ABSTRACT

Maritime transportation is the underlying force of today's global economy. It makes international trading possible, moves raw materials across the globe and does so in a way only shipping can – in extreme volumes and efficiency. But as the vessels are getting larger and the amount of cargo is growing, one could think that the crew also grow in size, but this is however not the case.
Skilled mariners are expensive and hard to come by so automated systems are implemented to a great extent to take on duties that were unthinkable a decade ago. A high level of automation helps to cut cost and fuel consumption, but it is not without its challenges.
With a growing amount of electronics on board, the man-machine interaction is critical and most of the equipment on modern vessels is, to a large extent, designed for the machine rather than the human. This imposes a high risk of errors that potentially lead to severe accidents and even disasters at sea.

The goal of this master thesis is to explore how to improve interaction between man and machine in critical manoeuvre situations at sea – a high-risk situation that is prone to mistakes if the interface is not designed with the user in mind.

The result of the project is a concept for a new control system that is to be located on both side of the ships operation control room (the bridge). The system allows the user to intuitively do advanced manoeuvring, while having a high degree of attention to the overall state of the ship and outside surroundings.

This product report takes basis on the process reports accomplishments and the design team advice the reader to start reading the process report, to get the fully understanding of the context and the user needs.

Title:	**Motion Control System (MCS)**
Period:	**01.02.2013 - 22.5.2013**
Group:	**MA4-ID10**
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Content pages:	**15**
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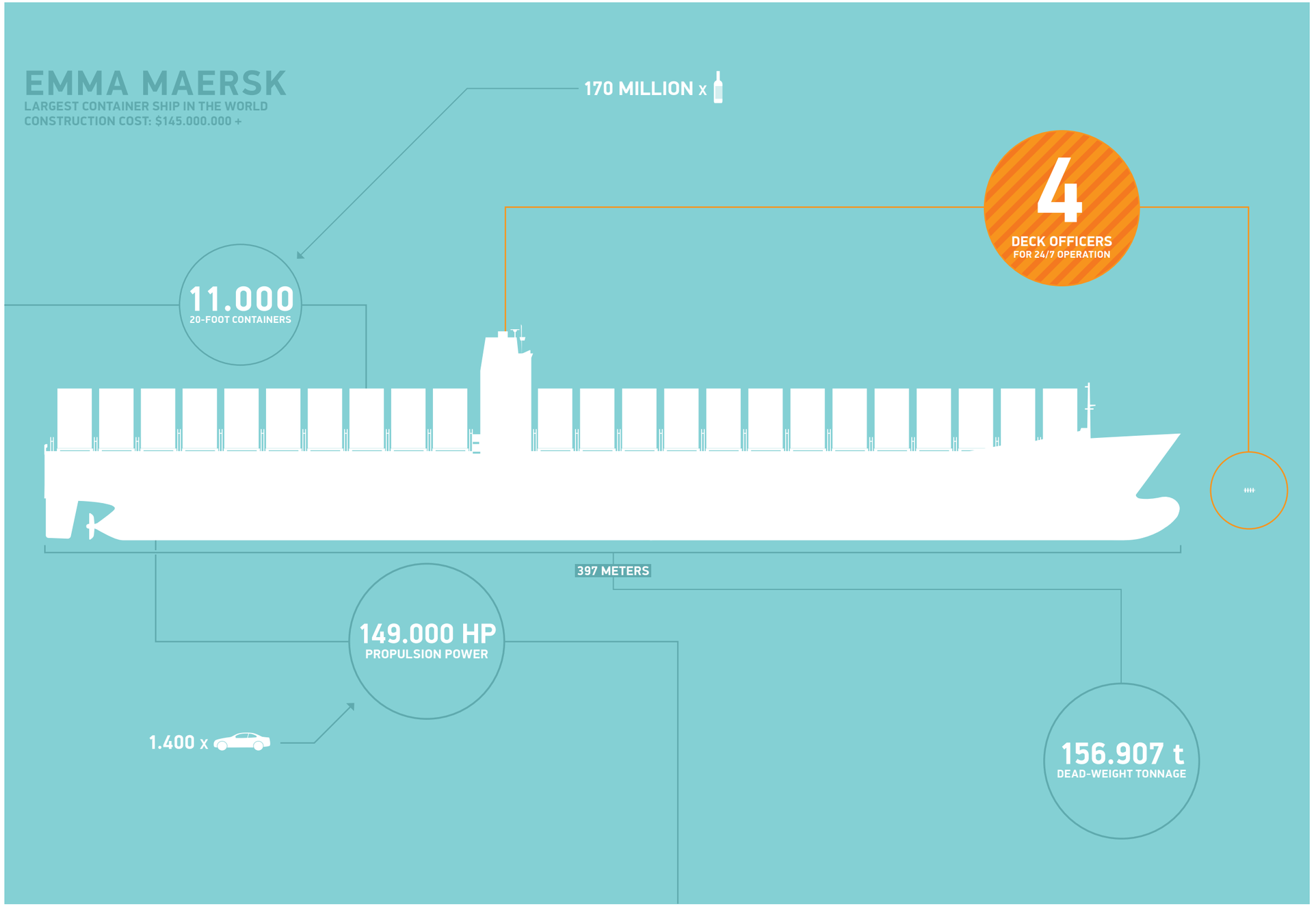

THE CHALLENGE

As an officer on today's large vessels, high-demand working conditions are part of your daily routine. The amount of tasks that you are responsible of is growing as the crew is getting reduced to cut costs and automated systems are implemented as replacement.
In a situation where so many operations are done by or with the help of high-tech systems, well-designed interfaces are becoming of increasing importance. Many manufacturers try to meet this demand by making subtle rearrangements and changing the visual style of their products. But this does not change the fact that most of them were originally designed with a technical system in mind and not the needs of the end-user. The lack of user-centred instruments is a major problem and poor design is indirectly responsible for a vast amount of maritime accidents with large vessels. So called human-errors counts for more than 84 per cent of all accidents at sea, but most of these are actually a direct result of a poorly design interaction between man and machine.

The product presented in this report aims to bring back the human aspect in complex bridge systems and to empower the crew by being intuitive by design, yet capable in function. The product in focus is a control interface, located on the bridge wings, that enables the user to do highly advanced manoeuvres in a simple and safe manner.


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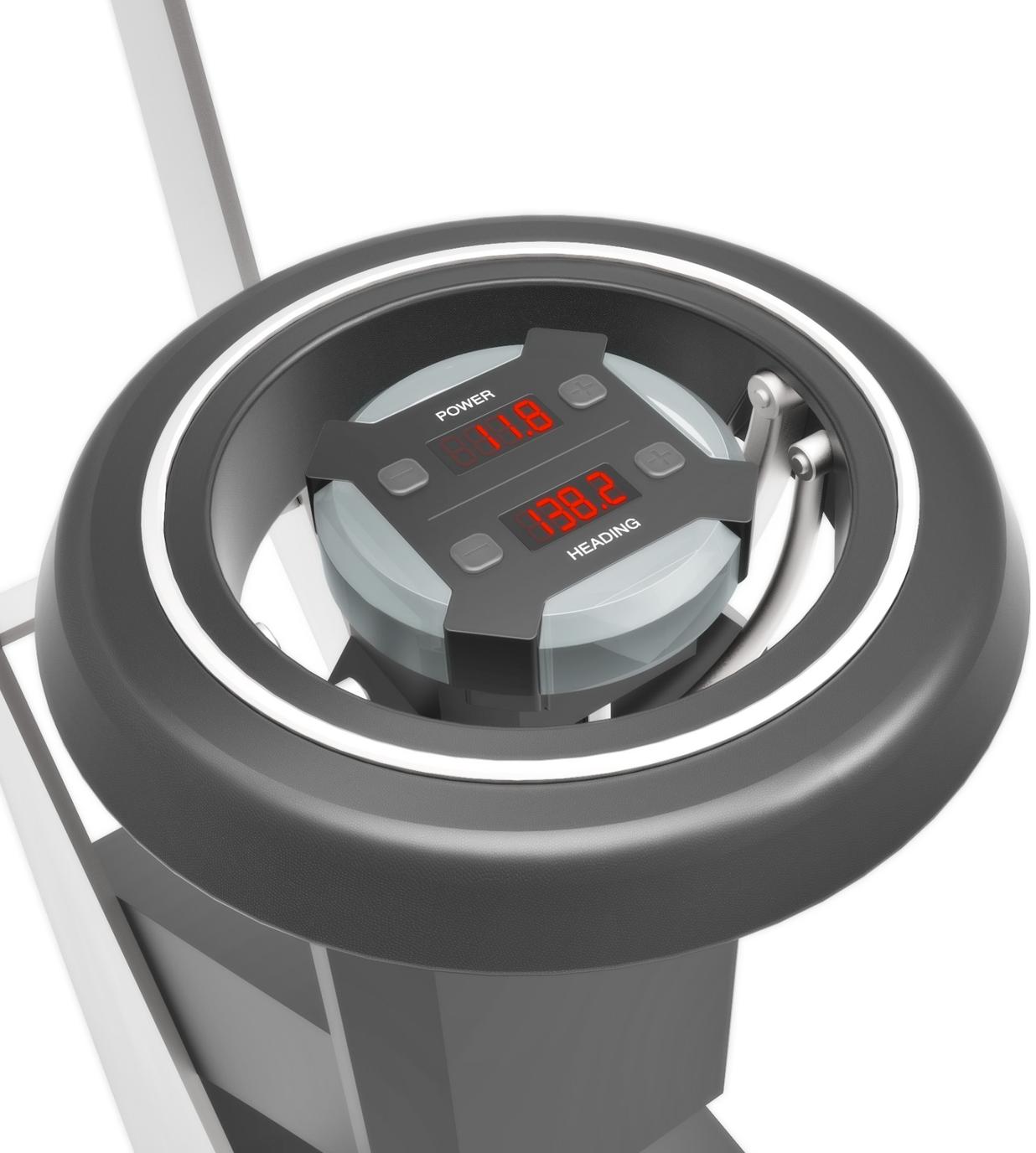


TAKE COMMAND

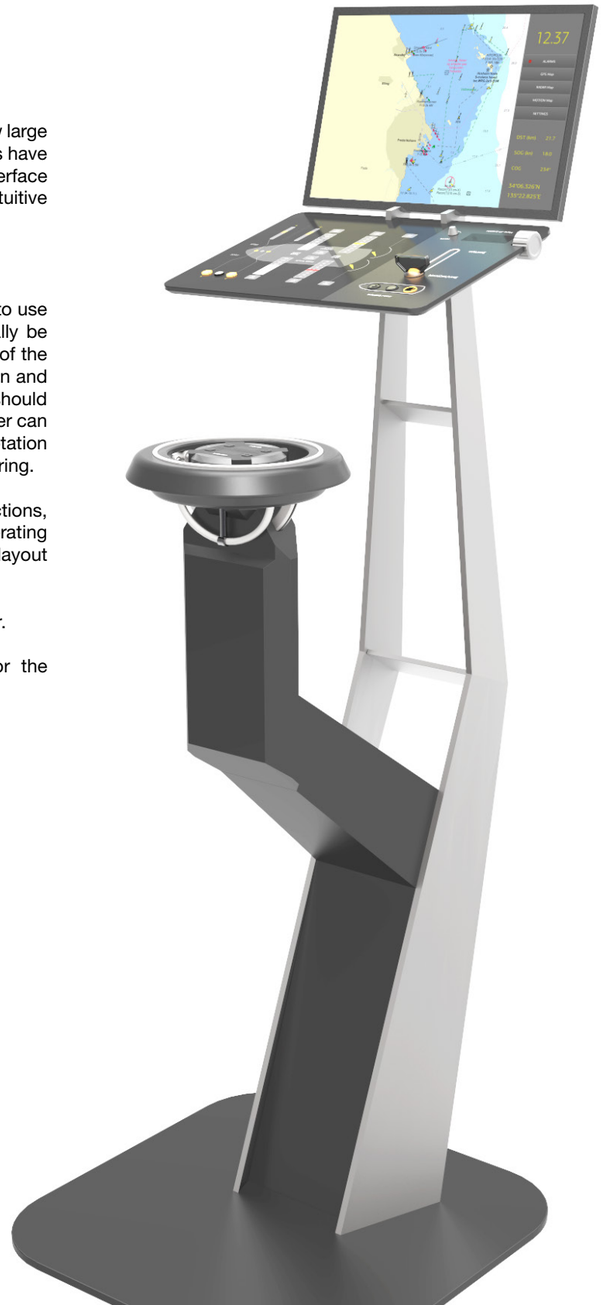
The purpose of the MCS is to create new standards for how large vessels do complex manoeuvring. Propulsion technologies have given vessel the ability to do this for years and now the interface will finally give the crew the tools they need to do it in an intuitive and safe way.

SAFETY THROUGH SIMPLICITY

The MCS is a motion control system that allows the user to use simple gestures to do manoeuvring, which would normally be rather complex with other systems. To control movement of the vessel, the controller is simply tilted in the wanted direction and the MCS will then calculate how the propulsion systems should act to fulfil the command. To rotate the vessel, the controller can be rotated to a given heading course – the point of the rotation can change to front, mid and aft ship for precise manoeuvring.

By cutting not only routines but also the complexity of functions, the MCS also reduces the risk of making mistakes while operating the controller. Furthermore, functions have been put into a layout that creates order and logical relations between buttons.

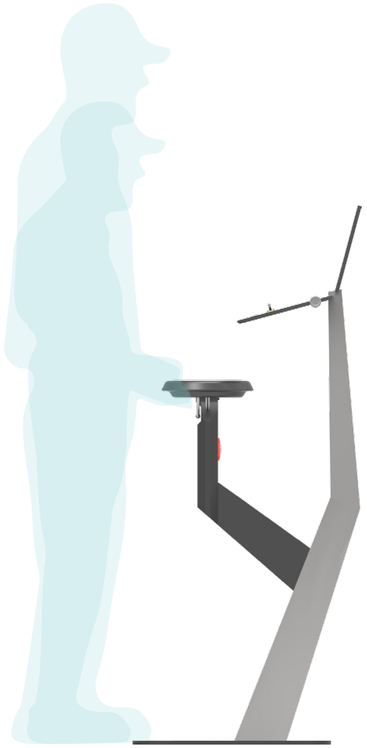
- ✓ Power direction and gyro rotation in a single controller.
- ✓ Motion control assisted by dynamic positioning for the highest level of precision.
- ✓ Hard-buttons for all critical features.
- ✓ Reduced complexity of the over-all system.



USER-CENTRED DESIGN

The MCS is designed with a clear “users-first” approach, which have affected the way the whole system is operated. The user has 180 degrees of freedom around the controller, making it possible to operate from almost any orientation on the wing. This flexibility combined with carefully crafted ergonomics offer the user pleasant working conditions that allow for an unrestricted use.

- ✓ 180 degrees freedom of orientation.
- ✓ Ergonomic design that fits a wide range of body heights.



BORN POWERFUL, EASY TO CUSTOMISE

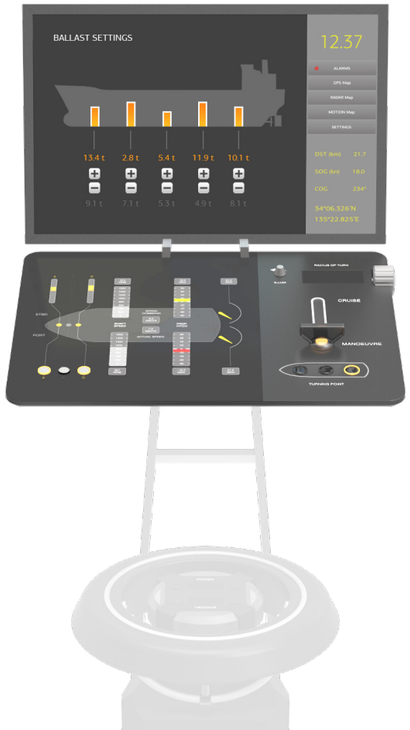
The controller is not designed for any specific propulsion setup, it can be integrated on virtually any vessel. The only requirement is that the propulsion system of the vessel is technically capable of doing advanced manoeuvres; how it should be done is calculated by the system and will not change the physical interface of the MCS.

The LED touch-screen monitors on the operation panel can be customised to show the exact vessel that the system is installed on. The information screens is also fully customisable to show any information wanted for the specific use of the vessel. Per default a GPS, Radar, Assisted-learning and Alarm screen is available via a simple touch menu on the top screen.

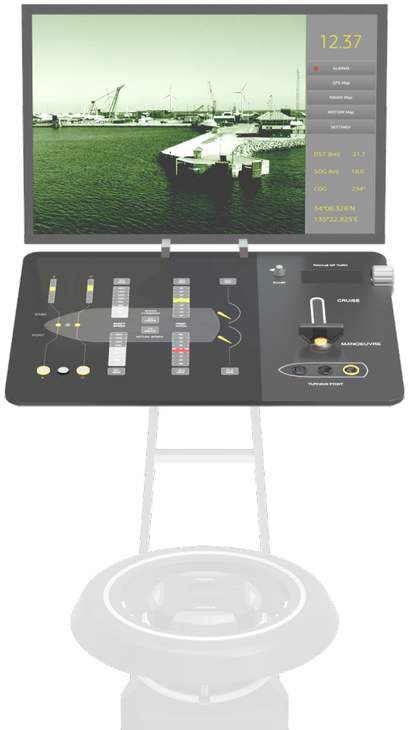
Unlike the solutions found in a majority of today’s vessels, the MCS is not a mix of instruments from various manufacturers – it is an integrated product right down to the propulsion control of the vessel. Every function and feature is there to make it as powerful and as easy to use as possible, without loosing the ability to have special build functions.

- ✓ Touch display provides for Radar, GPS, Assisted-Learning and purpose build functionality.
- ✓ Integrated product with all core functionality build in to one complete solution, fit for the vast majority of vessels.

CUSTOM: BALLAST SETTINGS



CUSTOM: NIGHTVISION INTEGRATION



AUTOMATIC SYNCHRONISATION

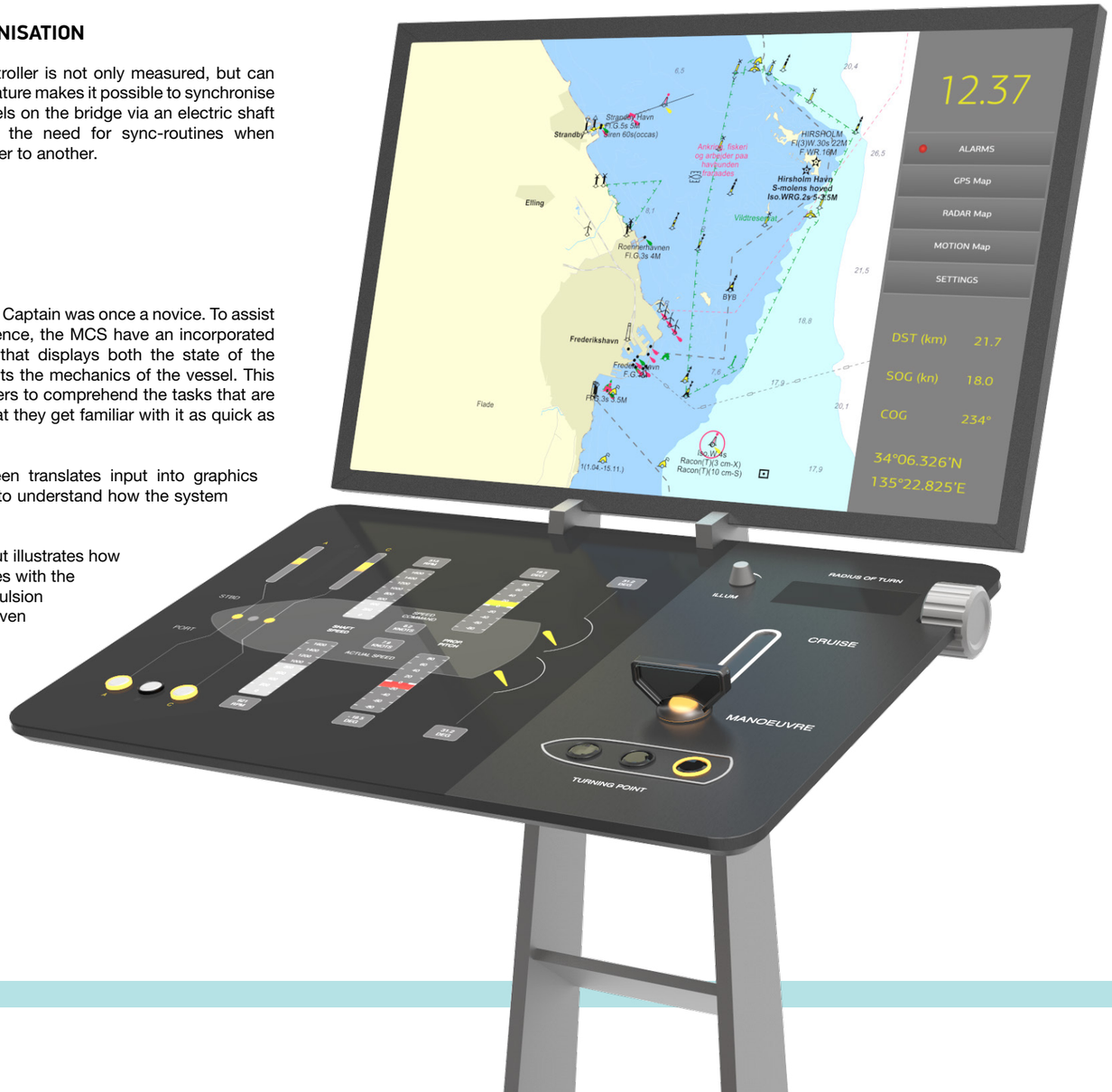
The movement of the controller is not only measured, but can also move by it self. This feature makes it possible to synchronise the system with outer panels on the bridge via an electric shaft system, thereby reducing the need for sync-routines when changing from one controller to another.

- ✓ Electric shaft system.
- ✓ Build in speed-pilot.

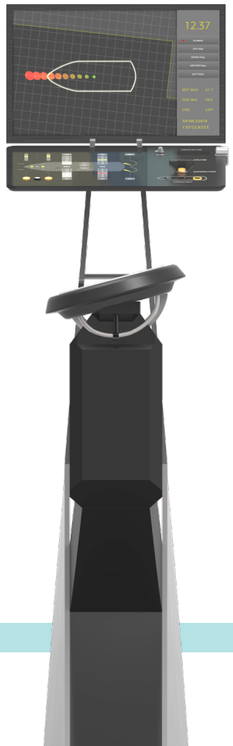
ASSISTED LEARNING

Even the most experienced Captain was once a novice. To assist the users with little experience, the MCS have an incorporated Assisted-learning feature, that displays both the state of the controller, and how it affects the mechanics of the vessel. This makes it easier for new users to comprehend the tasks that are automated and ensures that they get familiar with it as quick as possible.

- ✓ Assisted-learning screen translates input into graphics that assist new users to understand how the system reacts.
- ✓ True mechanical-output illustrates how automation manipulates with the mechanics of the propulsion system to perform a given task.

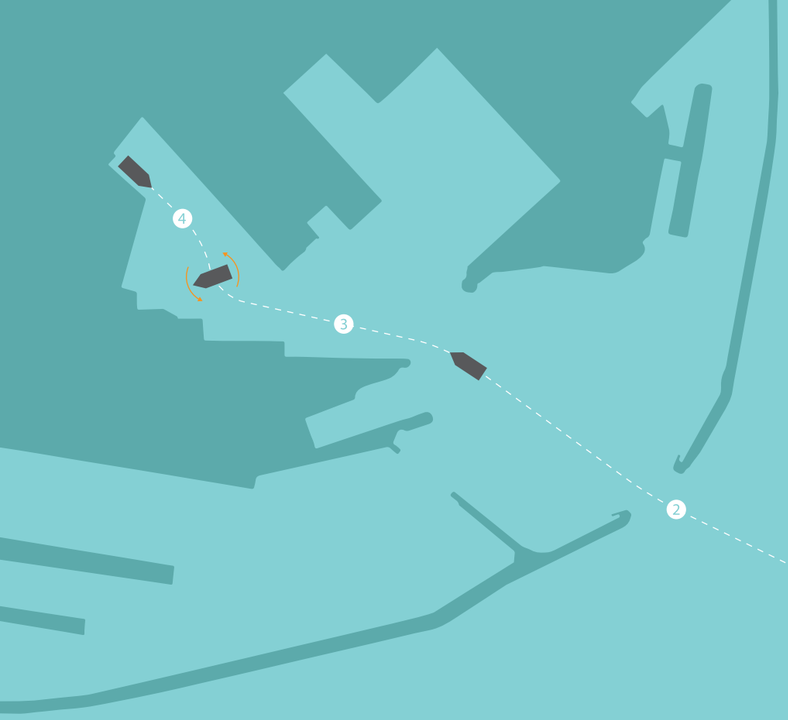


SIMPLE TILT FOR FORWARD MOTION



ROTATION OF CONTROLLER AND VESSEL

MULTI-AXIAL TILT FOR ADVANCED MOVEMENT



MCS IN ACTION

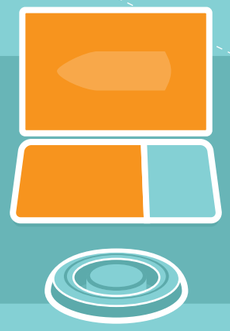
This is an example of how the MCS could assist the user to successfully perform advanced manoeuvring in a high-risk situation:

A medium sized roll-on-rool-off ferry is about to dock in a port that is highly trafficked by other vessels. The ferry must face outwards to the sea when docked to make it possible for cars and truck to be unloaded, and the ferry must therefore be turned 180 degrees inside the inner-harbour (step 3-4).

An addition to this complexity, is a demand to arrive on schedule and to make the journey as fuel-efficient as possible.

STEP 1

Preparing to enter port
The operator changes the information display to suit his needs in regards to weather conditions and his own experience with the vessel.



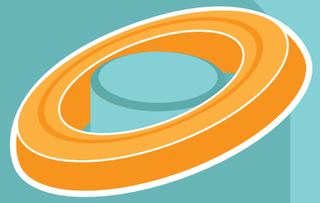
STEP 2

Taking manual control
Command is taken to the wing. The MCS center panel is used to micro-adjust power and heading, ensuring a safe port entry.

STEP 3

Changing orientation
While in harbour, the MCS handle is used to change vessel heading and propulsion direction, by tilting and rotating the controller handle.

The operator is highly focused on the outside, and is therefore assisted by a range of non-visual feedback systems.



STEP 4

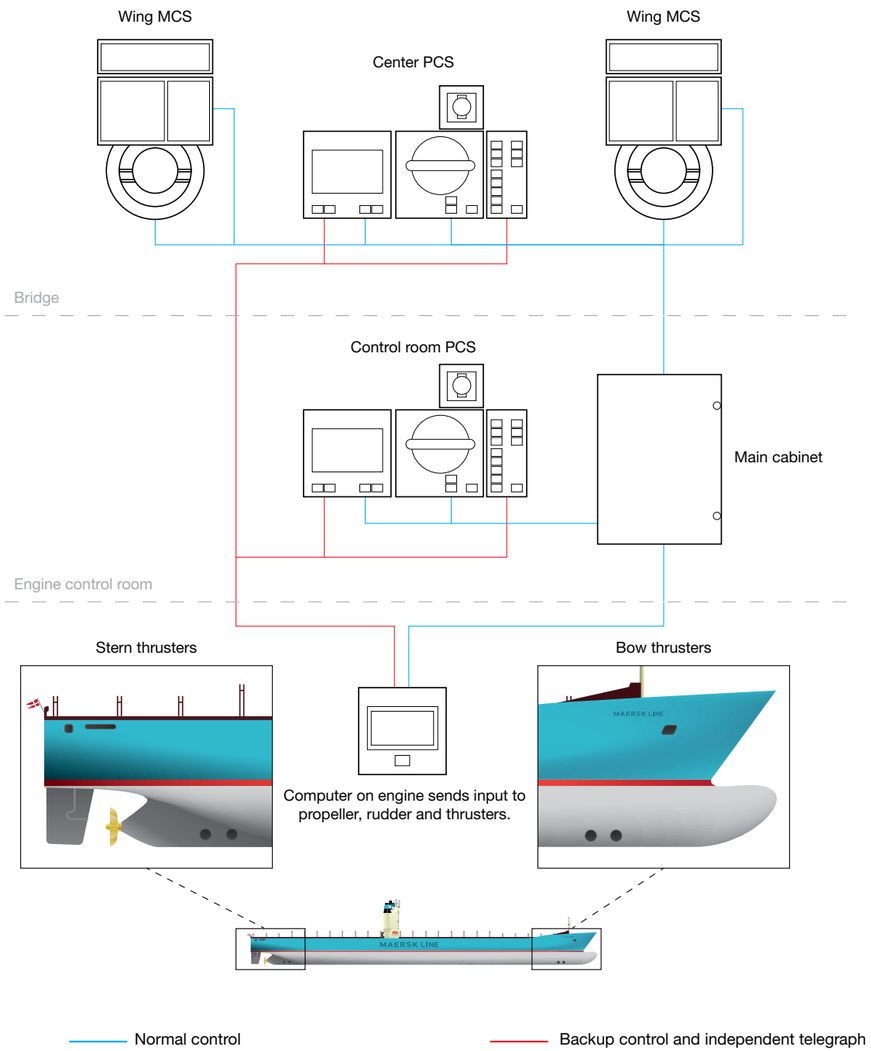
Docking in reverse
By taking full advantage of the system, the vessel is moved precisely to dock.

The operator has a limited view of the situation and is therefore assisted by the information display.

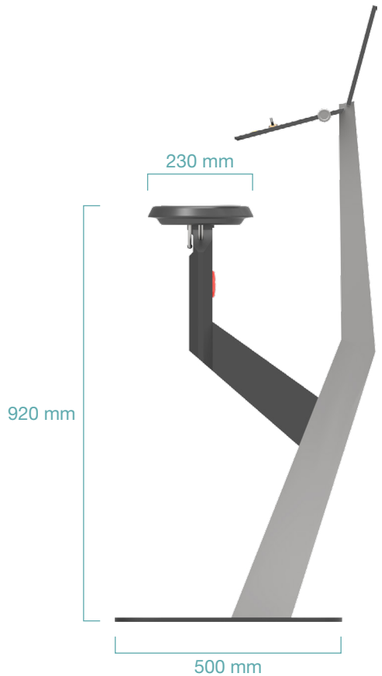
END

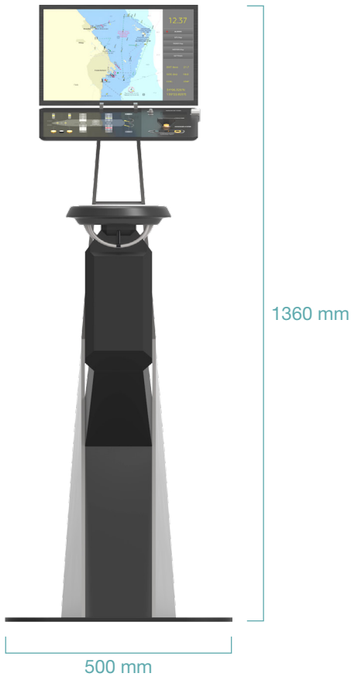
Command is taken to center panel to perform engine shut-down.

SYSTEM ARCHITECTURE



DIMENSIONS





RECOMMENDED PLACEMENT

- ✓ A MCS installed at both bridge wings, oriented with the front towards the center bridge.
- ✓ A floor clearance of 700 mm for both sides and the front is recommended for optimal 180-degree use.
- ✓ The product should be placed as far out on the wing as possible for an optimal view of the outside surroundings.