles in the front to give the operators the same equipment on both port and starboard side. My research and the observations done on field studies has shown me that there are very seldon two operators doing the exact same thing, and there are very seldom need of having double up of some equipment.

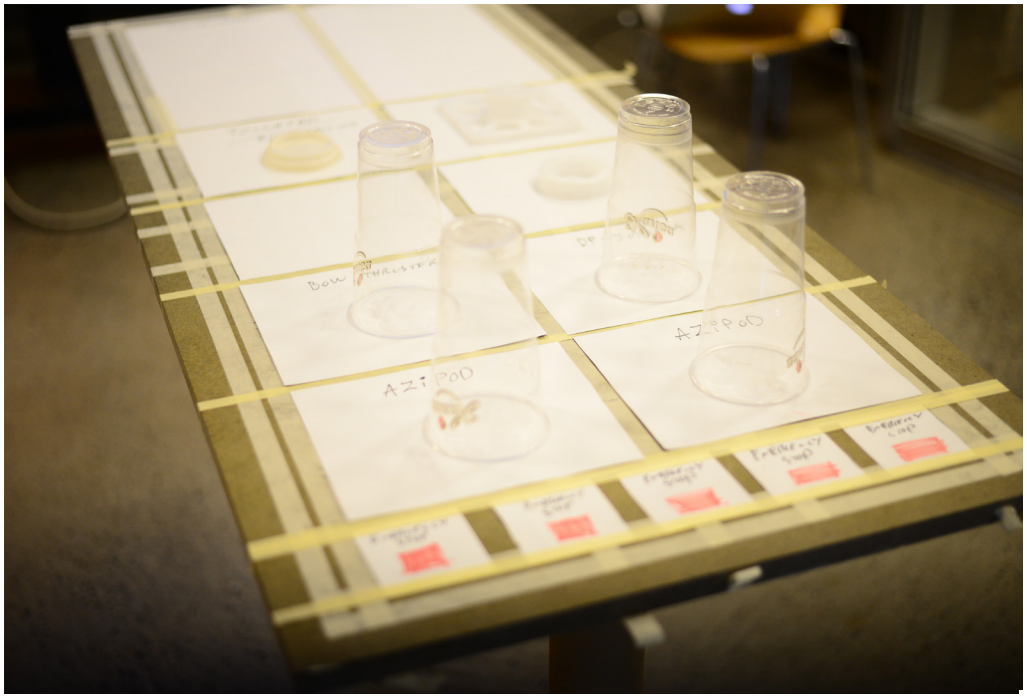
The most important components on the bridge: The equipment needed to navigate and steer the ship isn`t multiplied for both port and starboard, and the operators share the same controllers on the middle console.

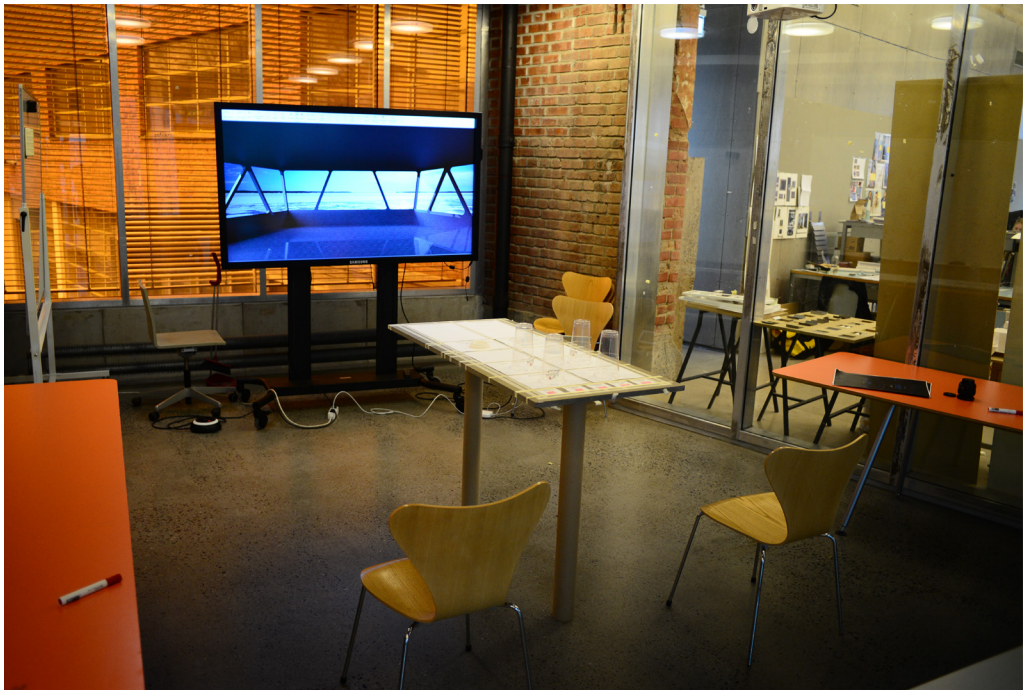
I have therefore tried to optimized the positioning of the main components on one console and rather moved the side consoles further back into a mixed planning/emergency station/computer station.

This solution would give a better separation between navigation and steering from other jobs like planning and observation of systems.









Testing arrangement of equipment

Getting the thoughts and ideas of the layout into a simple physical mockup was crucial to be able to test and discuss the different possibilities found within the modular system.

Would the system offer enough possibility for change? How modular should it really be?

After doing a session with different people with different height and arm length I quickly got feedback to the concept and size of the main module.

Wing & aft

One configuration

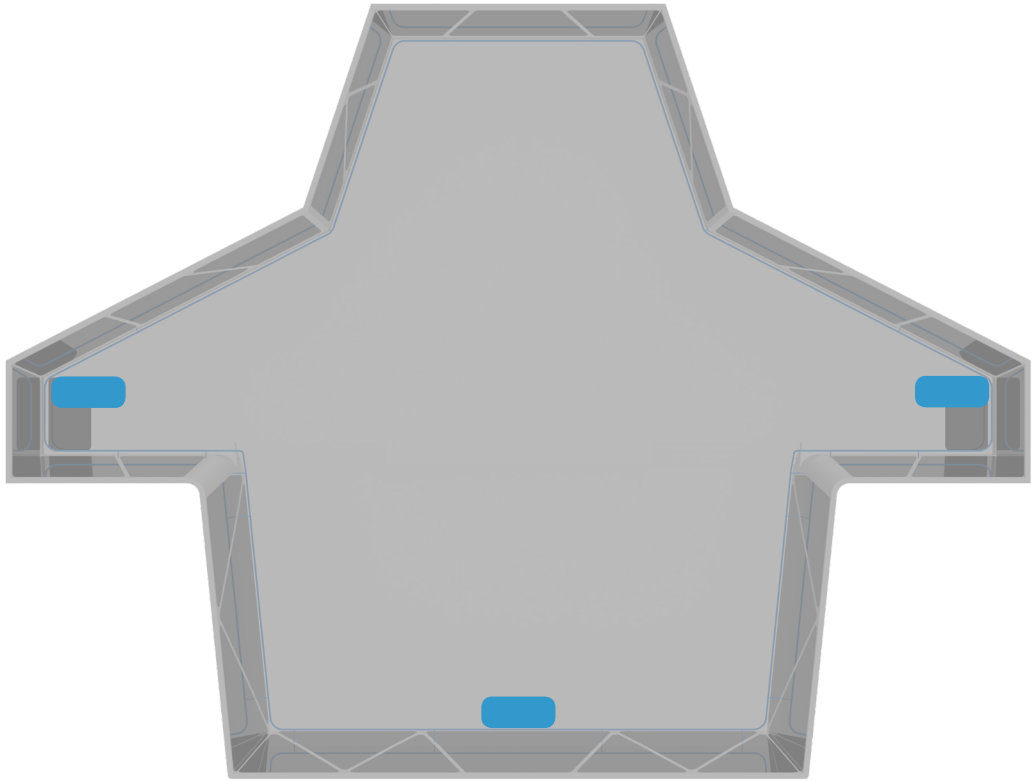
For the bridge wings and the aft bridge I wanted to make one layout that could work in all three places. Having just one layout ment less transition between different workstations and it also means that the crew dont`t need to learn the layout of different workstations.

I have rotated the single console 90 degrees so the user can access more equipment when standing on the long side of the console.

Since all of the consoles are based on a modular prinsiple all of them can be optimized for the different locations they are being placed. Both of the bridge wings will be mirrored on eachother with the power controllers near the windows on both sides.

Since the aft bridge is placed on the center of the ship it makes more sense to place the equipment symmetrical with the power components on the middle tiles.

The page to the right shows some different ways of arranging equipment on the bridge wing.



<table>
<tr><td colspan="2">Big flip up screen
Can show the same as the three big floor mounted screens in the fore bridge.
Ecdis, conning, webcam.</td><td colspan="2">Big flip up screen
Can show the same as the three big floor mounted screens in the fore bridge.
Ecdis, conning, webcam.</td><td>Big
Touchscreen</td></tr>
<tr><td rowspan="2">Touchpad
/rollerball</td><td>Emergency switch Portside azipod</td><td>Emergency switch Starboard azipod</td><td>Bowthruster</td><td>DP Joystick</td></tr>
<tr><td>Emergency switch Tunnel Thruster</td><td>Emergency switch All engines</td><td>Azipod thruster</td><td>Azipod thruster</td></tr>
</table>

<table>
<tr><td colspan="2">Big flip up screen
Can show the same as the three big floor mounted screens in the fore bridge.
Ecdis, conning, webcam.</td><td colspan="2">Big flip up screen
Can show the same as the three big floor mounted screens in the fore bridge.
Ecdis, conning, webcam.</td><td>Big
Touchscreen</td></tr>
<tr><td>Emergency switch Portside azipod</td><td>Emergency switch Starboard azipod</td><td>Bowthruster</td><td>DP Joystick</td><td rowspan="2">Touchpad
/rollerball</td></tr>
<tr><td>Emergency switch Tunnel Thruster</td><td>Emergency switch All engines</td><td>Azipod thruster</td><td>Azipod thruster</td></tr>
</table>

<table>
<tr><td colspan="2">Big flip up screen
Can show the same as the three big floor mounted screens in the fore bridge.
Ecdis, conning, webcam.</td><td>Big
Touchscreen</td><td colspan="2">Big flip up screen
Can show the same as the three big floor mounted screens in the fore bridge.
Ecdis, conning, webcam.</td></tr>
<tr><td rowspan="2"></td><td>Emergency switch Tunnel Thruster</td><td>Emergency switch All engines</td><td rowspan="2">Touchpad
/rollerball</td><td>Bowthruster</td><td>DP Joystick</td></tr>
<tr><td>Emergency switch Portside azipod</td><td>Emergency switch Starboard azipod</td><td>Azipod thruster</td><td>Azipod thruster</td></tr>
</table>

<table>
<tr><td colspan="2">Big flip up screen
Can show the same as the three big floor mounted screens in the fore bridge.
Ecdis, conning, webcam.</td><td colspan="4">Big flip up screen
Can show the same as the three big floor mounted screens in the fore bridge.
Ecdis, conning, webcam.</td></tr>
<tr><td rowspan="2">Big
Touchscreen</td><td rowspan="2">Touchpad
/rollerball</td><td>Emergency switch Tunnel Thruster</td><td>Emergency switch All engines</td><td>Bowthruster</td><td>DP Joystick</td></tr>
<tr><td>Emergency switch Portside azipod</td><td>Emergency switch Starboard azipod</td><td>Azipod thrus-ter</td><td>Azipod thrus-ter</td></tr>
</table>

Concept development

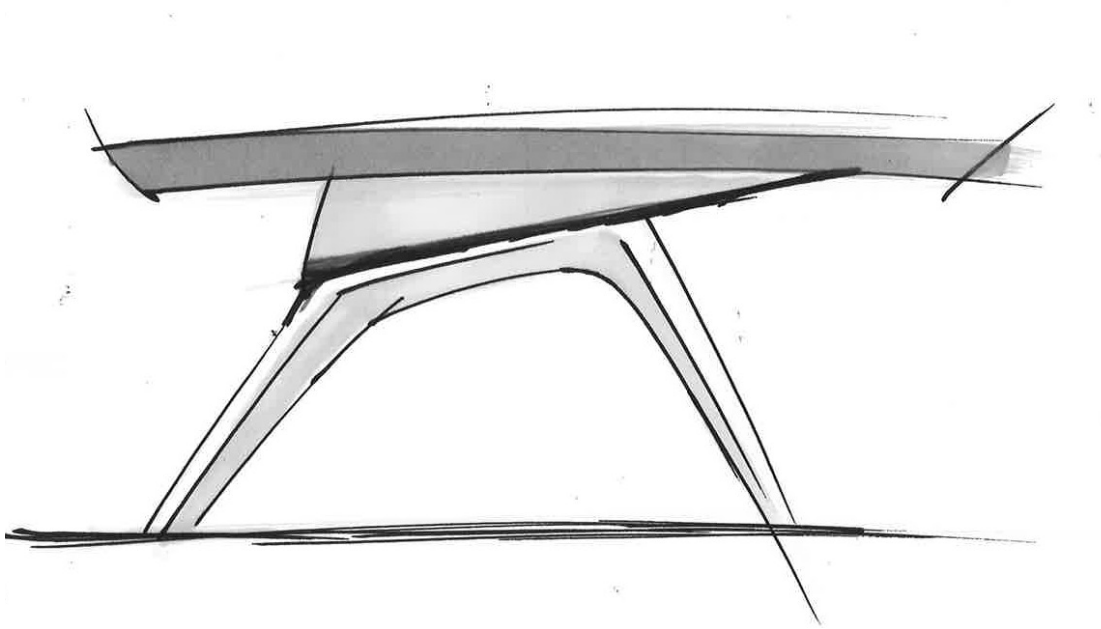
Quick sketches

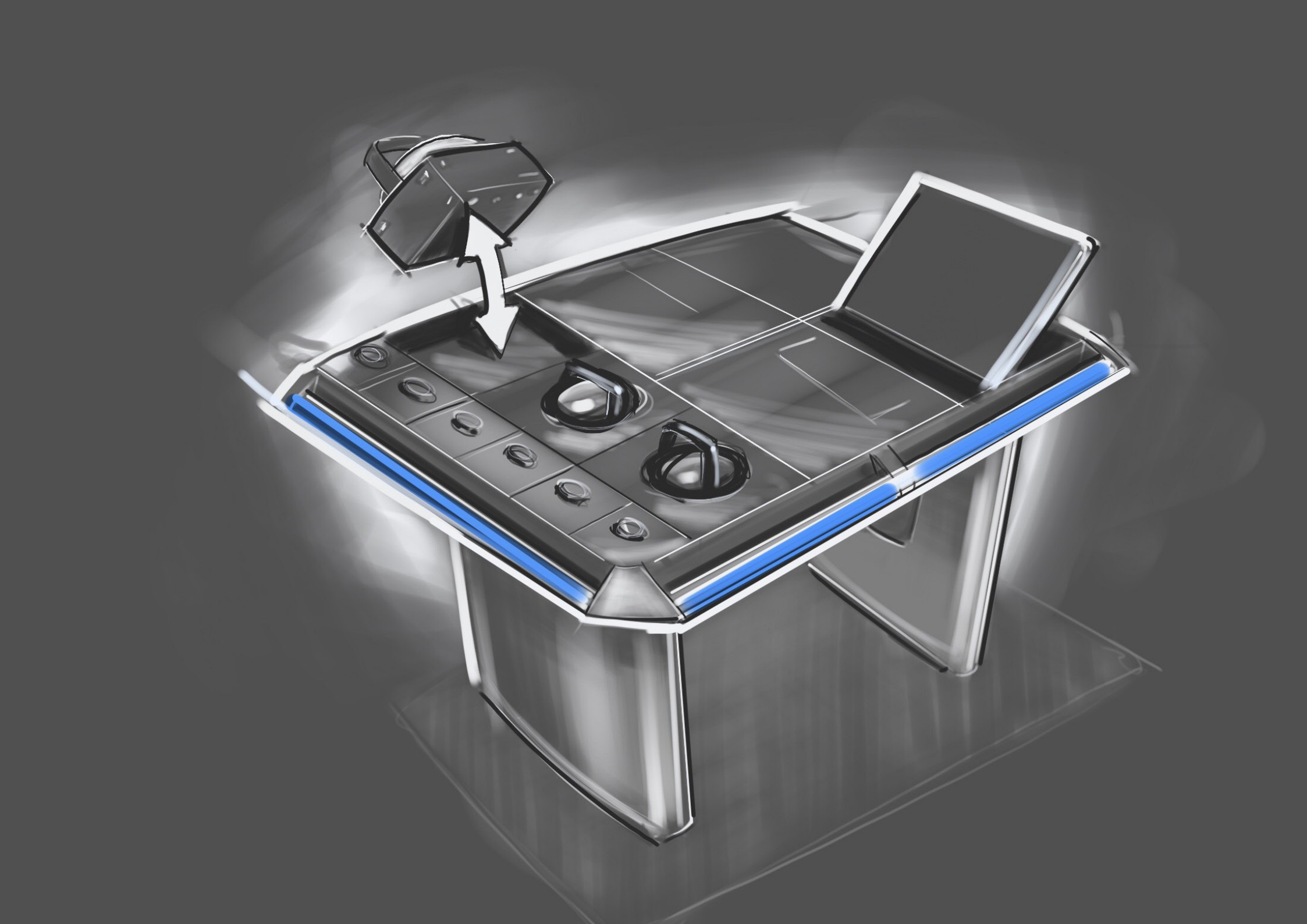
I have sketched throughout the whole project and worked with both shape and functionality within the product.

The two major form inputs were height adjustments and modularity.

How will a height adjustable modular console look like? Should the mechanic be visible? What about the equipment on top of the console? Should the modular pieces be visible? Should they be hided? How often should the console be moved? Should it be moved? What about handrail?

These were some questions I had during the sketch process, and I humoed back and forth between cad models and sketches trying to find a design that could be both clean, honest and functional.






96.3 m

Modular top

Early on in the project I had an idea of making a top plate of the console with different tiles for different equipment where tiles can be removed or changed for different missions and ship bridges.

This concept has been stuck throughout the whole process, but I`ve made some big changes from the first cad models you can see to the right.

The idea is to have a top plate with different modules that support different equipment. This can everything from thruster controllers, switches and joysticks to touchscreens and bigger monitors.

Tiles can be easily changed and the big questions is how often should they be changed and why should they be changed?

Underbody

I did a lot of sketching trying to find a direction for a underbody to support the top plate with the tiling concept.

The four different directions I looked into can be seen to the right on this page.

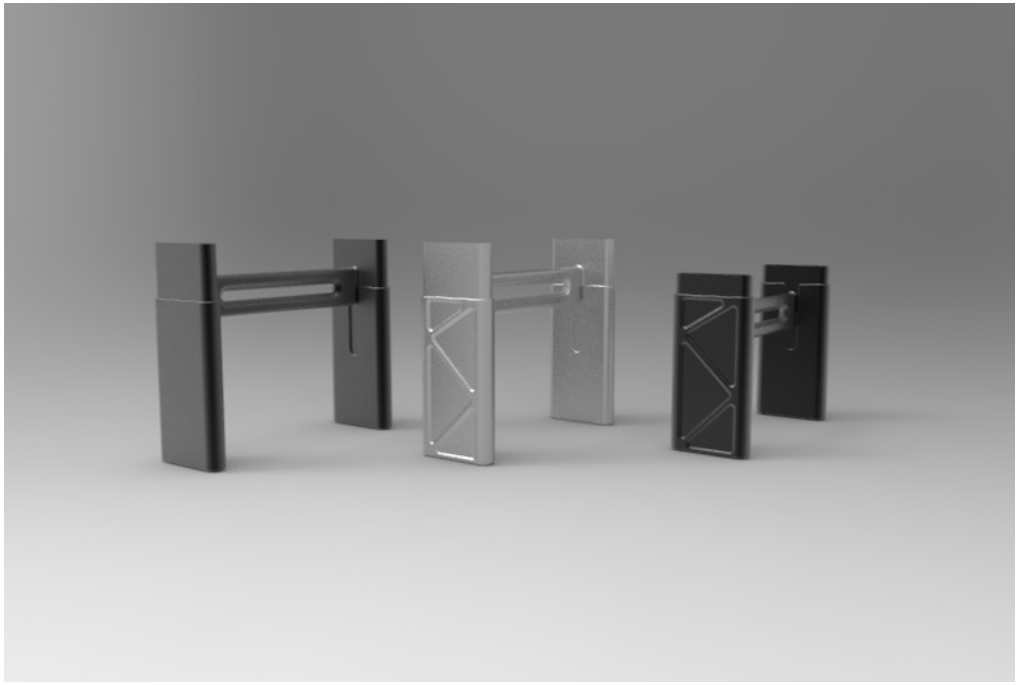
The directions were:

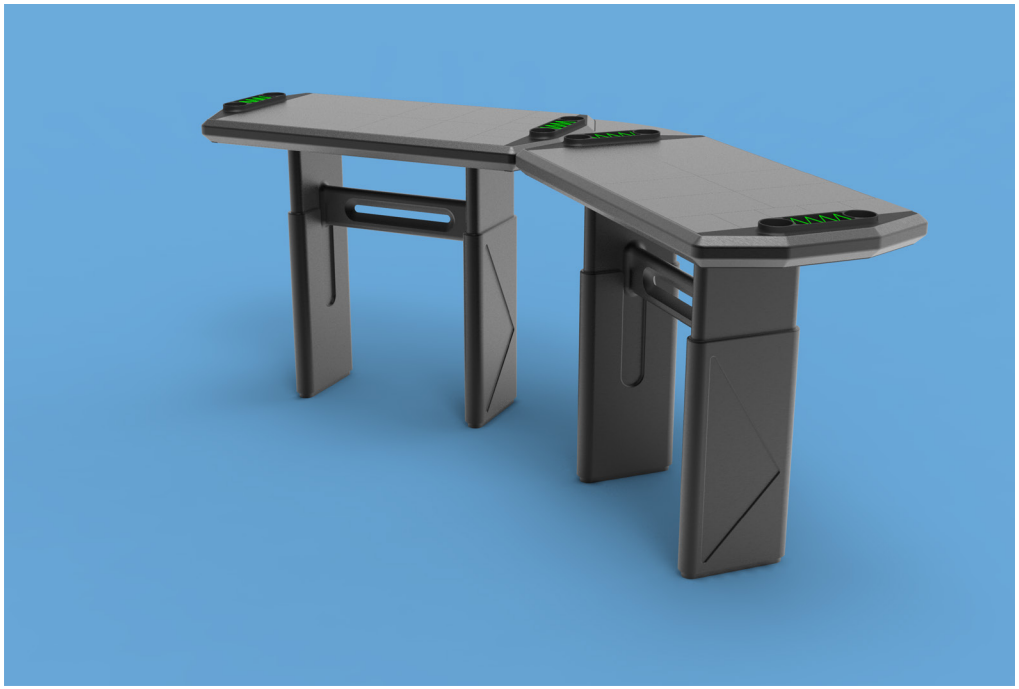
"Shape-shifter": I looked into how the shape of the console could be changed when adjusting the height of the console. I thought this was a fun direction, but all the problems regarding strength and stiffness made me jump of this concept

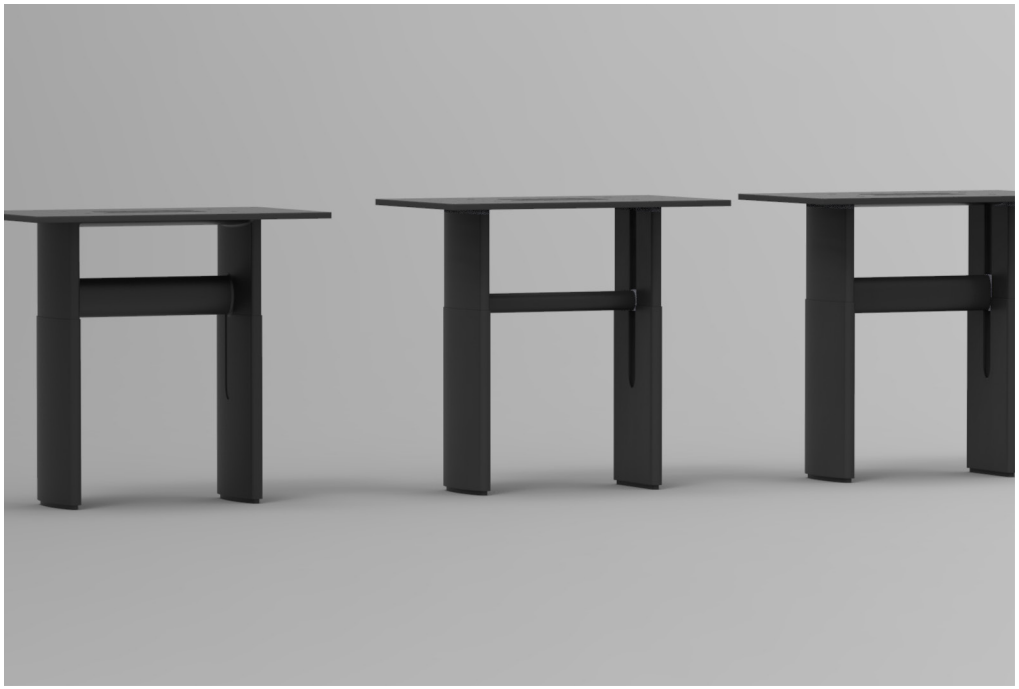
"Styling": I wanted to test some console renders with a styled and unhonest shape. This is nothing of what my moodboard wanted and this concept was also dropped.

"70s tubing": This concept was my big favourite for a while before I ended up with not being able to solve the mechanics of the tilted legs going up and down.

"Straight up": The last concept which is the concept I went for is a straight up console with a honest shape and a stabile and stiff structure. I went for this concept because it had potential in detailing and I really liked how honest and static it appears. The next page to the right shows further detailing of this concept until I reached the final iteration before delivery.







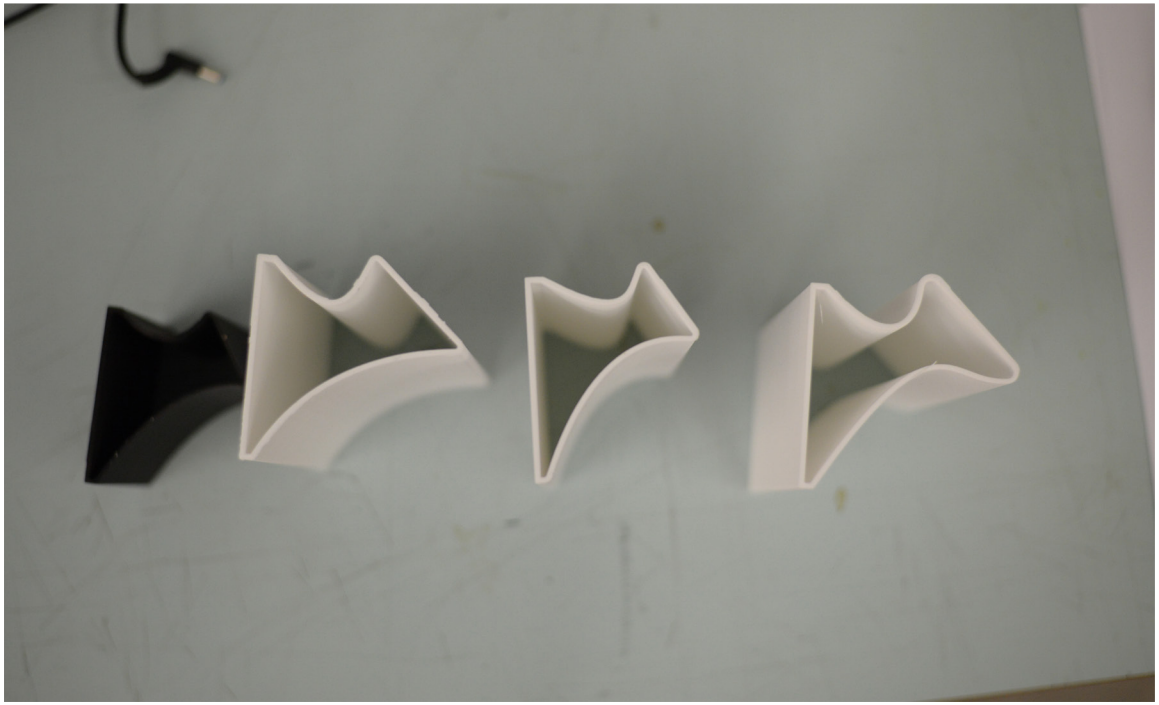
Handrail

Making a console with a handrail turned out to be trickier than I thought. There was no problem adding a conventional handrail to the console, but the issue was creating a nice bond without messing up the simple appereance of the console.

I wanted to have a handrail going around the console giving the navigational officers safety and support when needed. This could be during storms with much motion in the ship, or it could simply be to have a nice handle to get support whenever operating the ship.

I did a small exploration of different shaps and tested them on different people to see how they handled the grip and how secure they felt.

The conclusion was that the only handle that actually gave enough support was a conventional tube. After iterating on how the tube would connect to the console I found a solution I liked.



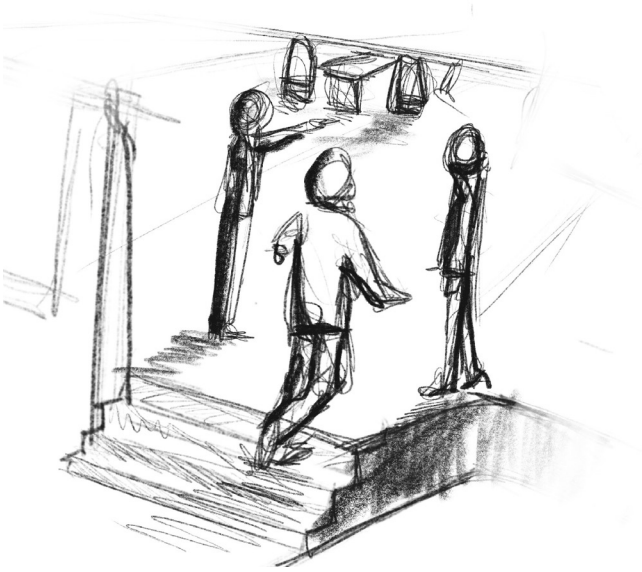
Research

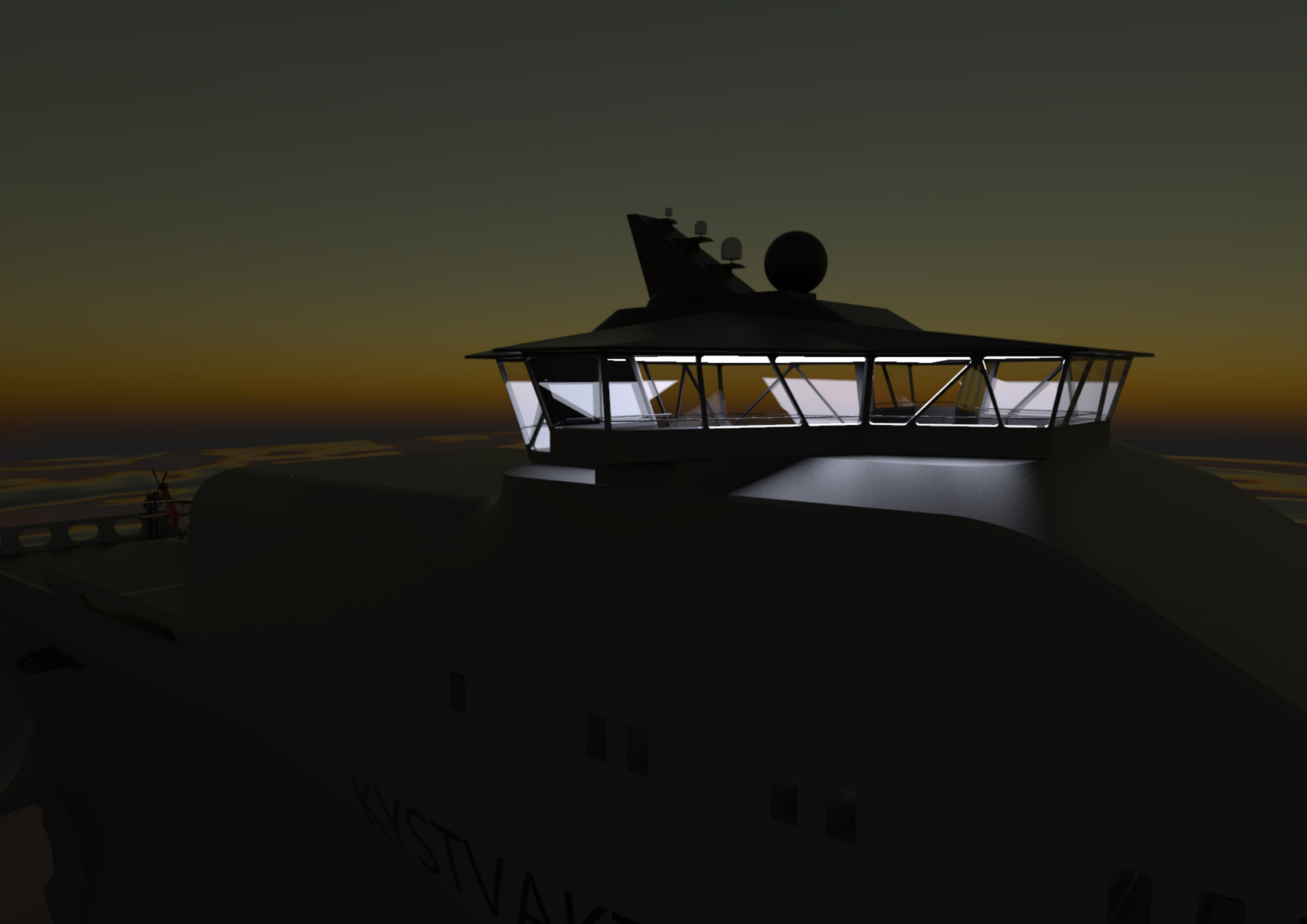
Development

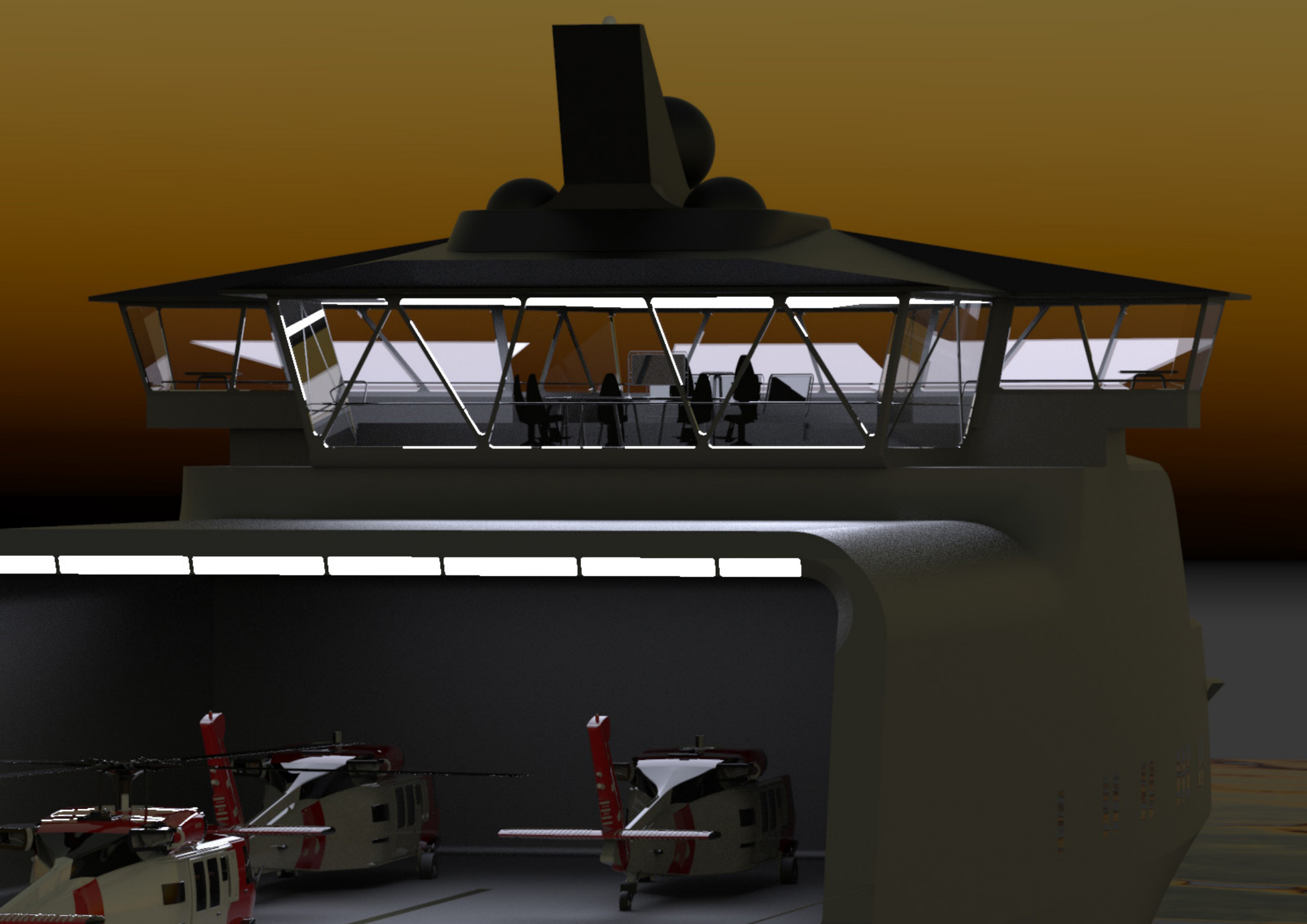
Delivery

Concept bridge

It was never my intention to design a whole new bridge during this semester, but my research and the trip to Greenland showed me just how important the relation between bridge layout and console layout is. I chose therefore to make a concept for how a new bridge layout for the Norwegian coast guard could be and after several discussions and interviews on the ship I made a final concept mixing ”A step forward”s aestethics and the feedback from KV Svalbard.







Thoughts and concepts for the new coast guard vessel

Spending 13 days on the bridge of KV Svalbard resulted in lots of ideas and thougts into how a next generation coast guard bridge could be designed.

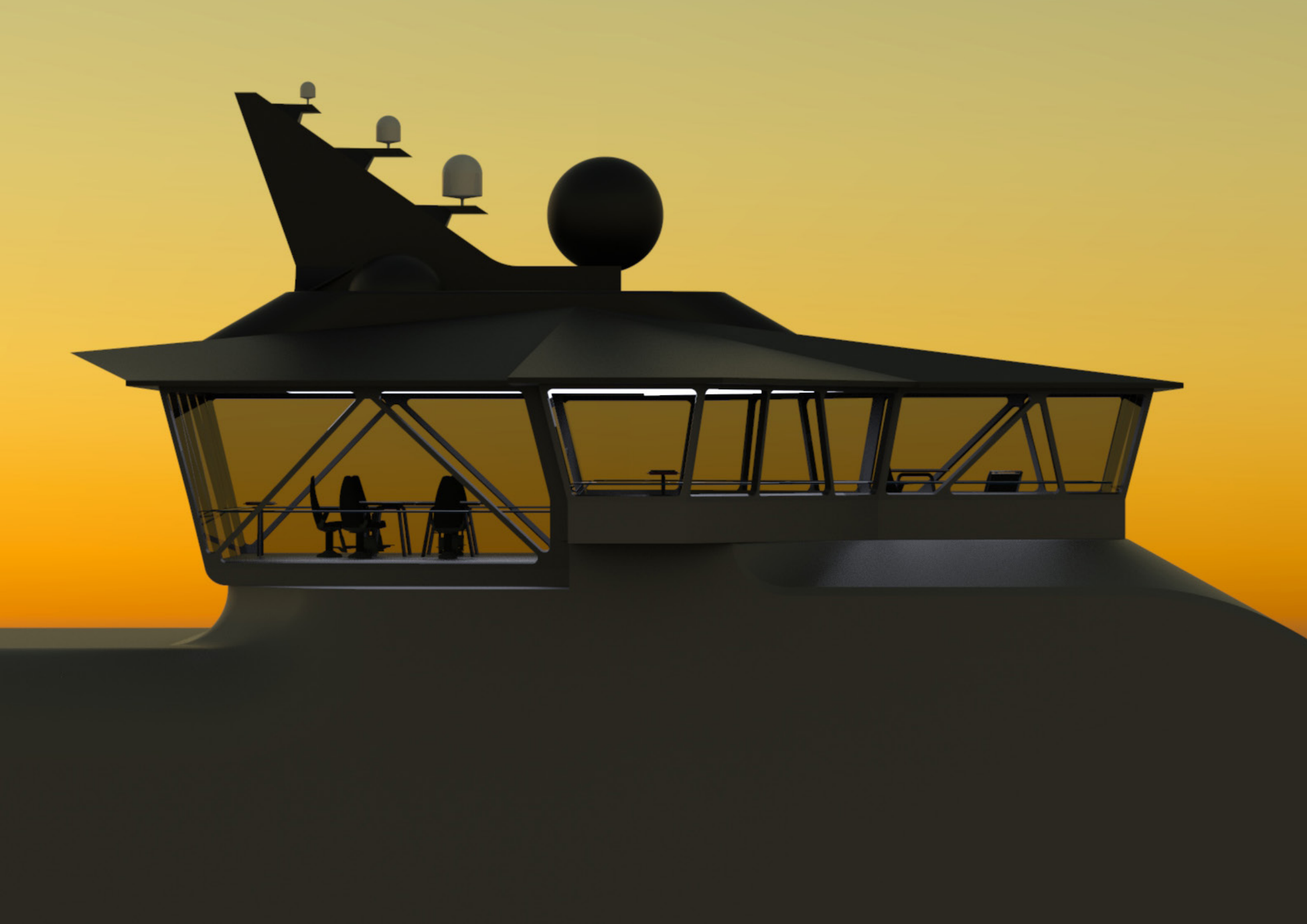
When designing a new bridge I looked into the bridge layout of KV Svalbard and discussed it with the captain. I introduced the thoughts made by Montaag when designing the concept ship ”A step forward” for Vard, and he gave me insight into his experience onbord different bridges on Norwegian coast guard vessels.

Engineers decide

When a new ship is being ordered the exterior design is the most important factor when winning a competition. The bridge layout is therefore in most cases based upon the exterior design of the ship, and after the exterior design is finished the bridge layout is handed over to the apartment in charge of decorating and instal-ling equipment inside the bridge.

Next step

When designing this conceptual bridge I wanted to use inspiration from ”A step forward” and include some of their aestetichs into a coast guard vessels bridge. I really liked the aestetichs of their Platform supply vessel, and it was a great excercise to try and create a concept that fits into the vision of how Vard wants to step into the future of maritime design.



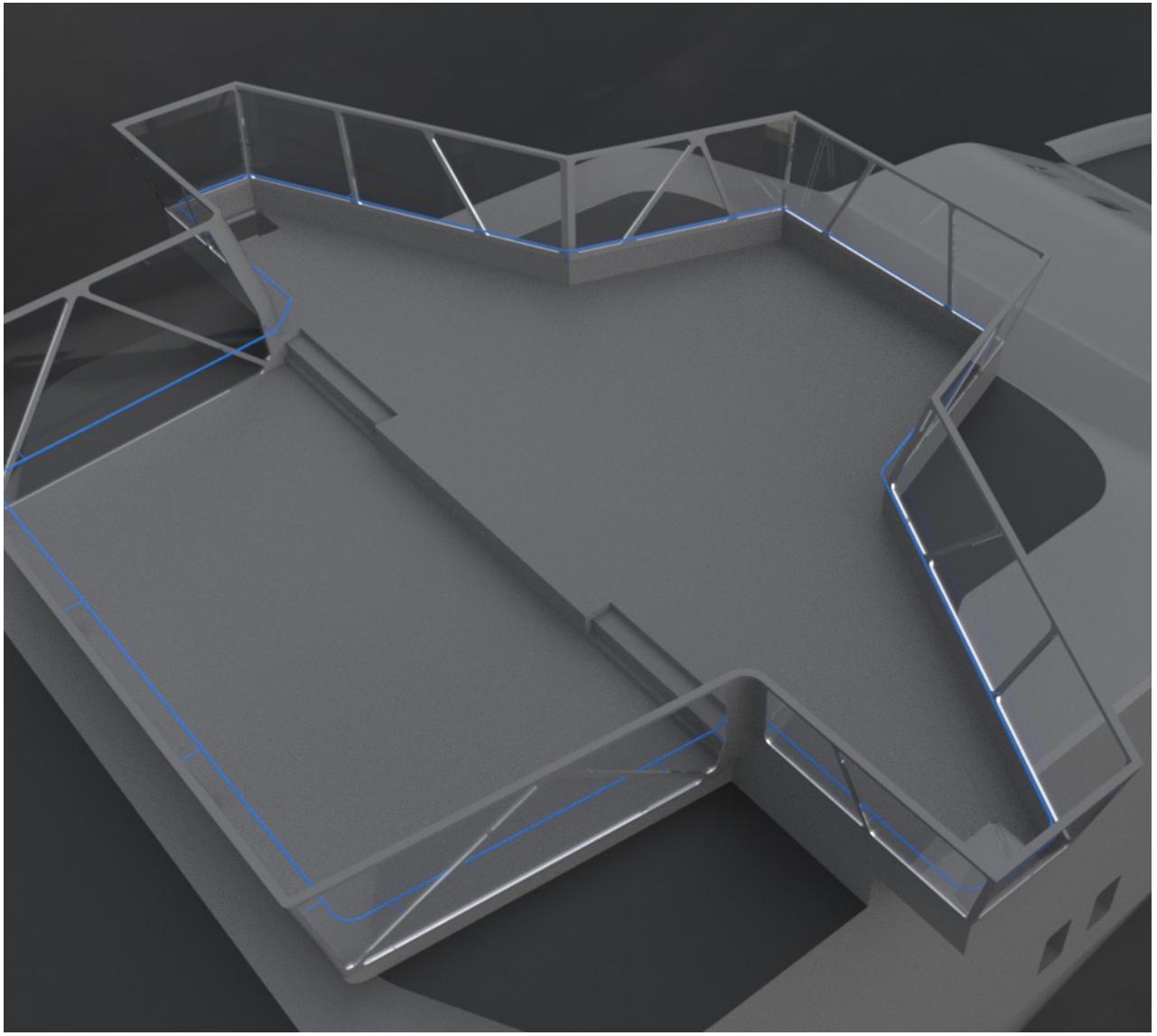
Half floor

Separating tasks

A coast guard vessel is a ship designed to handle lots of different missions and situations. The most special feature different from other civilian vessels is therefore the big operational room placed in the aft.

The operational room needs to work as a meeting place, warroom and during missions or expeditions be suited for specialised tasks.

Noise levels rise and stress is is a risk when navigation require a calm and comfortable environment at the same time crew working with the operation are doing stressfull and critical work where noise levels and activity rises.



Adding an extra floor to the bridge

The concept ”A step Forward” made by ”Montaag” observed and expierenced how the bridge was used for much more than just the navigational purpose of steering the ship.

Montaag made a concept for a whole new ship and which means they did both exterior and interior on the ship. This gave them a lot of freedom when designing the bridge and to reduce stress and noise on the navigational crew, they made a bridge separated in two floors with a operational floor and a navigational floor.

Discussing layout on KV Svalbard

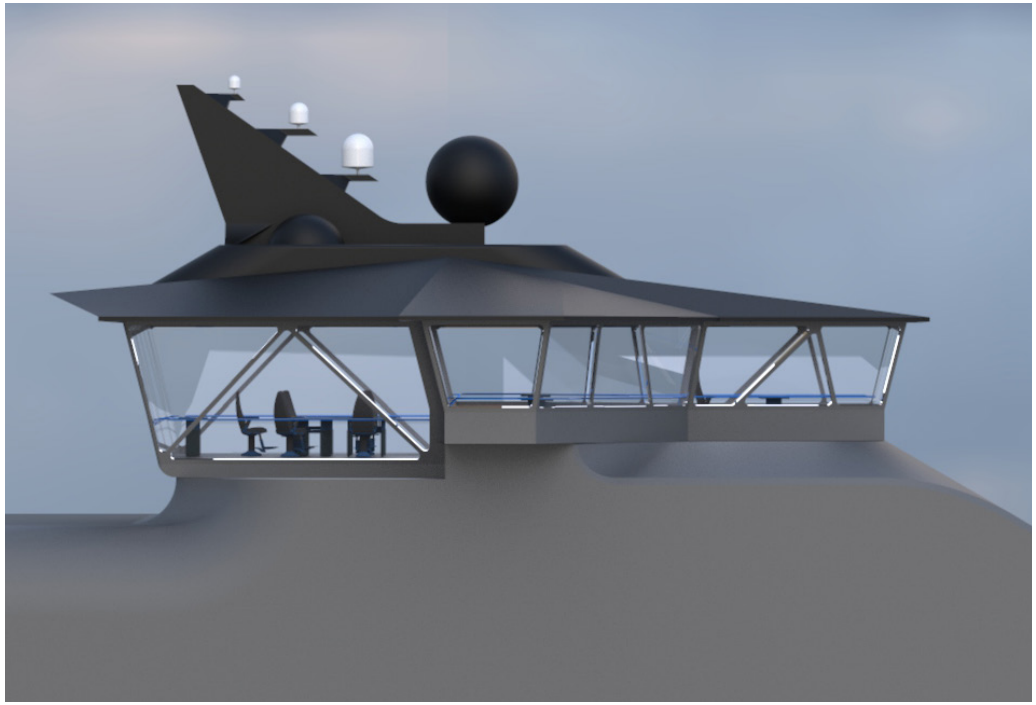
Spending 13 days on KV Svalbard showed me how important the bridge of a coast guard vessel is. It`s the nerve centre of the ship and it`s by far the most important meeting point during a mission or expedition.

Together with the captain and navigational officers I discussed bridge layouts and I showed pictures of ”A step forward” and other interesting layouts. They really liked the idea of having a second floor, but the big downside with ”A step forward” is that you`ll need to walk down a floor to steer the ship from the bridge wing. When breaking ice the ship is in 90 percent of the time steered from one of the wings making it a bad solution to walk down a floor to use the wings. I also did observations and learnt through interviews how important communication is during missions between navigation and operation.

Half floor

I really liked the idea of separating tasks on the bridge into two floors, but I thought that having the bridge wings on one floor and the rest of the navigational bridge on another like a bad solution for the coast guard. Especially after observing how much they walked from the fore bridge to the wings while breaking ice and sailing through shallow water.

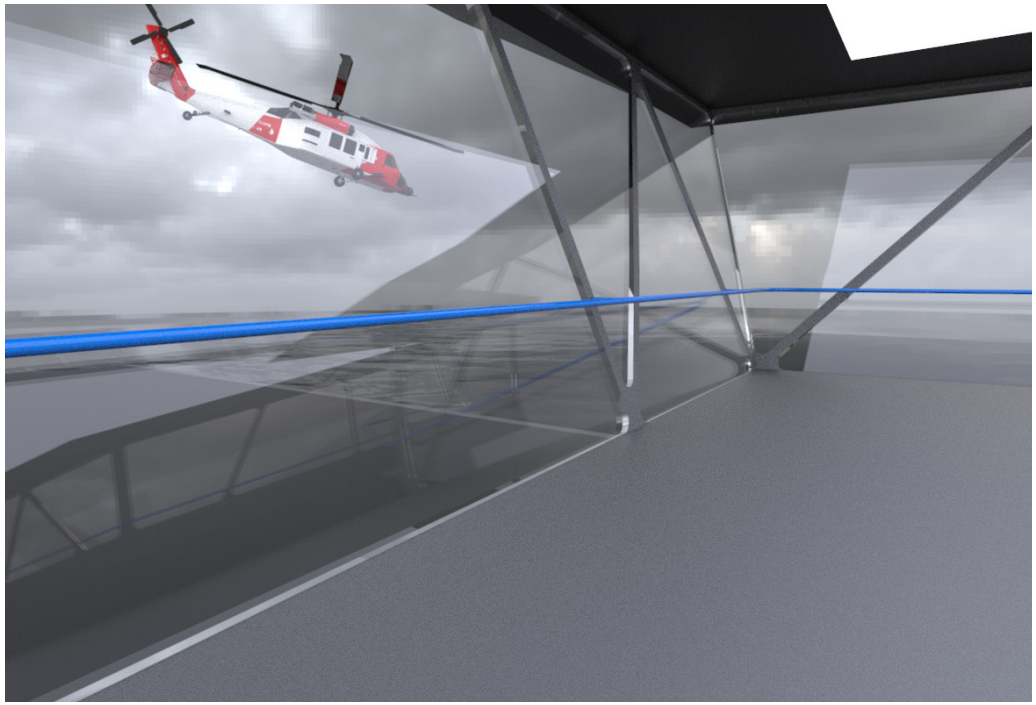
For the concept bridge I came up with the idea of separating the bridge by stepping down a half floor from the navigational bridge to the operational part. This would create a separation between the groups on the bridge during missions, but it wouldn`t kill communication or separate the bridge wings from the navigational bridge. .



Bigger windows

By adding a half floor to the operational part of the bridge, it was now possible to add bigger windows for greater view.

Interviews with the crew about missions gave me insight into how important it is to have great view from the operational room during missions. KV Svalbard would often work as a command central in f.ex. rescue or oil spill missions where it`s crucial to have visual confirmation of whats going on outside the bridge. I got to experience Helicoptermissions where the helicopter landed and took off, and I observed how the crew looked out the windows to have visual confirmation of the helicopter.

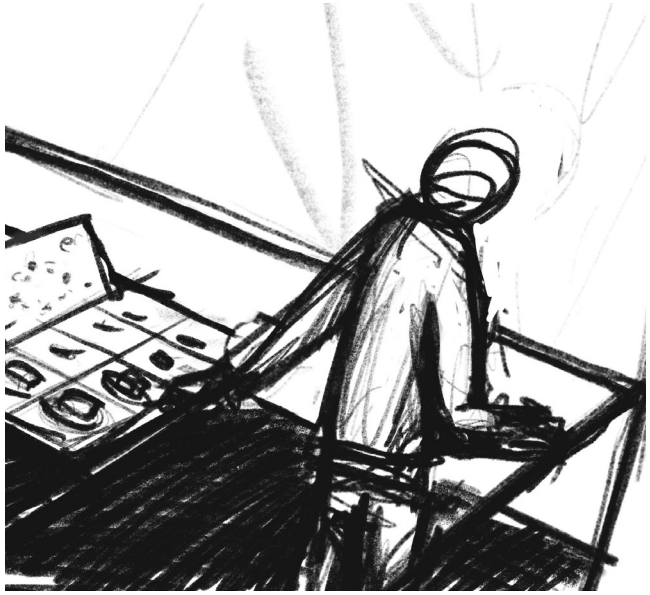



W313

Bridge wing

The biggest wish from the crew when talking about the bridge layout was the bridge wings. KV Svalbard doesn`t have wings that extend beyond the width of the ship which results in a lesser view of the side of the ship while steering from one of the wings.

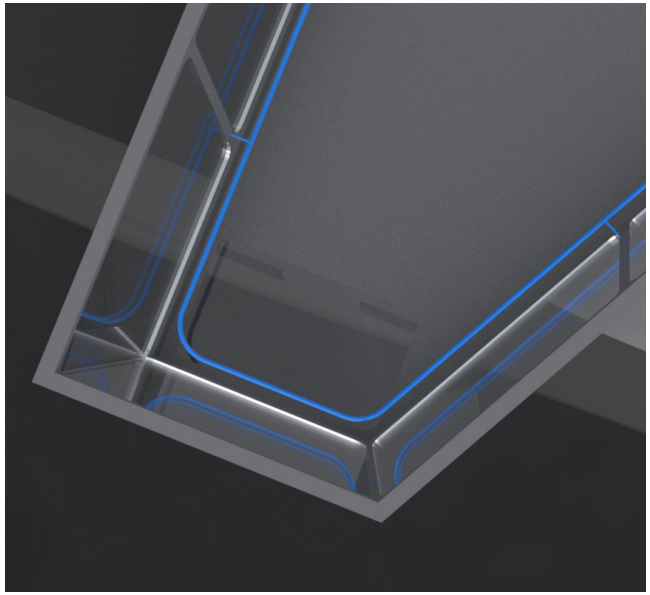
The concept bridge has therefore 1m extended wings for better view while steering from the wings. This will help with both laying the ship to port and navigating through ice.

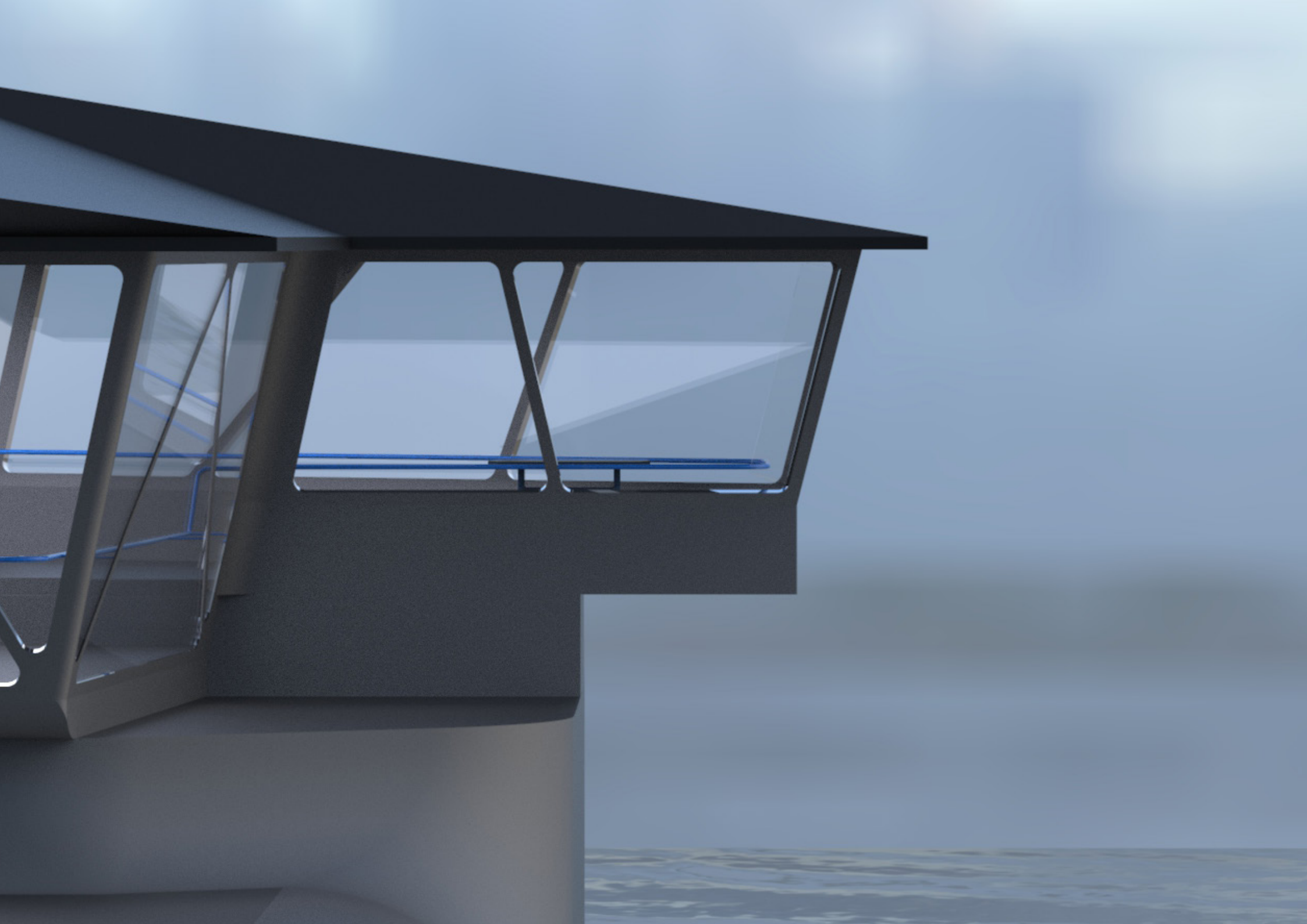


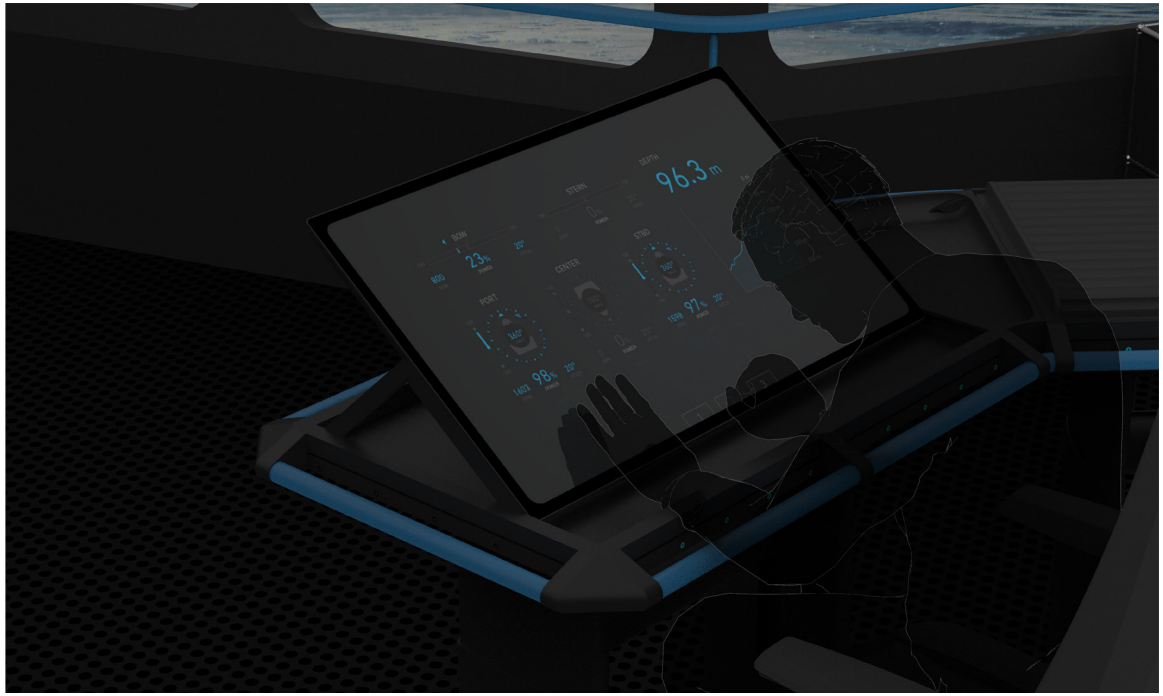
Windows

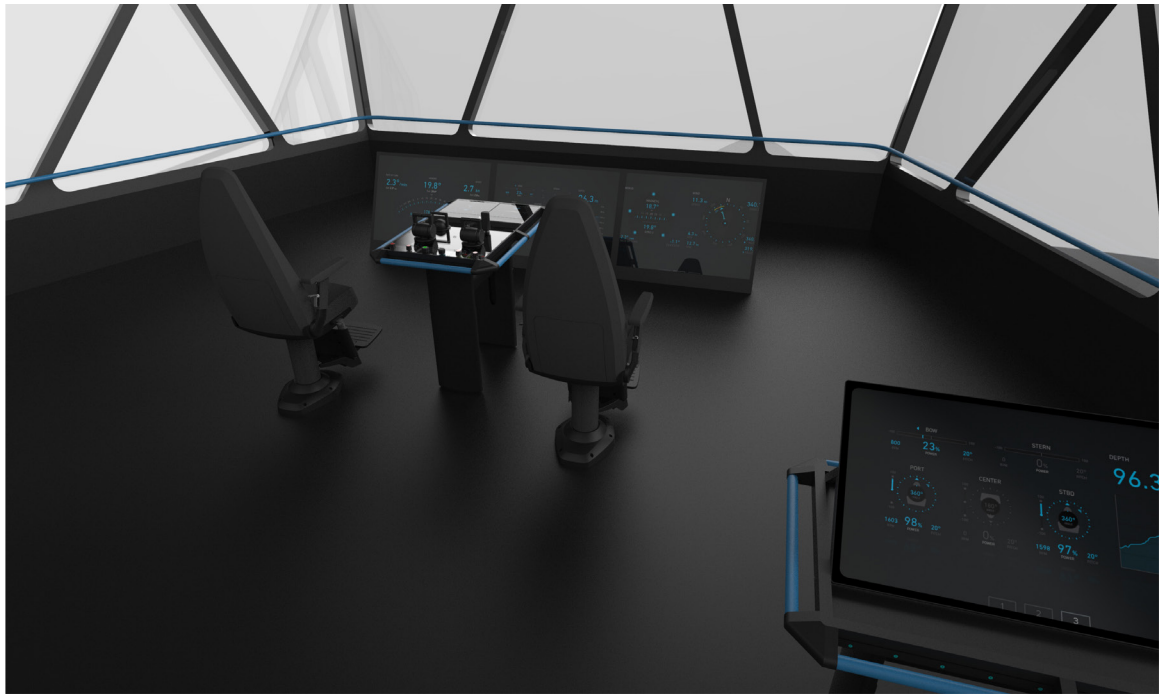
The other feature I discussed with the crew was to have windows in the floor on the bridge wing. This would enhance the view on the side of the ship, and my observations when breaking ice was that the navigators spent much time observing how the ice was cracked right under the wing. This resulted in a lot of stretching while steering to be able to see along the side of the ship.

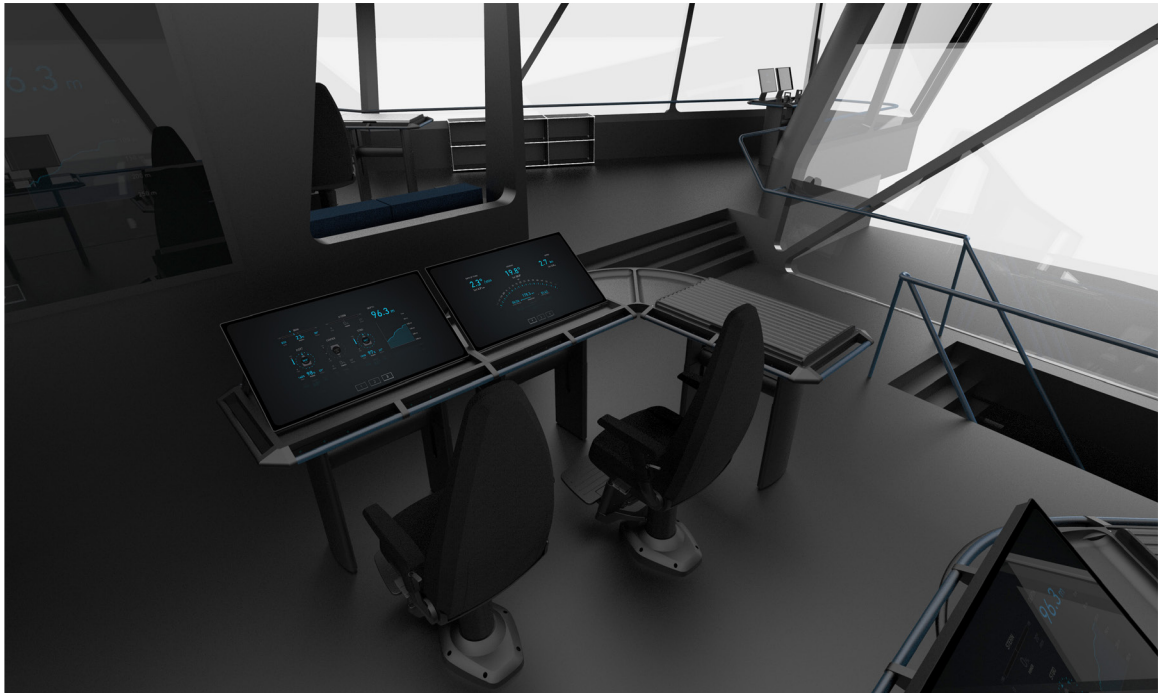
I have therefore added windows in the floor of this conceptual bridge so the navigators can have a better view while steering the ship from the wings.

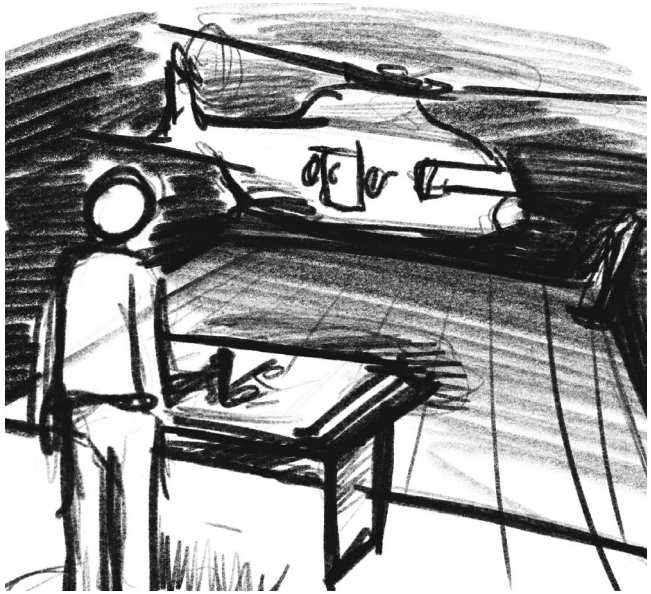


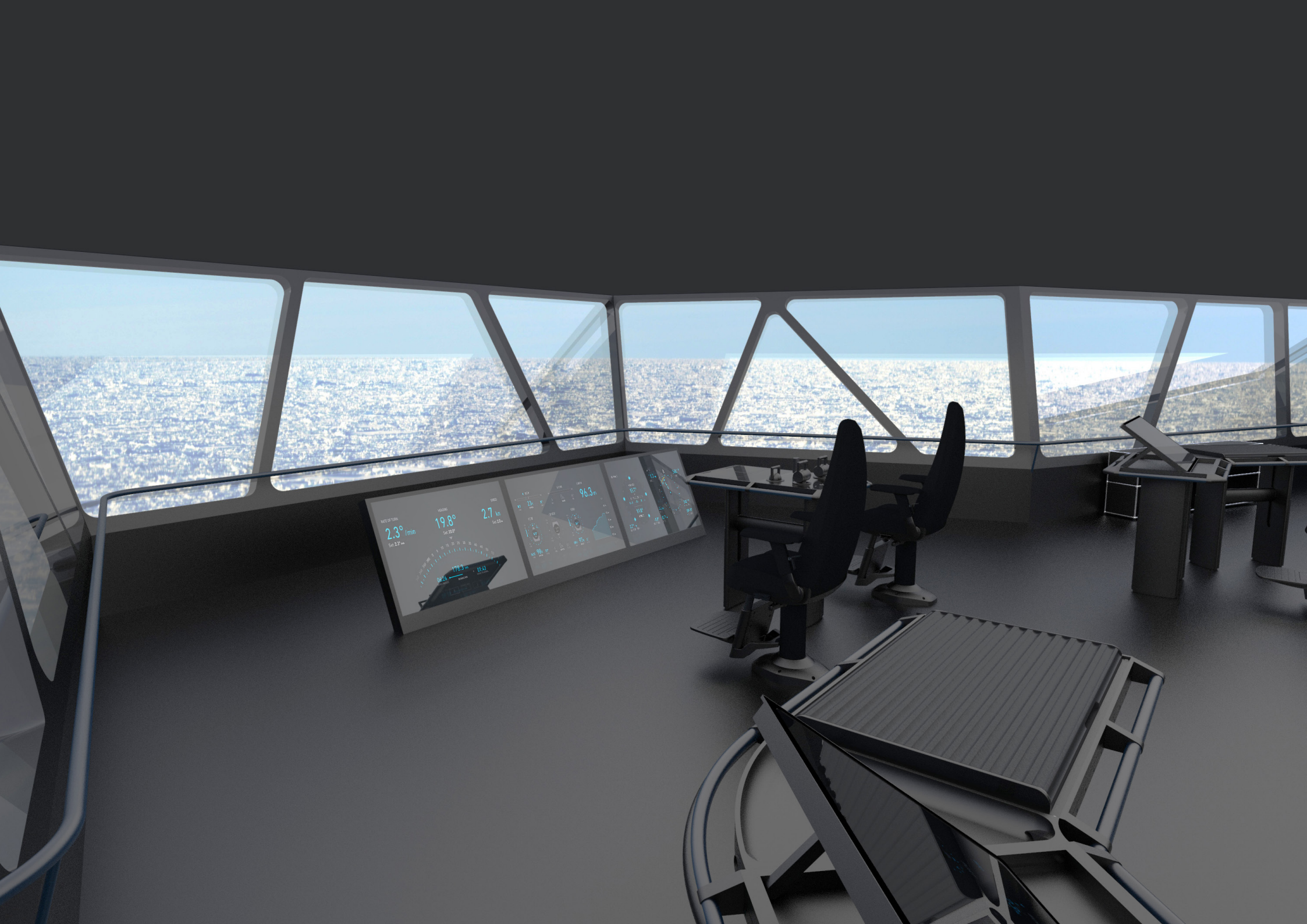


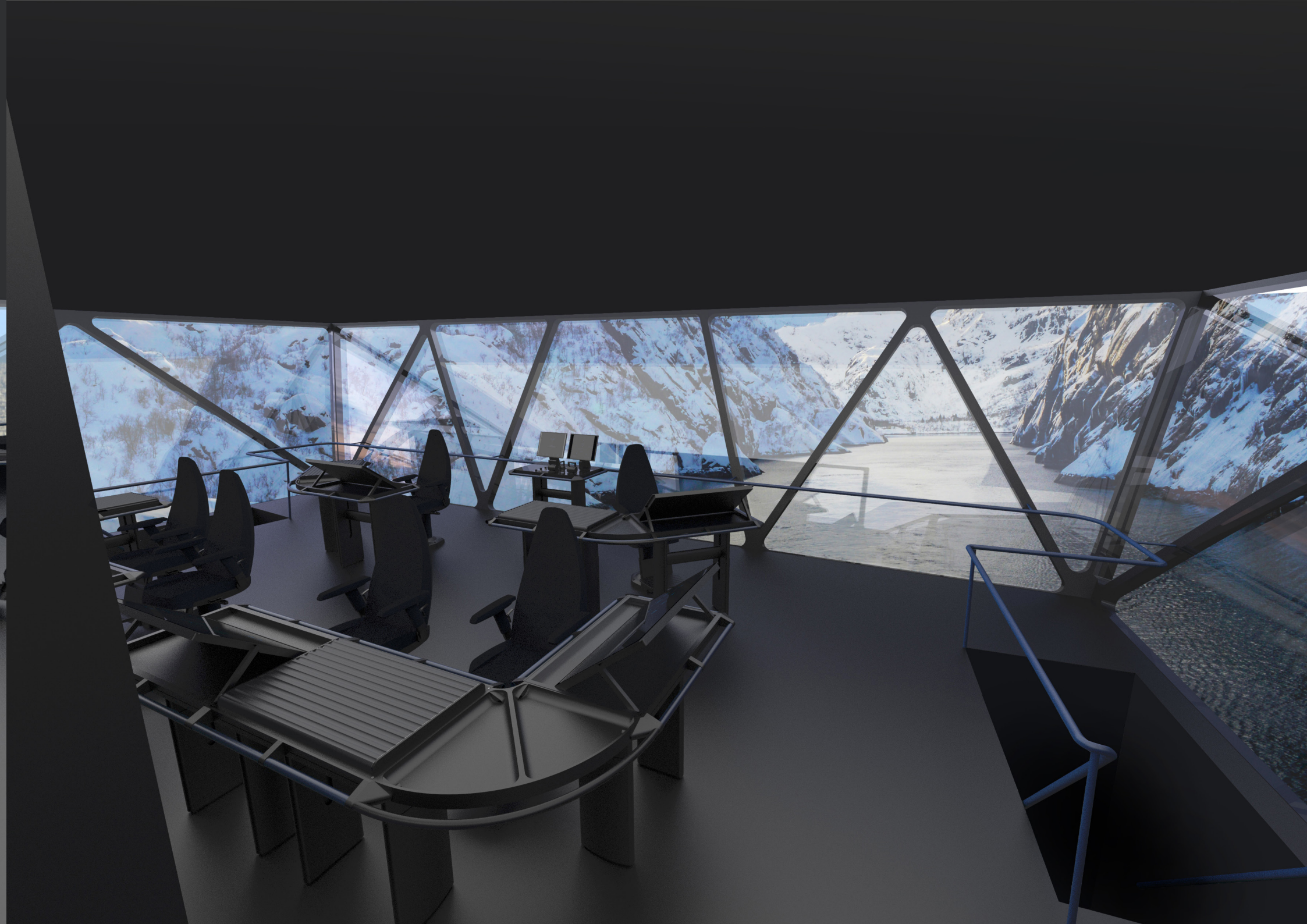

96.3m








2.3°
19.8°
2.7
96.3m

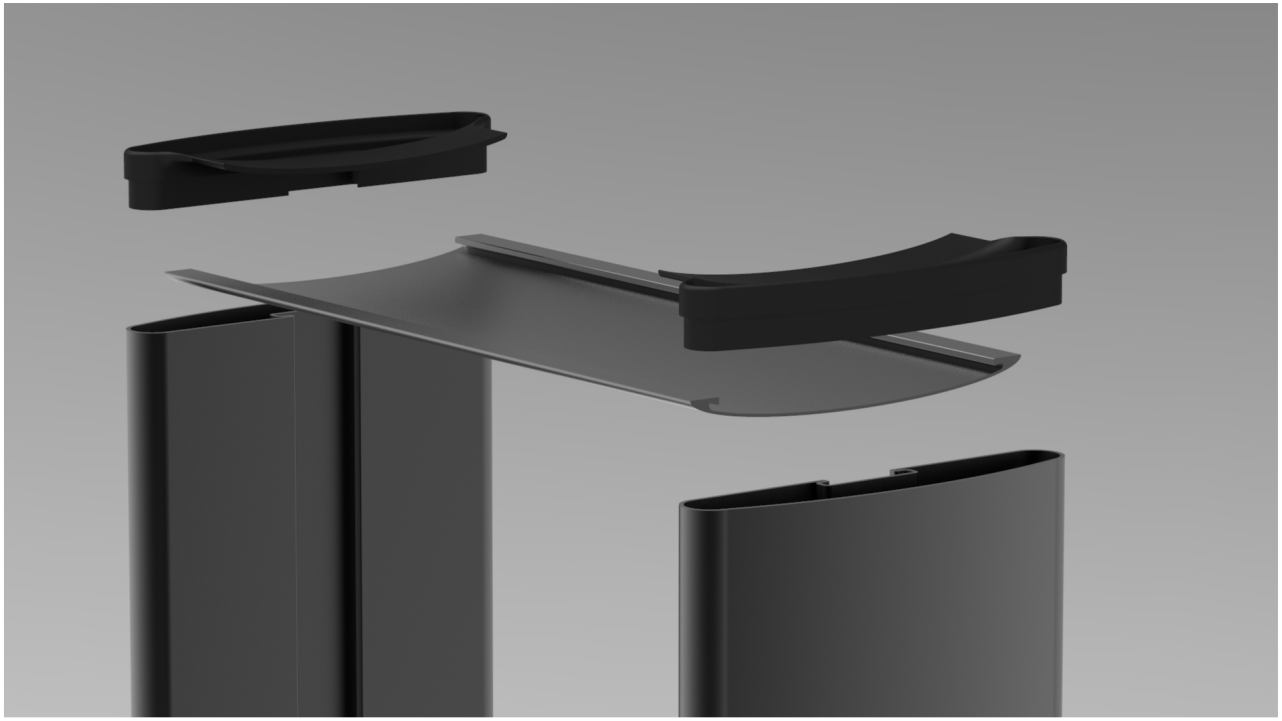


Borealis

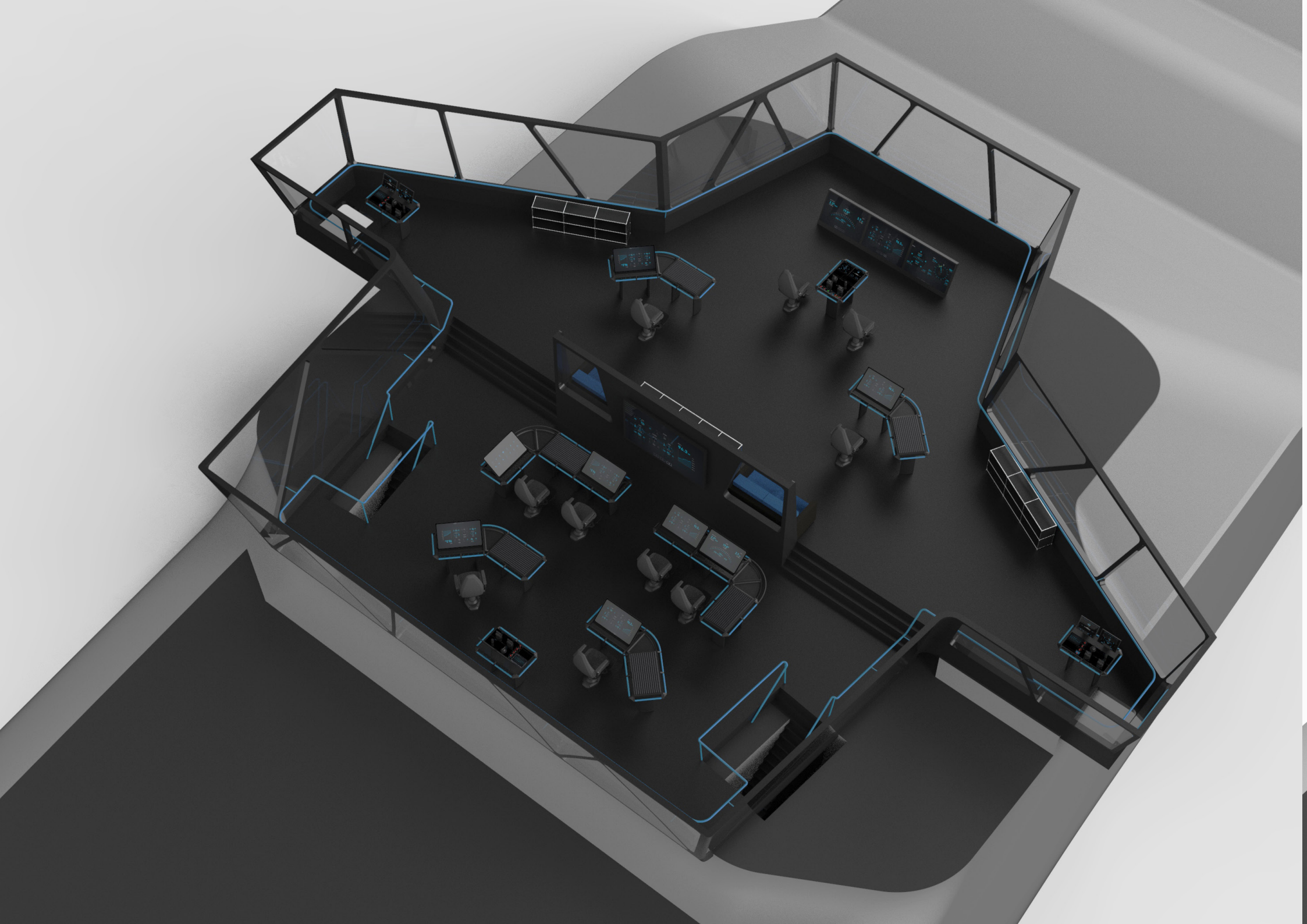
Modular bridge system

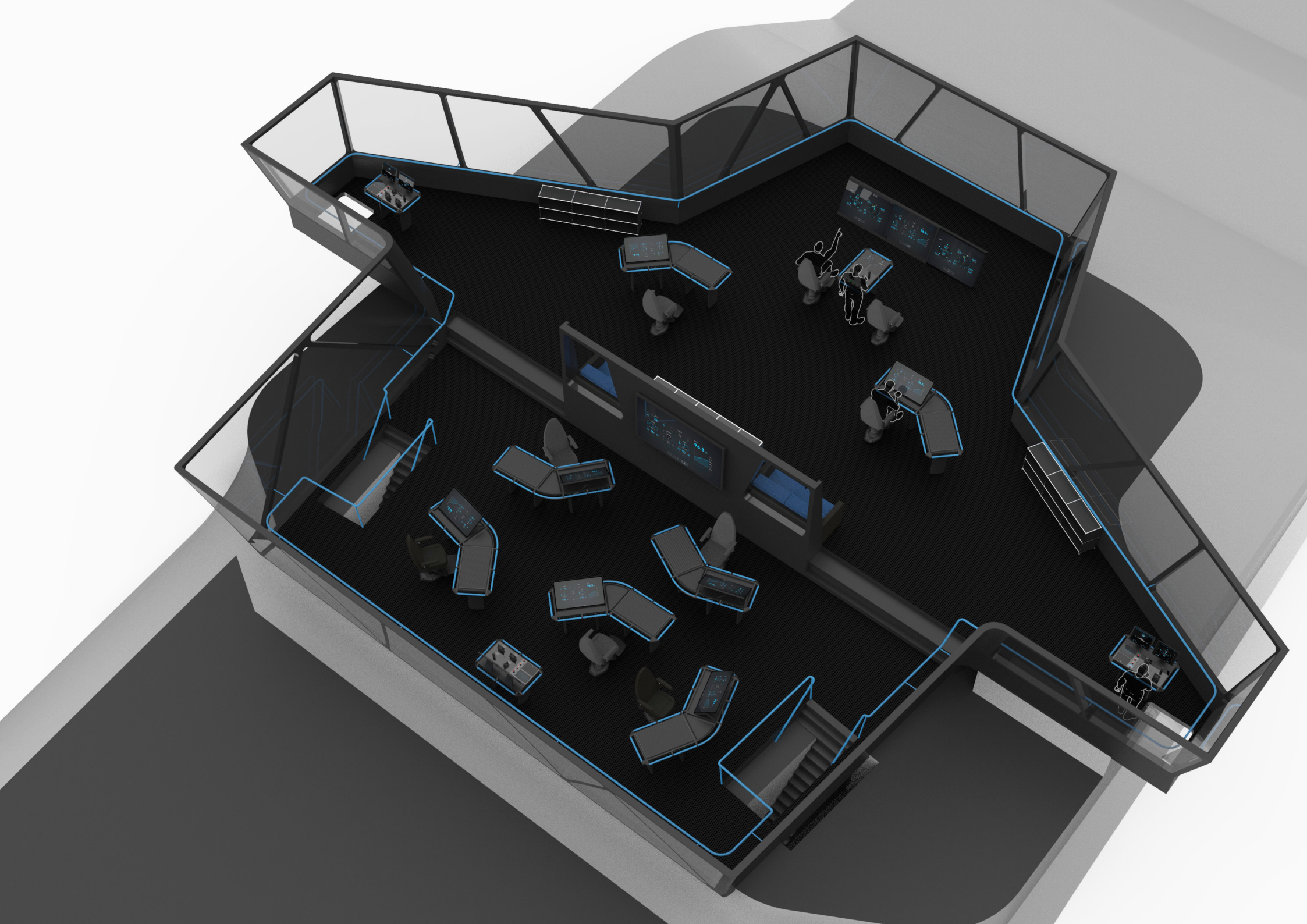
A ship bridge is a complex workspace with lots of different workstations in need of both different layout and components.


Starboard
Emerge
STOP
Joystick
11.3kn
-1°




SPEED
HEADING
198°
2.7 Kn
2.3°/min
178.3m
00:26
01:43





Console

The main part of every workstation that can be seen and used on the Boreal mdoular bridge is the main console.

The console consists of a heigh adjustable underbody, a top plate and a handrail going around the console.

The console can be fitted with any kind of equipment and be mounted together with another console to create different workstations for different tasks.

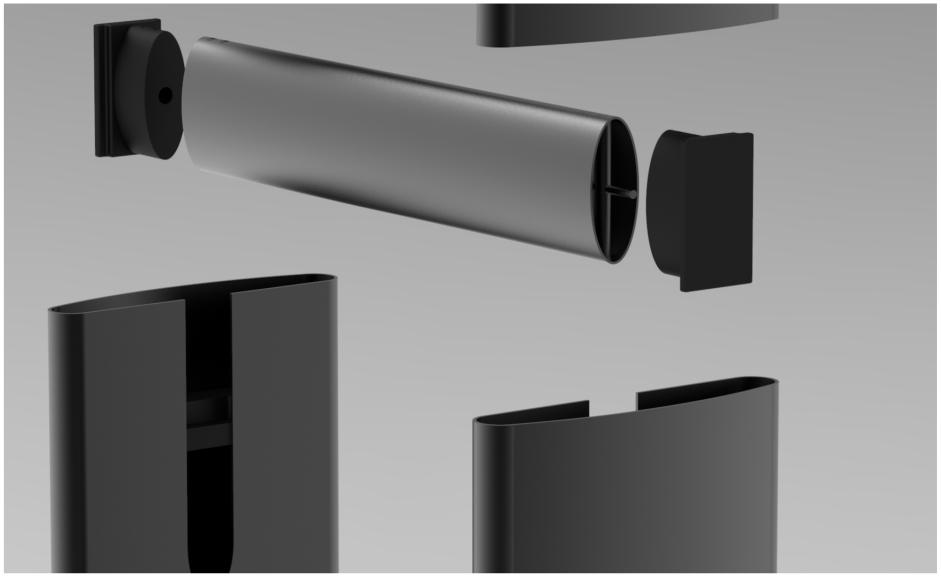
Extruded aluminium

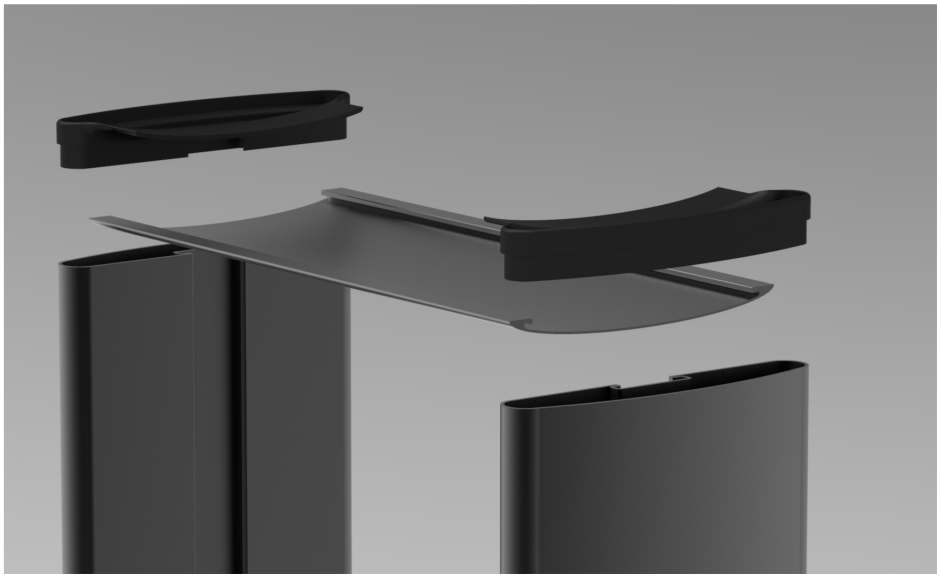
The base of the console is made in extruded aluminium profiles. This is to obtain strength both structural but also against wear and tear.

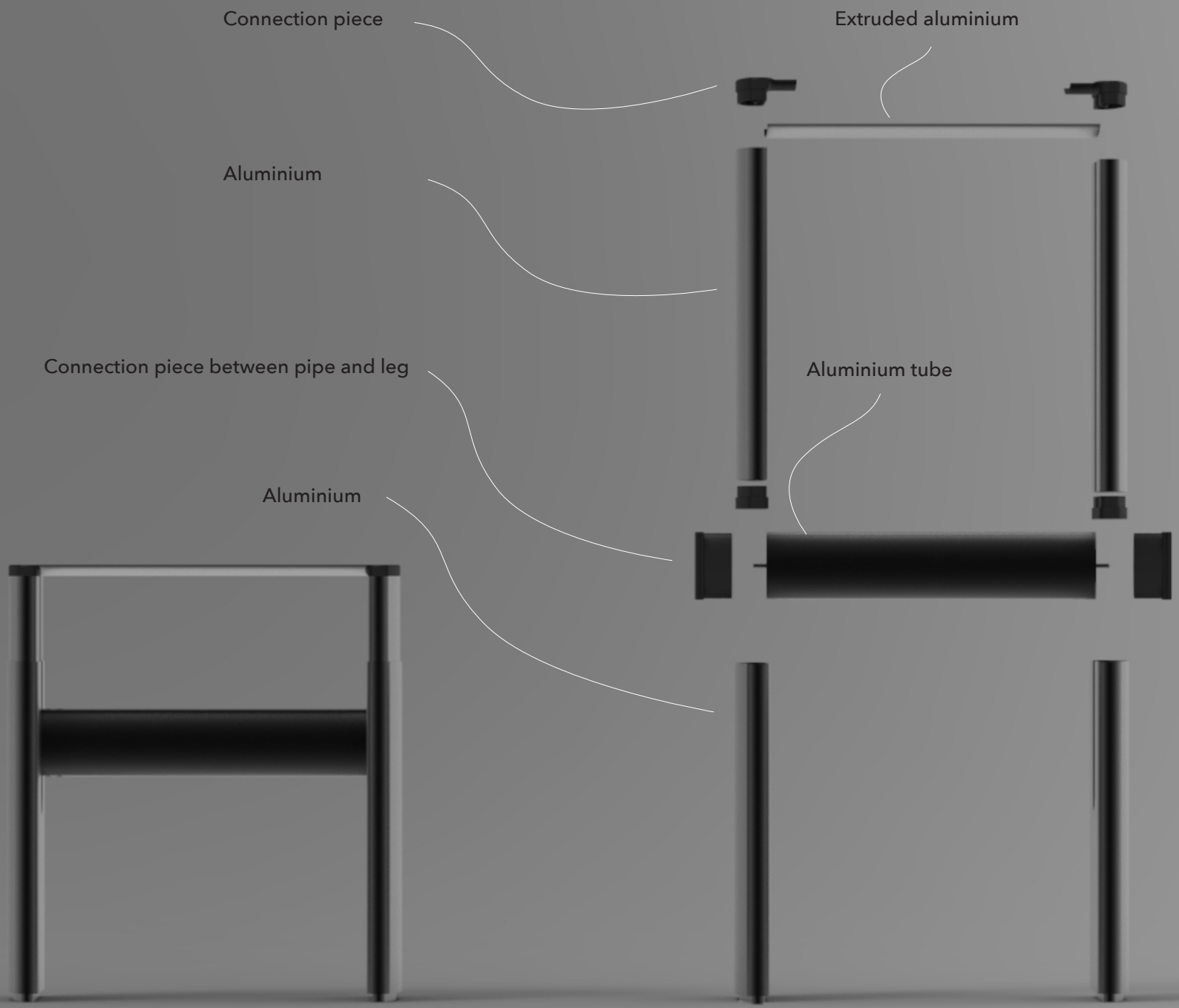
I haven`t had the chance to strength approve or test the structure of the design, but my goal has been to make a concept with realistic dimensions. I will guess a internal structure would be made to hold the mechanism needed for the height adjustment, and in that case it could be used form pressed aluminium welded or fastened to make the intended shape of the product.

Connections

Between all the aluminium parts there will be connections. I haven`t worked with the details of production and material of these parts, but I will reckon they could be die casted in aluminium to offer both strength and reliability.



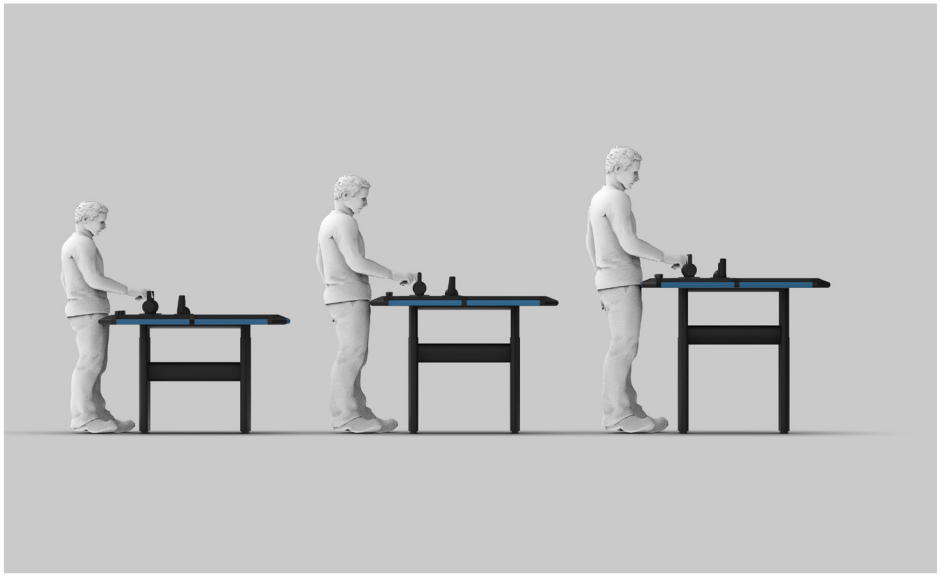



Connection piece
Extruded aluminium
Aluminium
Connection piece between pipe and leg
Aluminium tube
Aluminium

Height adjustment

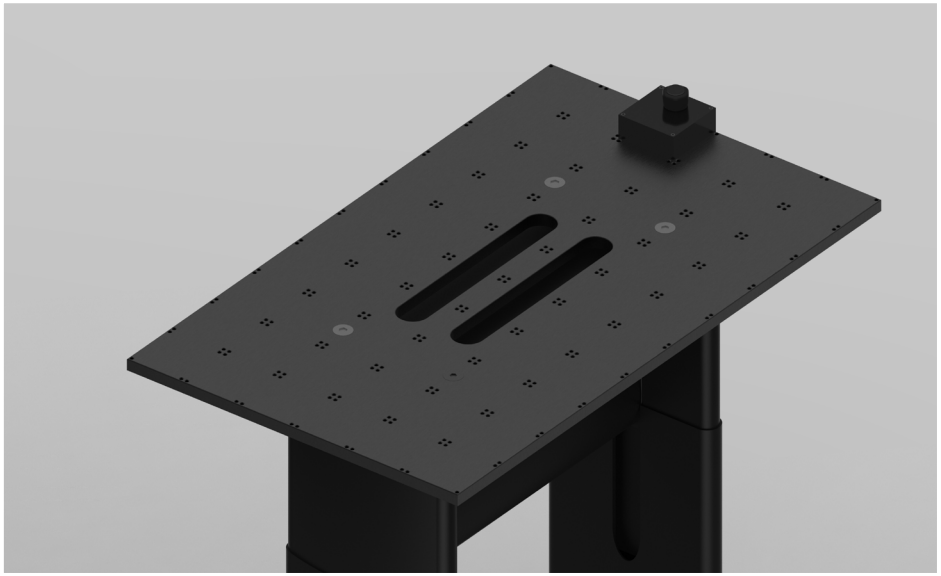
One of the biggest findings from my field studies was the lack of heigh adjustment. I observed how big a problem this was for the tall guys operating the way to low consoles at KV Svalbard and I saw it therefore crucial to include height adjustment in my console.

The console can be adjusted 40cm from 70 to 110 cm.



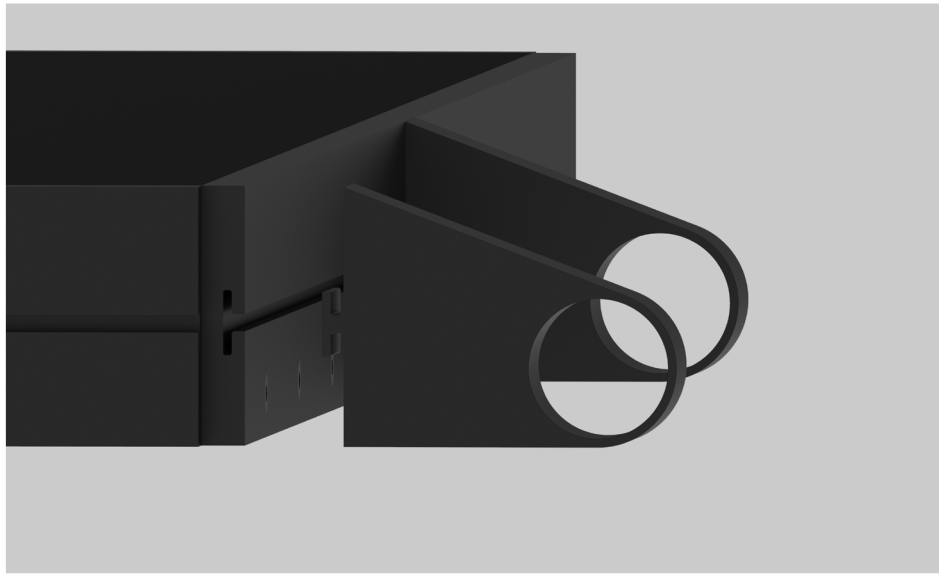
Mounting plate

On top of the underbody there is a mounting plate with predrilled and threaded holes for mounting of equipment. The equipment can be screwed directly into this mounting plate and cables can be pulled down into the holes on the middle of the plate.



ALuminium profile edge

Around the mounting plate I have placed an aluminium profile which surrounds all of the equipment that is mounted on the mounted plate. These aluminium profiles are made with a groove for mounting of hand rails.



Handrail

After experiencing full storm and extreme weather on the expedition to Greenland I understood how important a good handrail is on this kind of product.

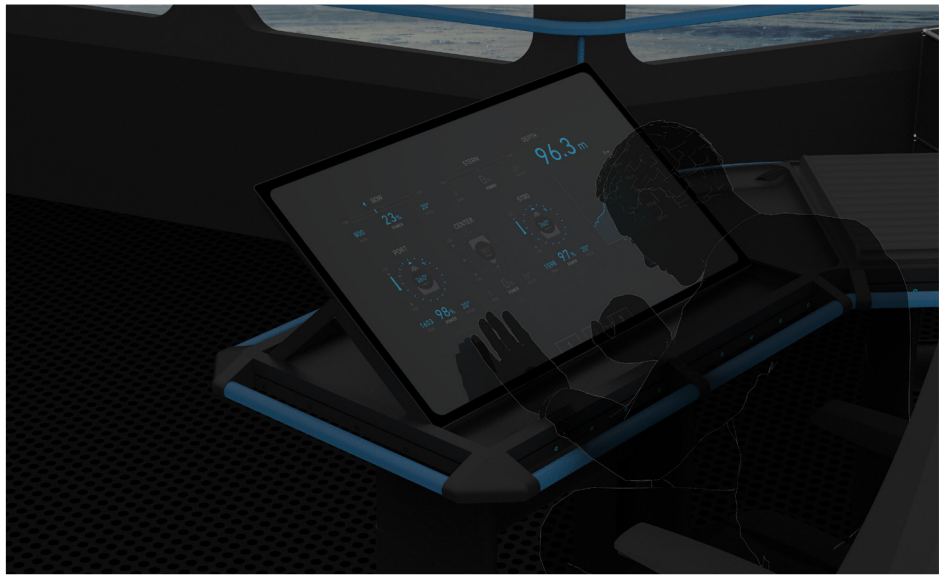
The handrail is made from aluminium tubing which is fastened on the aluminium profile surrounding the mounting plate. Tubes can easily be bended which makes it easy to add rails to the different workstations.

Computer station

I wanted to make a multifunction workstation on this concept for a future coast guard vessel. The intention of the computer station is to have a multifunction workplace where different tasks can be done. A big touch screen is ideal for this purpouse since the software can be used for different tasks without changing the hardware of the station. The goal has been to make a multifunction workstation that suits both everyday tasks and more specialized once in the month specialized tasks.

Big multifunction screen

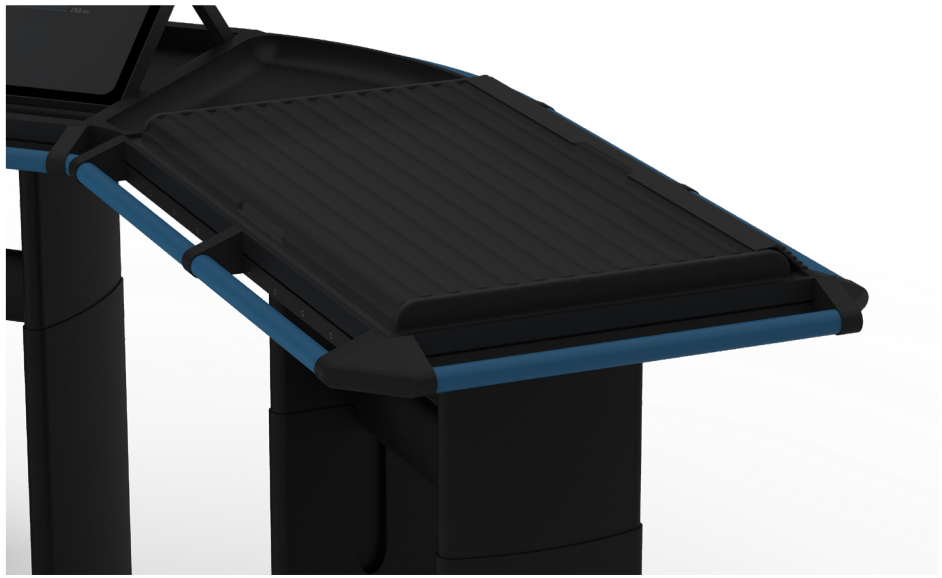
The multifunction screen is a big 42 inches touchscreen that can be controlled purely as a touch screen or with a rollerball, mouse or trackpad. When slid up a touchpad and keyboard is revealed. The screen is connected to a stationary computer in a room on the deck below the bridge. The intention of the computer station is to have a multifunction workplace where the crew can work on a daily basis, and at special missions like research trips researchers can use the workstations for their own work on the bridge.



Storage and workspace

The basic composition of the computer station consists of one big multifunction screen and a storage/tabletop module. The storage module can be opened by sliding the top-lid for easy access of things to storage inside the module.

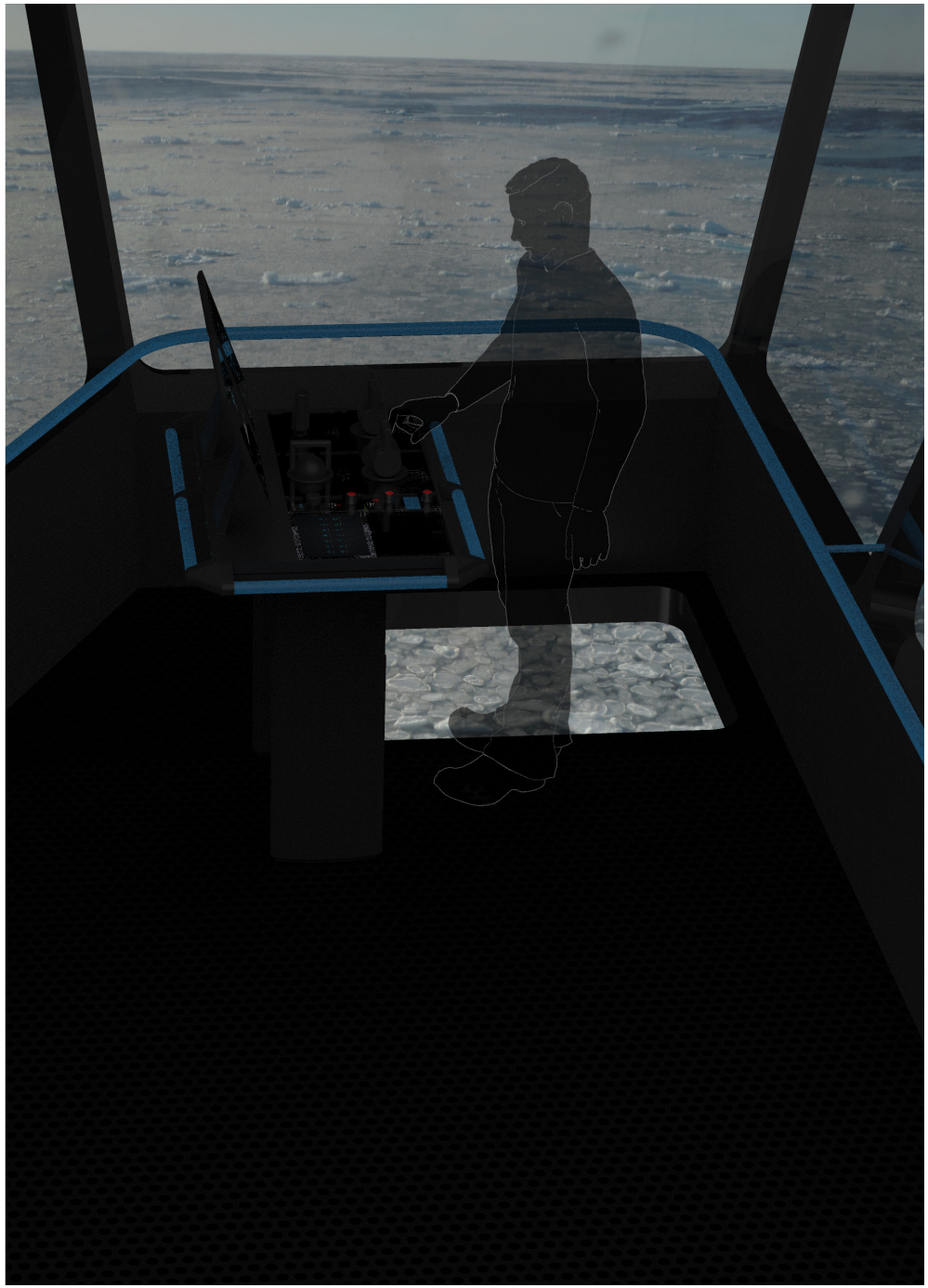
The top-lid is in aluminium with a rubber coating which makes it possible to place items on top of the module when closed. This can be useful on a ship constantly in motion.



Bridge wing & Aft

Since the bridge wing and aft workstation need as much visibility as possible, I have rotated the front console ninety degrees to give the user a bigger working area with the possibility to slot in two medium sized monitors. This layout has derived from the cardsorting exercise on KV Svalbard and a further study done at school looking into how state of the art ship places the equipment.

Because of the modular system, tiles can be moved around to find a better layout if wanted



Bridge wing

The bridge wing has all the same equipment as the fore bridge, but because it`s rotated ninety degrees its possible to have some modules that are better suited for this purpouse than the fore console.

The two monitors are the biggest change from the fore bridge, and instead of two big touchscreens that can be found on the fore bridge, it has a smaller touch screen placed right next to the touchpad controlling the monitors.

Aft

The aft bridge has the exact same layout as the consoles for the bridge wings. Here you can either have the power controllers placed on the middle or you can have it as one of the bridge wings with the controllers either placed to the left or the right. I think it`s nice to have the aft workstation as one of the bridge wings to easier switch between stations, but since it is on the centerline of the ship it would be more natural to have it on the middle.

The modular system makes this easy to test and this question can easily be answered by testing.

Switches

Background

Today different producers deliver their own switches which makes the console messy and frustrating.

Switches are being drilled through sheet metal and labeled with stickers to communicate their function

Design requirement

Six different switches within the same family

A group of different switches which belongs within the same class of generic switches for a bridge console.

Modularity within switches

I wanted to make a modular system within the switches where different knobs share the same base.

Identity

The class of switches should complement the bridge design and be designed with the same design language as the console.

Types of switches

Emergency switches

An emergency stop push button switch is used as a safety measure to stop hazardous parts (loads).

An Emergency Stop Switch must be highly visible in color and shape, and must be easy to operate in emergency situations.

Pushbutton switch

Push Button Switches are manually operated switches that are available in many different types

16 - 30mm in diameter and square or round design is most usual.

Rotation switch & clicking rotation switch

A rotary switch is a switch operated by rotation.

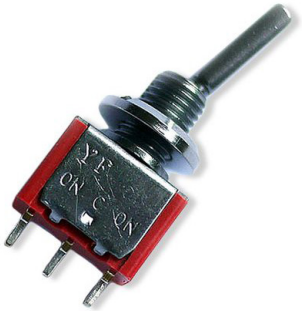
These are chosen when more than 2 positions are needed or dimming by increasing or decreasing intensity is wanted. For example dimming lights.

A clicking rotation switch can be made to be positioned in 1-10 different positions.

Toggle switch

An electric switch operated by means of a projecting lever that is moved up and down.

Toggle switches have a long lever, which moves in a rocking motion. As they move to a new position, toggle switches make a really satisfying “snap”.



Product development

Inspiration

The inspiration for the switches on the console has been minimalistic and bald existing switches.

I want to make a switch which is easy to understand and I don`t think it should be a confusing design or a design which can lead to stress.

Modularity

I want the switch to be modular and easy to move around. In reality switches won`t be moved around after mounting, but upgrades and damage can happen, and in that case change of switches should be easy.

My goal is to make a base for the switch which can be used for different tasks by switching only parts of the switch.

Prototyping

I made some very easy prototypes testing out some ideas for modular switches. My main concepts was about using findings from the field studies regarding labeling and try to use a screen on every switch to easily differantiate between the types of switches and what they were used for.

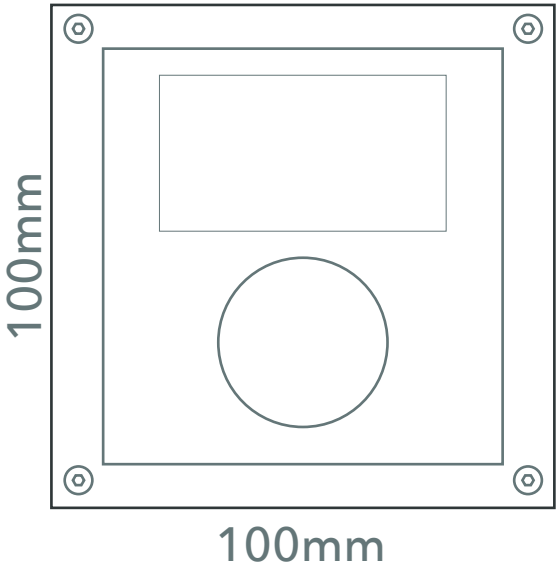
I tested the screen concept by printing graphical elements and placing acrylic glass on top to simulate a screen.

Paper prototyping

Paper prototyping was a great way to test out concepts and most importantly sizes of switches. How big should the unit be? and how big should the knobs be? This was a typical ergonomic task where I made the knobs in styrofoam and testet different sizes before finding a good shape which was bith comfortable and gave enough control.

I also had to test different sizes on the module, and since I was planning on using a screen the size of the module was very leading to how big or small the screen would be.

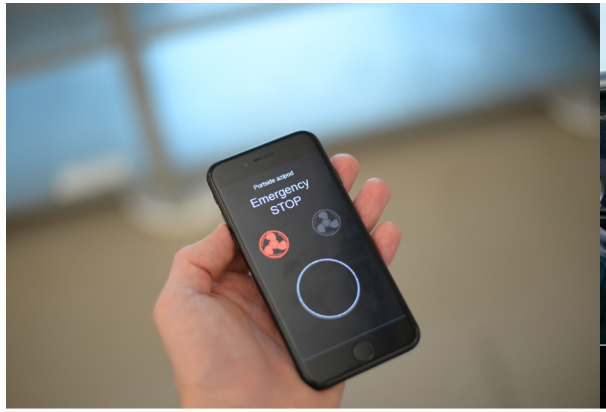
I ended up with a base unit thats 10x10cm with a smaller screen on top. I chose to have the screen on the upper side of the knob when operating so the hand don`t block out the screen while using it.



Display and challenges with using a screen

I quickly found out that using a screen on the switch would open up lots of opportunities for how to use the switch. It could now be a more active part of the console where information can be dynamic and adaptable showing the right information at the right time.

But the challenge with a screen could offcourse be glare and issues with light. I tested some graphical elements on my phone without issues and the switches can be mounted with screen protector to eliminate glare. This needs to be tested.

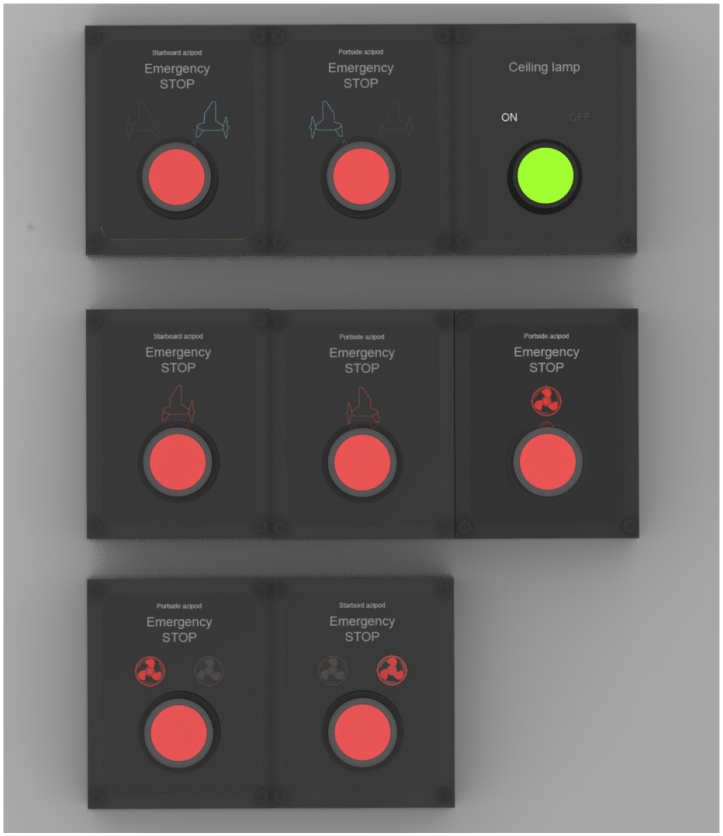



LCD display washed out

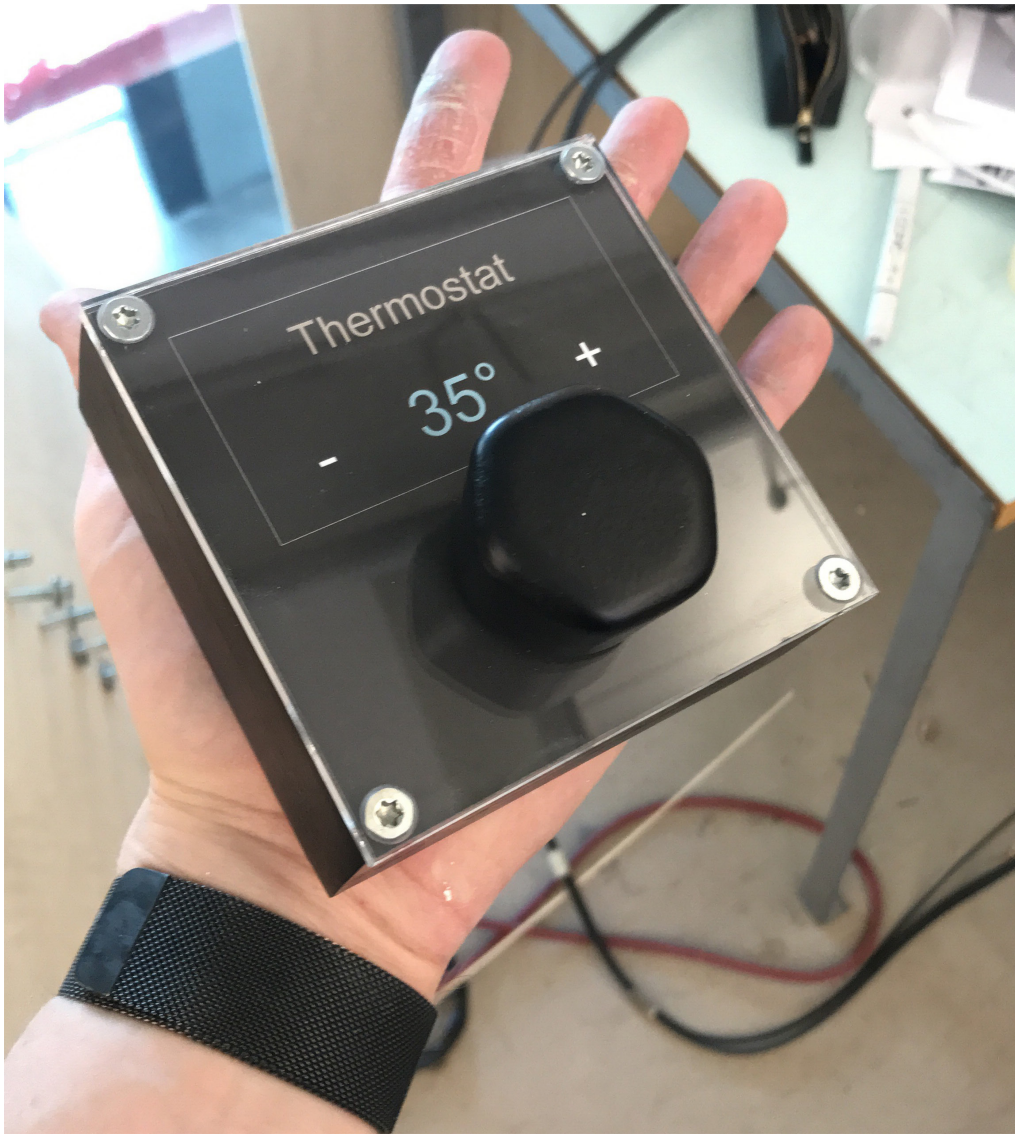

NuShield DayVue screen protector installed

Oppurtunities with using a screen

Putting a screen on the switch opens up for many possibilities and it is now possible to use graphical elements and pictures to help the user understand and use the different switches. I have only tested some elements and to the right you can see how graphical elements are being used to easier guide the user to the right switch.



Result


Thermostat
35°
-
+


Screen dimmer
35%
-
+
Starbord azipod
Emergency
STOP
Starbord azipod
Emergency
STOP

Prototype

As a industrial designer I think its really important to work with physical materials and get the shape of the product in your hands.

I therefore made the choise of making a full scale prototype the last week to better present the product.

I didn`t have time to make it functional, but I think it`s the shape and not the height adjustment that needs to be expressed through this prorotype.

For a better understanding of the context and to show the concept of tiles I also made a full set of the components needed for navigating and steering a ship.

Rapid prototyping

Making components to show the concept of having modular tiles that are mounted on the console, I used 3d printers with different quality to quickly make the components before sanding and painting them for the prototype.

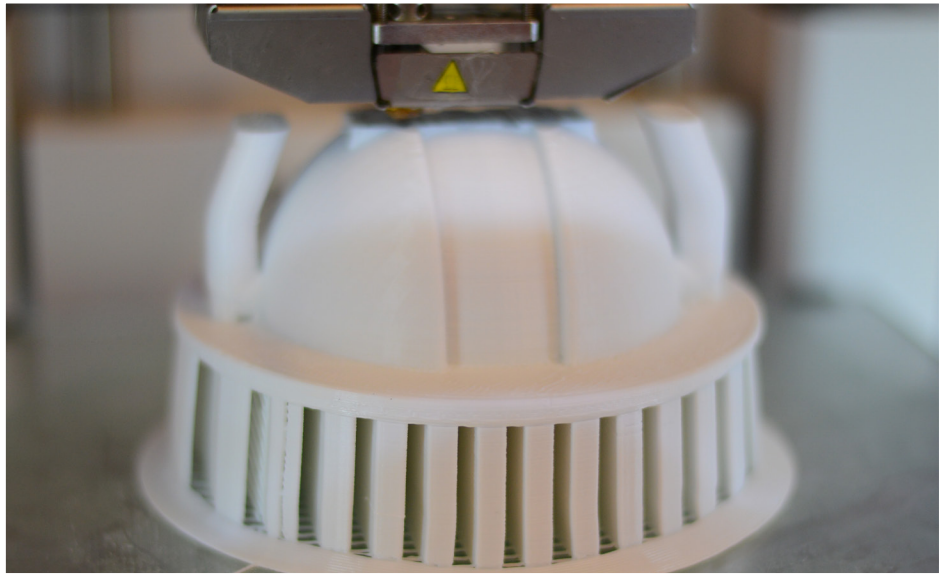
For the bigger parts like thruster controller and joystick I used the ultimaker, and for smaller parts like switches I used a gypsym printer to make switches with good weight and a realistic feel.

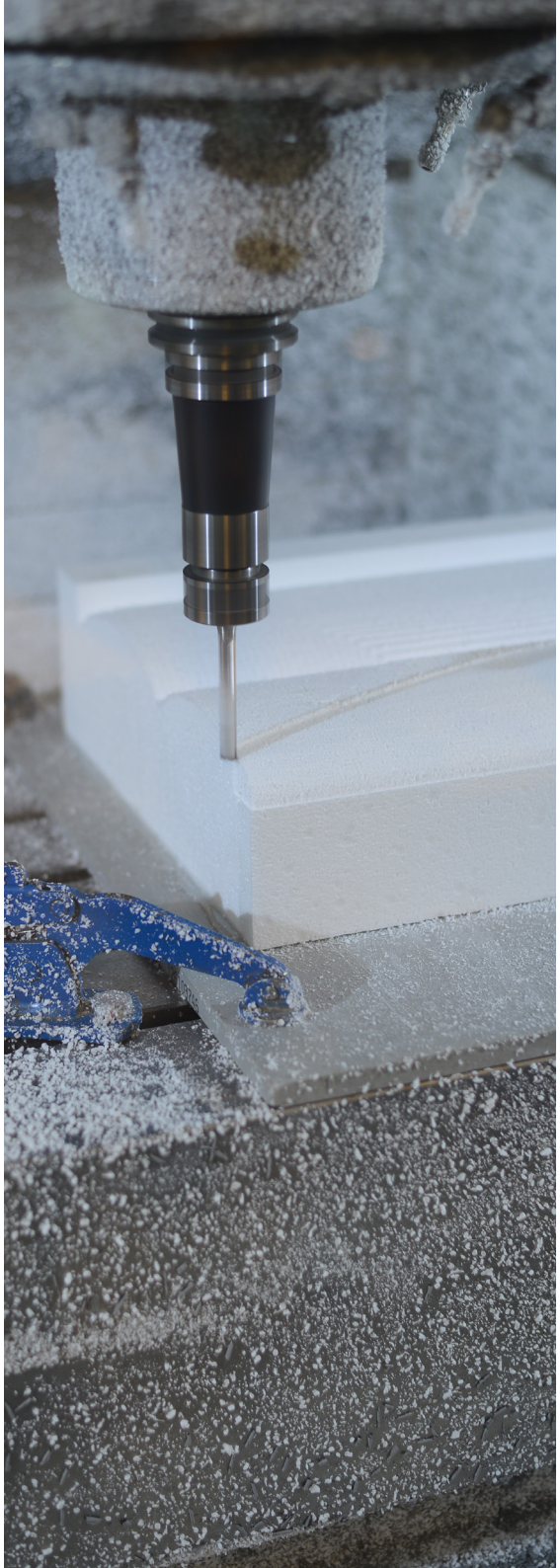
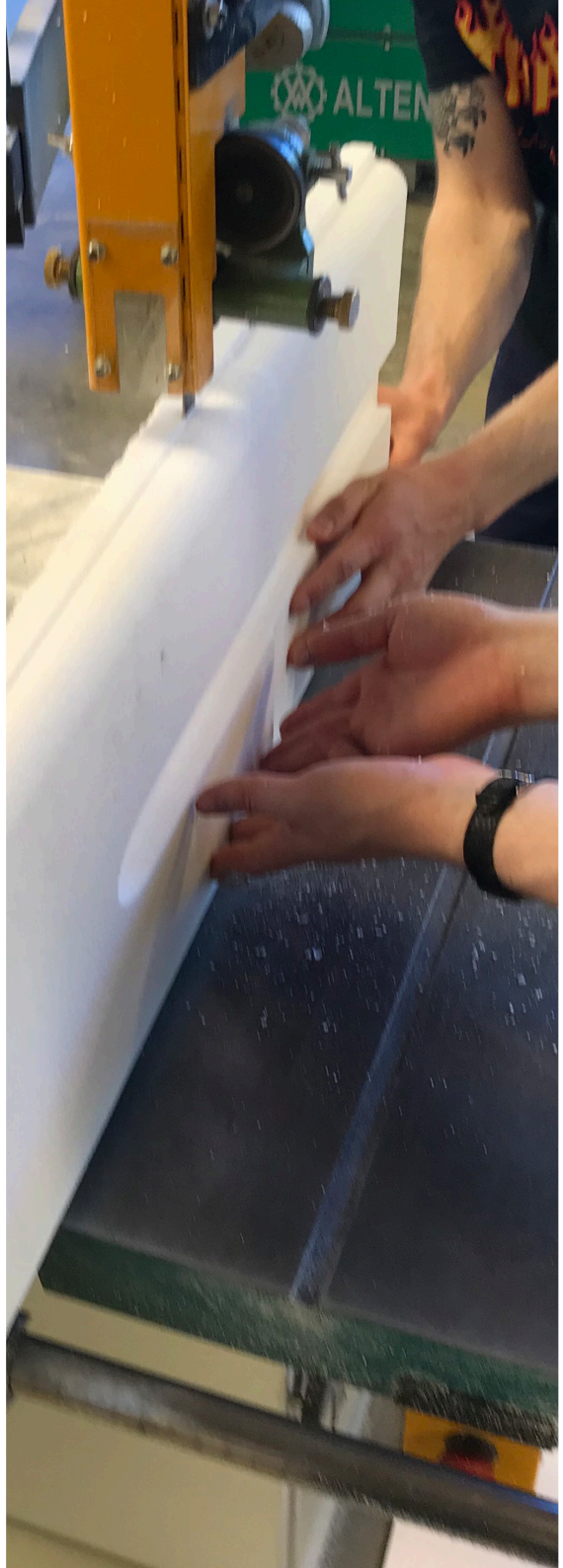
All of the printed parts went through several rounds of sanding before painted in the right color.

Look and feel

Look and feel I decided to make a full size prototype of the fore console to get a better feeling of the size and the decisions made for the different parts of the product.

My goal for the prototype was to make a realistic look with a reasonable finish considering the time I had to make the prototype. I decided to mill the legs of the console in styrofoam and filler it before many rounds of sanding until painting it.

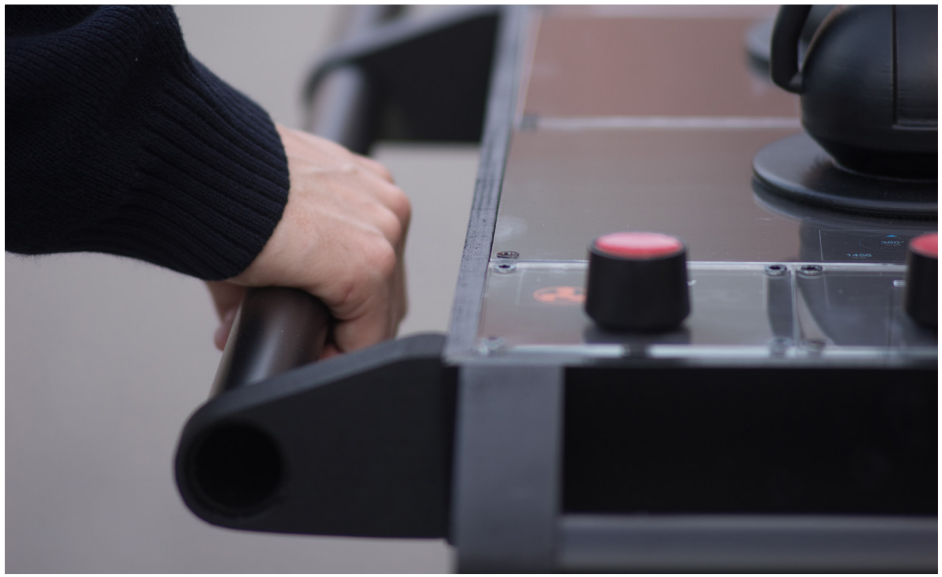


Testing

Getting the model I have been working with for the last months out in the right scale was a fantastic feeling. I got to do some basic function testing of the handrail and it was great to test both the reach when standing on different sides of the model and getting a feeling of the components with the right color and form.

It was great to feel the handrail and get that calm feeling I wanted to give the user when knowing that a safe and secure handrail is within reach at all time when operating the ship.



Look and feel

A full scale prorotype gives an understanding of both shape and function you don`t get from sketches and digital renders. Even though I made some full scale plotts of renders, some cardboard mockups and used VR as a evaluation tool for my design, I now have an understanding of the design which I never would get from not building the prototype.

The overall look and feel of the model gave me much insight and I wish I could have moved the project into the next phase of iterating it further.

When choosing a name for the modular console my ambition was to find a northern name with strength and identity.

I chose the name Borealis, which is latin for northern or of the north


BOREALIS

Conclusion

This diploma project has turned out to be the most challenging and inspiring semesterof my education at AHO. The concept was developed in line with my ambitions and goals.

The result is a concept that answers well on the problem areas and possibilities found in the research phase and field studies. I feel I have executed good decision making throughout the project and even though I feel that more time could have been spent developing the final product my delivery fulfills my requirement of challenging todays status quo and thereby creating a fora for discussion

It has been a very challenging educational experience both throughout the diploma and the five years in total.

Thank you

I would like to give a big thanks to everyone who has in some way helped me in this project.

My supervisors at Aho:

Kjetil Nordby

Stein Rokseth

External supervisor:

Adrian Paulsen

My collaborator:

Andreas Hjellbakk

The guys in the workshop; **Halvor Hjort Guttu, Roald Jenssen, Tron Andersen and Geir Jarle Jensen.**

The Royal Norwegian Navy and the Norwegian Coast Guard for letting me take part on the 13 days expedition to Greenland onboard the coast guard vessel KV Svalbard.

Thank you

I would also like to give a special thank you to friends and fellow students which have helped me thorughout the semester.

Jens Christian Boxaspen
industrial design student

August Lund
industrial design student

Gustav Refsnes
industrial design student

Gard Hagen
industrial design student

Bai Daniel Øgaard Kanu
industrial designer

Per & Jane Marit
mom & dad

Synne Frydenberg
Phd student

Jonas Carlsen
Industrial design student

References

Online references:

Ulstein bridge vision: https://www.youtube.com/watch?v=Np7iqZe-mU9c

crystal endeavor https://www.ship-technology.com/projects/crystal-endeavor-megayacht/

Info about the northeast passage:

https://en.wikipedia.org/wiki/Northeast_Passage

Transpolar sea route:

https://en.wikipedia.org/wiki/Transpolar_Sea_Route

NUSHIELD - antireflective glare film

https://www.nushield.com/anti-reflective-film

https://www.nushield.com/nushield-dayvue-film-battle-tested

Aftenposten.no (2009), “Lasteskip seilte gjennom Nordøstpassasjen“,
Available: http://www.aftenposten.no/nyheter/uriks/article3264462.ece#.UT-SGxx318E

Page 19 - Picture from Vard:
https://motorcove.com/2016/02/22/montaag-vard/

Page 9 - SEDNA project
https://sedna-project.eu/

Local references:

Toward a General Modular Systems Theory and Its Application to Interfirm Product
Modularity
Author(s): Melissa A. Schilling

Erikstad, 2009, “Modularisation in Shipbuilding and Modular Production”, NTNU.

Walsh B. (Sep. 11, 2012), “Arctic Sea Ice Vanishes — and the Oil Rigs Move In”, Time Magazine, Science & Space.
Available:http://science.time.com/2012/09/11/arctic-sea-ice-vanishes-and-the-oil-rigs-move-in/#i

VARD™
a Fincantieri company