Webinar "The challenges of the blue world"

AUTONOMOUS SHIPS
THE FUTURE OF SHIP NAVIGATION

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Fabio Faraone
Naval and mechanical engineer
Head of Naval Technical Service Safety Environment
Italian Confederation Shipowners Rome

AUTONOMOUS SHIP
DO WE KNOW WHAT IT IS?

3 December 2018

«Today Rolls-Royce and Finferries, State-owned Finnish shipping company, have successfully demonstrated the world's first fully autonomous ferry in the archipelago south of the city of Turku, Finland. The ferry, Falco, used a combination of Rolls-Royce Ship Intelligence technologies to independently navigate during its journey between Parainen and Nauvo. The return journey took place in remote control mode. During the demonstration, Falco - with 80 guests on board - conducted the trip under fully autonomous control. The ship detected objects using sensor fusion and artificial intelligence and avoided collision. The ship also demonstrated an autonomous docking using a recent developed autonomous navigation system. All of these operations have been conducted without any human intervention from the crew».

ABOUT MASS

Maritime Autonomous Surface Ships

There can be different degrees of automation

…and different rules to apply depending on the automation level

IMO HAS BEGUN TO CLARIFY IN 2017

To facilitate the progress of the regulatory scoping exercise, the degrees of autonomy are organized (non-hierarchically) as follows (it was noted that MASS could be operating at one or more degrees of autonomy for the duration of a single voyage):

Ship with automated processes and decision support*: Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated.*

Remotely controlled ship with seafarers on board*: The ship is controlled and operated from another location, but seafarers are on board.*

Remotely controlled ship without seafarers on board*: The ship is controlled and operated from another location. There are no seafarers on board.*

Fully autonomous ship*: The operating system of the ship is able to make decisions and determine actions by itself.*

BUT PROCEEDING IS NOT EASY

MARITIME SAFETY COMMITTEE
99th session
Agenda item 5

MSC 99/5/3
8 March 2018
Original: ENGLISH

REGULATORY SCOPING EXERCISE FOR THE USE OF MARITIME AUTONOMOUS SURFACE SHIPS (MASS)

Recommendations on identification of potential amendments to existing IMO instruments

Identification of relevant IMO instruments

4 Acknowledging the views put forth by documents MSC 98/20/2 and MSC 98/20/13, the co-sponsors are of the view that one of the first tasks should be to identify the IMO instruments relevant to the operation of MASS. For a start, we suggest to initially categorize existing IMO instruments into the following two categories:

.1 those that do not require any amendments; and

.2 those that, as presently drafted, may require amendments to enable the operation of MASS.

BUT PROCEEDING IS NOT EASY

What is the methodology for the scoping exercise?

The framework and methodology for the MSC's regulatory scoping exercise on Maritime Autonomous Surface Ships (MASS) was approved by MSC 100.

The Legal Committee has decided to follow the same approach as MSC and a slightly adjusted framework and methodology for the LEG's regulatory scoping exercise was approved by LEG 106.

The Facilitation Committee (FAL 43) agreed a similar process.

DIFFERENT DEGREES OF AUTONOMY

The degrees of autonomy identified for the purpose of the scoping exercise are:

•Degree one: Ship with automated processes and decision support.
Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated and at times be unsupervised but with seafarers on board ready to take control.

•Degree two: Remotely controlled ship with seafarers on board.
The ship is controlled and operated from another location. Seafarers are available on board to take control and to operate the shipboard systems and functions.

•Degree three: Remotely controlled ship without seafarers on board.
The ship is controlled and operated from another location. There are no seafarers on board.

•Degree four: Fully autonomous ship.
The operating system of the ship is able to make decisions and determine actions by itself.

WHAT TO BEAR IN MIND

The first step has been completed.

The next step is to analyse and determine the most appropriate way of addressing MASS operations, taking into account, inter alia, human element, technology and operational factors.

The analysis will identify the need for:

- Equivalences as provided for by the instruments or developing interpretations; and/or
- Amending existing instruments; and/or
- Developing new instruments; or
- None of the above as a result of the analysis.

The aim is to complete the regulatory scoping exercise in 2020.

WHO IS INVOLVED?

Which treaties are being looked at?

Maritime Safety Committee (MSC)

The list of instruments to be covered in the MSC's scoping exercise for MASS includes those covering:

- safety and maritime security (SOLAS);
- collision regulations (COLREG);
- loading and stability (Load Lines);
- training of seafarers and fishers (STCW, STCW-F);
- search and rescue (SAR);
- tonnage measurement (Tonnage Convention); Safe Containers (CSC); and
- special trade passenger ship instruments (SPACE STP, STP).

Facilitation Committee

The Facilitation Committee is considering the Convention on Facilitation of International Maritime Traffic (FAL Convention).

THE IMO LEGAL COMMITTEE MUST VERIFY

Legal Committee
The list of instruments to be covered in the Legal Committee's scoping exercise for MASS include:
Conventions under the purview of the Legal Committee:
BUNKERS 2001 – International Convention on Civil Liability for Bunker Oil Pollution Damage, 2001.
•CLC 1969 – International Convention on Civil Liability for Oil Pollution Damage, 1969.
•CLC PROT 1976 – Protocol of 1976 to amend the International Convention on Civil Liability for Oil Pollution Damage, 1969.
•CLC PROT 1992 – Protocol of 1992 to amend the International Convention on Civil Liability for Oil Pollution Damage, 1969.
•FUND PROT 1992 – Protocol of 1992 to amend the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971.
•FUND PROT 2003 – Protocol of 2003 to the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1992.
•NUCLEAR 1971 – Convention relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material, 1971.
•PAL 1974 – Athens Convention relating to the Carriage of Passengers and Their Luggage by Sea, 1974.
•PAL PROT 1976 – Protocol of 1976 to the Athens Convention relating to the Carriage of Passengers and Their Luggage by Sea, 1974.
•PAL PROT 2002 – Protocol of 2002 to the Athens Convention relating to the Carriage of Passengers and Their Luggage by Sea, 1974.
•LLMC 1976 – Convention on Limitation of Liability for Maritime Claims, 1976.
•LLMC PROT 1996 – Protocol of 1996 to amend the Convention on Limitation of Liability for Maritime Claims, 1976.
•SUA 1988 – Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation, 1988.
•SUA PROT 1988 – Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms Located on the Continental Shelf, 1988.
•SUA 2005 – Protocol of 2005 to the Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation.
•SUA PROT 2005 – Protocol of 2005 to the Protocol for the Suppression of Unlawful Acts against the Safety of Fixed Platforms Located on the Continental Shelf.
•SALVAGE 1989 – International Convention on Salvage, 1989.
•NAIROBI WRC 2007 – Nairobi International Convention on the Removal of Wrecks, 2007.
•HNS PROT 2010 – Protocol of 2010 to the International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea, 1996.
Conventions emanating from the Legal Committee, with shared cognizance with other IMO committees
•INTERVENTION 1969 – International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969.
•INTERVENTION PROT 1973 – Protocol relating to Intervention on the High Seas in Cases of Pollution by Substances other than Oil, 1973.

WHAT HAS HAPPENED IN TWO YEARS?

INTERNATIONAL MARITIME ORGANIZATION

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MARITIME SAFETY COMMITTEE
102nd session
Agenda item 1

MSC 102/1/Rev.1†
23 September 2020
Original: ENGLISH

PROVISIONAL AGENDA

for the 102nd session of the Maritime Safety Committee, to be held remotely* from Wednesday, 4 November, to Wednesday, 11 November 2020

Session commences at 11.00 a.m. (GMT) on Wednesday, 4 November 2020

Opening of the session

1 Adoption of the agenda; report on credentials

2 Decisions of other IMO bodies

3 Consideration and adoption of amendments to mandatory instruments

4 Capacity-building for the implementation of new measures**

5 Regulatory scoping exercise for the use of Maritime Autonomous Surface Ships (MASS)**

** To be postponed to MSC 103.

Let's get back to MSC 101

INTERNATIONAL MARITIME ORGANIZATION

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MARITIME SAFETY COMMITTEE
101st session
Agenda item 24

MSC 101/24
12 July 2019
Original: ENGLISH

REPORT OF THE MARITIME SAFETY COMMITTEE ON ITS 101ST SESSION

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Let’s get back to MSC 101

5.10 During the ensuing discussion, the following views were expressed:

.1 several findings in the document were supported, however, they should be considered after RSE was completed;

.2 it was essential to consider the glossary in detail, but not at this stage of the work;

.3 the glossary should be considered at this stage, to achieve a common understanding of terms used and to support RSE;

.4 the Committee should agree on a glossary before proceeding with RSE;

.5 the terms and definitions currently used for RSE had been agreed after lengthy debates and only for the purpose of RSE;

.6 terms and definitions should be finally established in cooperation with other international organizations; and

.7 ISO/TC 8 was currently developing a relevant international standard and would submit it to MSC 102.

Let's get back to MSC 101

Interim guidelines for MASS trials

5.12 The Committee recalled that MSC 100 had noted a list of provisional principles prepared by the MASS Working Group and had invited potential submitters to take them into account when preparing proposals for draft guidelines for MASS trials to guide their development (MSC 100/WP.8, paragraph 23).

Establishment of a working group

5.16 The Committee established the MASS Working Group, and instructed it, taking into account comments and decisions made in plenary, to:

.1 consider the progress made with the regulatory scoping exercise, taking into account document MSC 101/5, and advise the Committee on any necessary actions;

.2 finalize draft interim guidelines for MASS trials, bearing in mind the provisional principles outlined in paragraph 23 of document MSC 100/WP.8, and taking into account documents MSC 101/5/1, MSC 101/5/3, MSC 101/5/5, MSC 101/5/6 and MSC 101/INF.17; and

.3 prepare terms of reference for the intersessional Working Group on MASS.

Interim guidelines for MASS trials

5.21 The Committee approved MSC.1/Circ.1604 on *Interim guidelines for MASS trials*.

BUT PROCEEDING IS NOT EASY

Interim guidelines for trials of autonomous ships

The Maritime Safety Committee (MSC), 101 session, in June 2019 approved Interim guidelines for Maritime Autonomous Surface Ships (MASS) trials

Meanwhile...

Fincantieri (Vard) delivers the first electric and self-driving container ship

30 November 2020

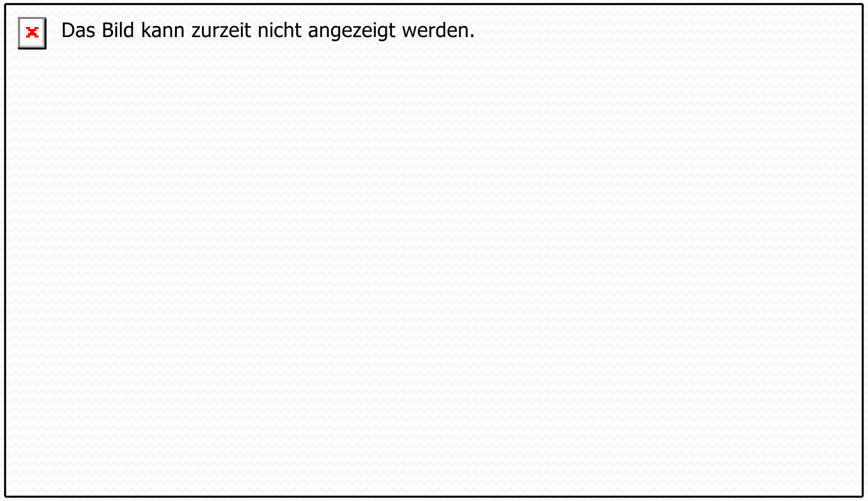
With a length of 79.5 metres and a width of almost 15 metres, the ship will use a battery pack with a capacity of 7 MWh which could be expanded to 9 MWh. This will allow the ship to sail at a speed of 6 knots, with the possibility of reaching a peak of 13 knots if necessary.

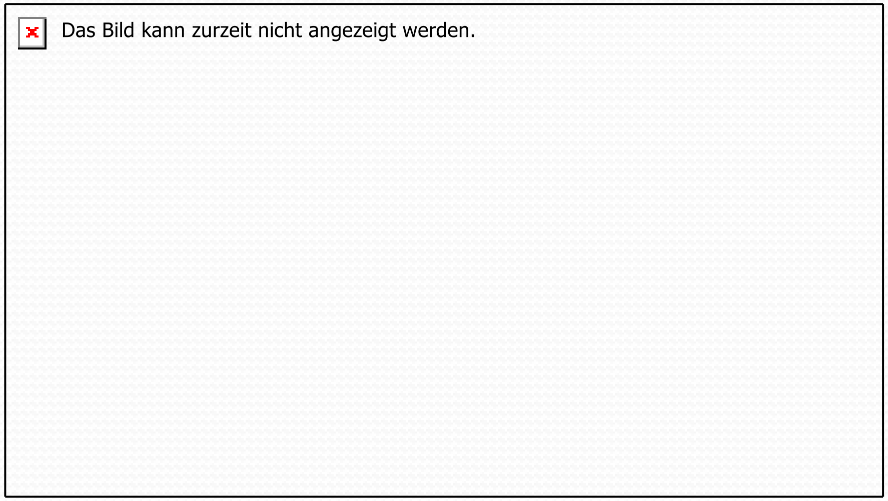
Length: 79.5 metres

Width: 14.8 metres

Cruising speed: 6 knots

Maximum speed: 13 knots





The ship, which was due to be launched in May but has been delayed for a few months due to the pandemic, has now started a series of tests.

The testing phase

There are two areas in which the reliability of the vessel must be checked. The first concerns the loading and unloading of containers. As the vessel was built to transport chemicals and fertilisers, it must be tested very carefully to ensure that it remains stable even when fully loaded.

The second concerns autonomous driving. The Yara Birkeland will be used to navigate along the Norwegian coast and will gradually introduce assisted navigation and eventually **do without a crew**. This is expected to happen in 2022.

To become fully autonomous, the ship will have to read and coordinate information coming from radars, lidars, sensors and cameras on board and interface them with GPS information and satellite communications.

What is happening at European level?

Horizon 2020: Smart, Green and Integrated Transport

Programme type: Funding programme

Origin: European (Horizon 2020)

Duration: 2014 – 2020

STRIA Roadmaps: Cooperative, connected and automated transport, Transport electrification, Low-emission alternative energy for transport, Network and traffic management systems, Smart mobility and services, Infrastructure

PROJECT AUTOSHIP

Autonomous Shipping Initiative for European Waters

Funding: European (Horizon 2020)
Duration: Jun 2019 - Nov 2022
Status: Ongoing
Total project cost: €29,546,161
EU contribution: €20,109,109 CORDIS R

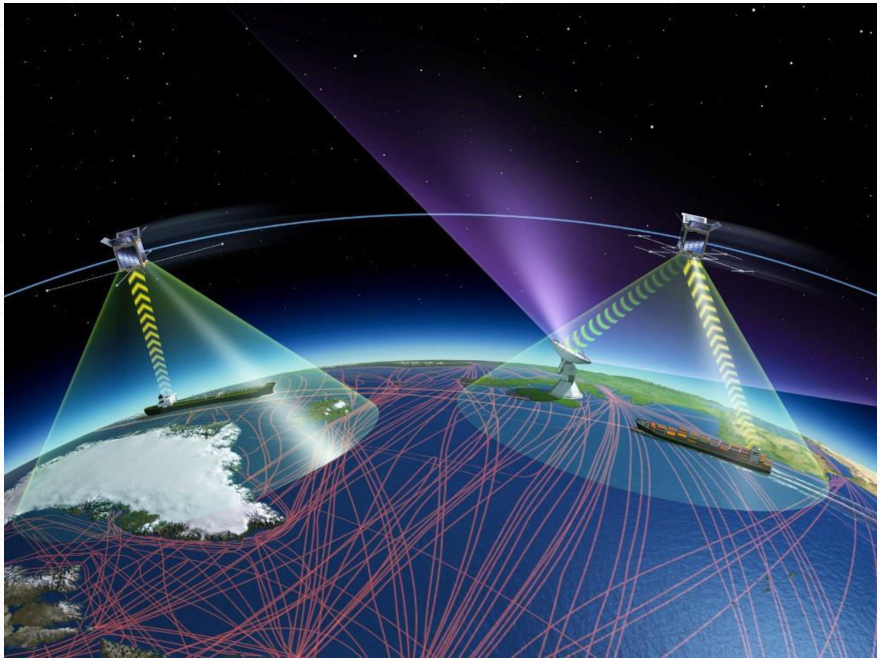
May 30, 2019, **The European Commission revealed a new funding for an autonomous shipping initiative for the European waters.**

Under the project titled Autoship, two remote and autonomous (R&A) vessels would be built and operated, along with their needed shore control and operation infrastructure, reaching and going over technology readiness levels 7 -system prototype demonstration in operational environment.

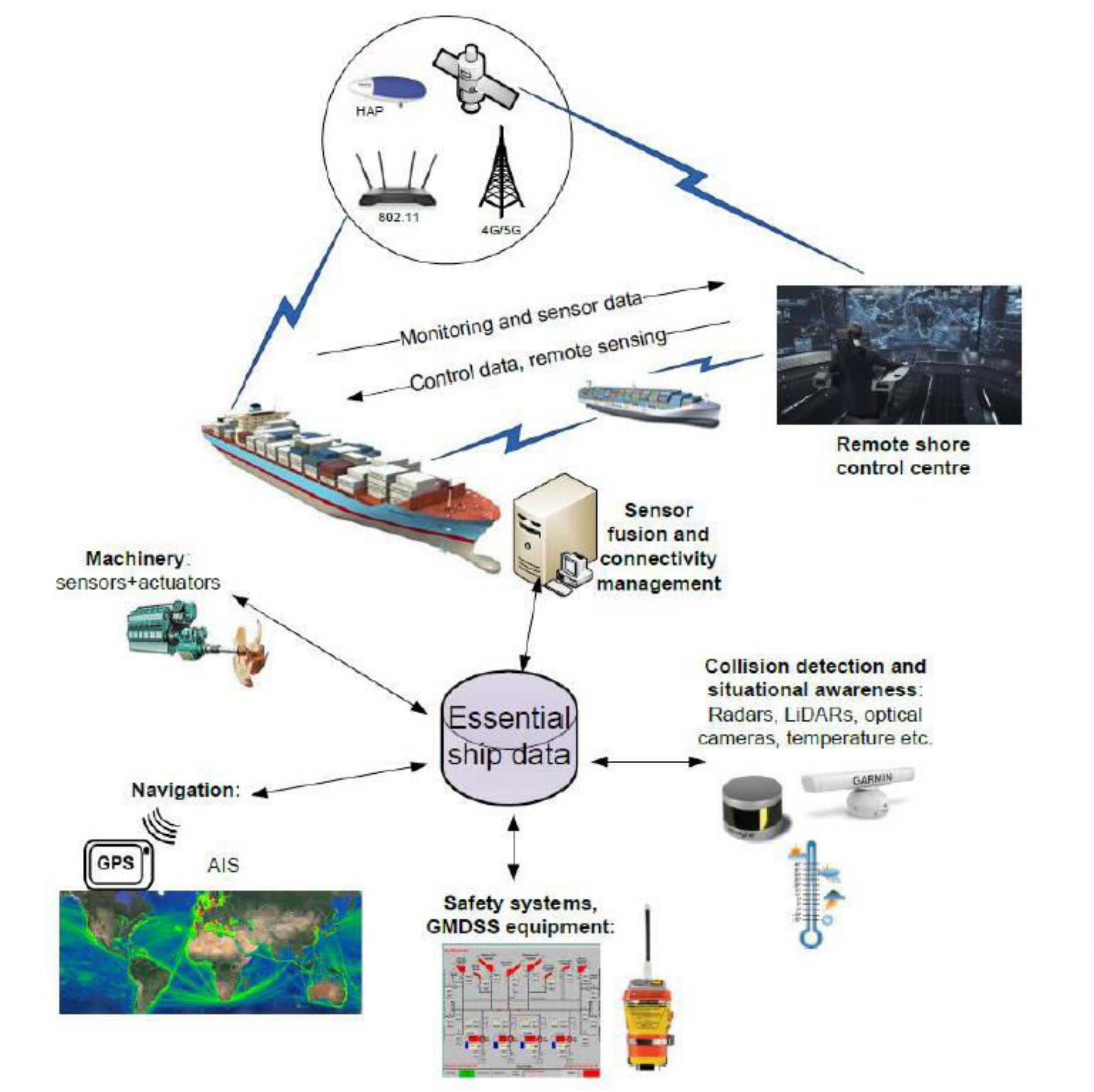
Testing will take place during two pilot demonstration campaigns addressing goods mobility from the Baltic Corridor to a major EU seaport and hinterland. Autoship would build around two EU technology providers, such as Rolls Royce and Kongsberg, to create a stronger European cluster

The technology package would include full-autonomous navigation, self-diagnostic, prognostics and operation scheduling, as well as communication technology enabling a prominent level of cyber security and integrating the vessels into upgraded e-infrastructure. In parallel, digital tools and methodologies for design, simulation and cost analysis would be developed for the whole community of autonomous ships.

SATELLITES HAVE A ROLE TO PLAY!



SATELLITES HAVE A ROLE TO PLAY!



BUT CONSIDERABLE PROGRESS WILL BE NEEDED

As an example, we cite a not very recent (2017) but rather interesting publication

Connectivity for Autonomous Ships: Architecture, Use Cases, and Research Challenges

Marko Höyhtyä[1], Jyrki Huusko[1], and Markku Kiviranta[1] Kenneth Solberg[2], and Juha Rokka[2]
[1]VTT Technical Research Centre of Finland Ltd
[2]Rolls-Royce Marine, Ship Intelligence
marko.hoyhtya@vtt.fi

***Abstract*—A critical component of any unmanned and autonomous ship is the wireless communication system supporting efficient and safe operations. This paper studies connectivity challenges of autonomous ships in different environments, including ports, deep sea, and Arctic regions. Data requirements for wireless transmission regarding the environmental sensors and remote maintenance as well as remote control needs are identified in the paper. Multiple wireless systems are needed for resilient operations to fulfill capacity, latency, and secure communication needs. A hybrid connectivity concept that integrates satellite and terrestrial system components is defined and its components described. An essential part of the concept is a connectivity manager that ensures quality of service (QoS) for communications. Finally, research challenges for future are given.**

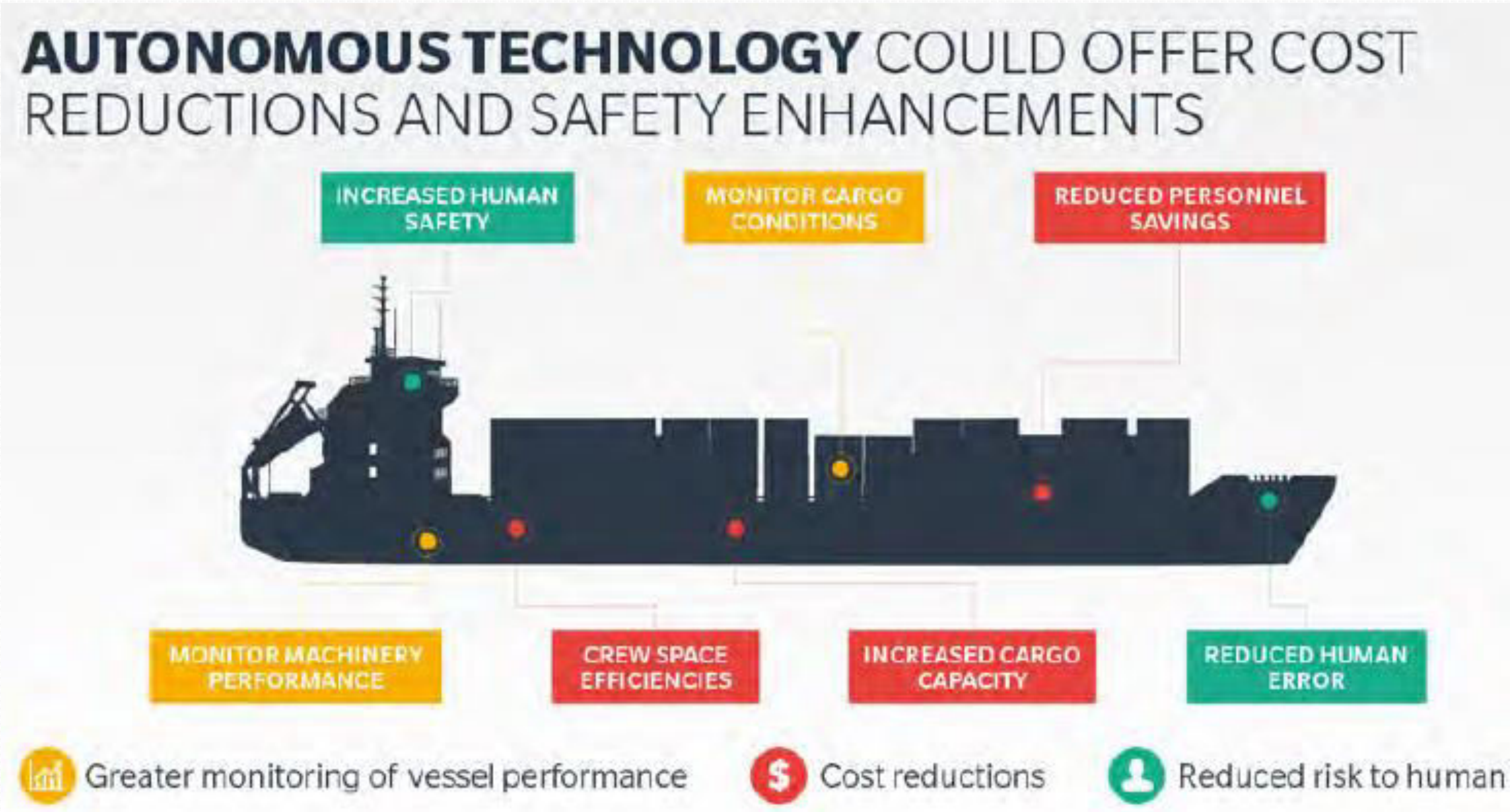
HOWEVER CONSIDERABLE PROGRESS WILL BE NEEDED

Satellite systems: Geostationary (GEO) satellite systems such as Inmarsat provide connectivity to the ships anywhere in the world, except Polar Regions [6]. However, the achievable capacity currently is in the range of hundreds of kilobits per second which is enough only for limited operations. There are plans related to Low Earth orbit (LEO) megaconstellations composed of hundreds of small satellites that aim to provide tens of Mbits/s connections anywhere in the world. If these will become reality, they will be great enablers for many capacity hungry maritime applications. In addition, next generations of the current satellite systems, high throughput satellites (HTS) can support capacity needs of the ships.

For autonomous and remote controlled ships the connectivity must be always available. Thus, the satellite systems on-board should operate in different frequency bands. For example, low frequency bands such as 1.6 GHz L-band is resilient to heavy rain whereas connection using high frequencies may be totally lost. On the other hand, frequency bands such as Ka and Q/V bands above 20 GHz allow high capacity and reduced antenna dimensions without decreased antenna gain which is advantageous for small satellites and Earth terminals.

Conclusion/ food for thought

Why are we looking at autonomous ships?



Fabio Faraone
Naval Architect & Marine Engineer
Head of Technical Safety & Environmental Department
Italian Shipowner's Association
Piazza SS. Apostoli, 66 – 00187 Rome
Phone +39 06 67481237
Mob. +39 338 6124361
fabio.faraone@confitarma.it