



Autonomous ships - Employee?

Norwegian Union of Marine Engineers 2018

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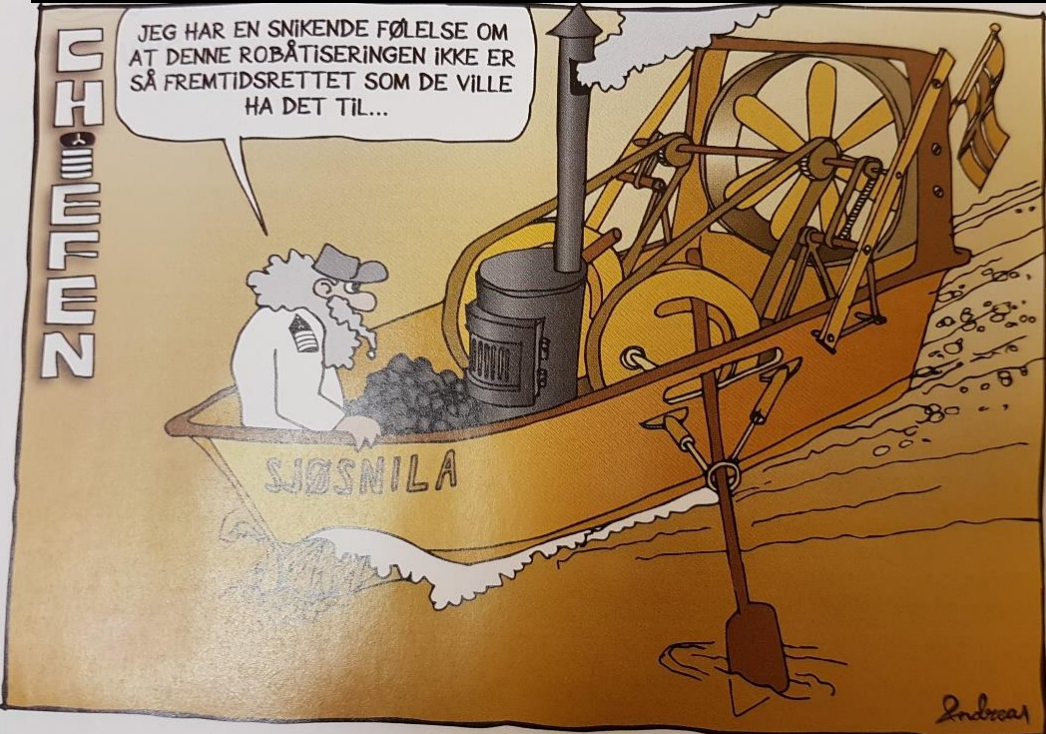
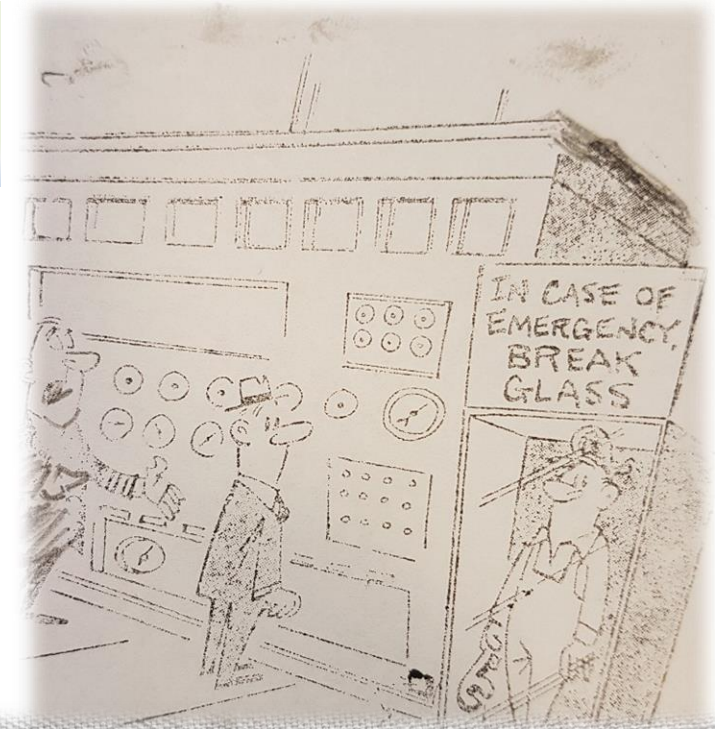
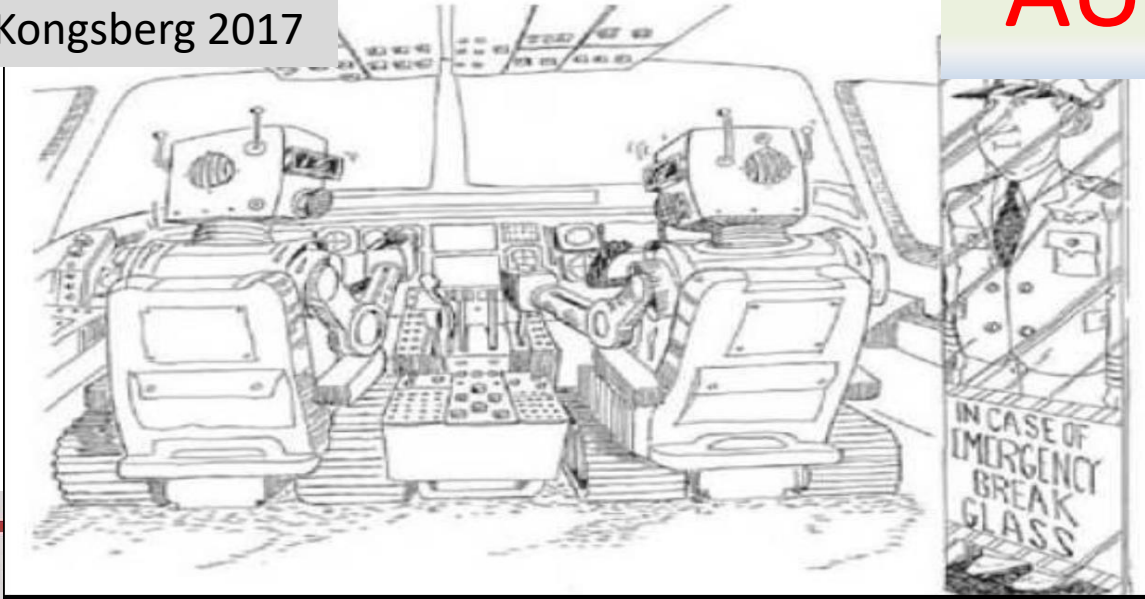
- Background
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- International work
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- Summary



Keep the human in the loop!

Kongsberg 2017

AUTOMATION?



Print plate from NUME's news magazine back in the 1970, when Engine Zero (E0) started

Autonomous Ships



Maritime Unmanned Navigation through Intelligence in Networks

Scope: Feasibility study - Test-bed development

Budget: Total: EUR 3.8 million.

Need for new sensor systems, better technical availability, legislation, environmental impacts, communication and support features.



October 4, 2016 NFAS opened by Minister of Transport and Communications, Ketil Solvik-Olsen.

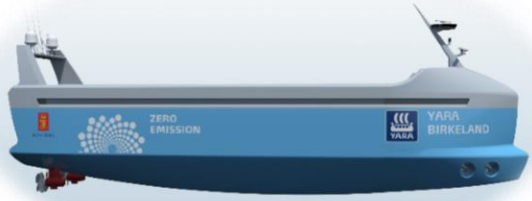
Increase of 41% coastal vessels to replace trailers, increase NUMBER of seafarers with the right skills, etc. at the LAND centers.

Optimistic testimonials:

- There seems to be no major problem in addressing national and international legislation in order to use unmanned ships.
- Resolutions proposed as a quick solution. Whoever starts is the duty subject - not the captain.
- This is a three-step process of technology's gradually replacing crew - from partially unmanned ships to completely unmanned ships, namely fully autonomous ships.
- On smaller ships, cost can be saved. Reduction of the cost by eliminating crew is estimated at approx. 38%.

Counterpart views:

- In the previous estimation, the cost of building infrastructure and operator centers and maintenance personnel all stay in land was not considered.
- New types of accidents, landing time in port, more expensive cost in port, maintenance on board in port should be resolved.
- Insurance will not be applicable before the regulations are in place.



The ship



Higher security

"Human error is estimated at 70 to 80 percent of all accidents at sea. Replacing human control with reliable technology has the potential to increase security significantly ."

What about all the accidents - which are prevented every day by human control?

Kongsberg's autonomous YARA Birkeland = no problems with anything.

First radar assisted collision: SS Andrea Doria and MS Stockholm, [Nantucket](#) in 1956



Rules on OPERATION & WATCHKEEPING



1. IMO: STCW Chapter VIII

2. AMSA: Watchkeeping Standards



Australian Government

Australian Maritime Safety Authority

95 The chief engineer officer, in consultation with the master, shall ensure that engineering watchkeeping arrangements are adequate to maintain a safe engineering watch while in port. When deciding the composition of the engineering watch, which may include appropriate engine-room ratings, the following points are among those to be taken into account:

- .1 on all ships of 3,000 kW propulsion power and over there shall always be an officer in charge of the engineering watch; and
- .2 on ships of less than 3,000 kW propulsion power there may be, at the master's discretion and in consultation with the chief engineer officer, no officer in charge of the engineering watch; and
- .3 officers, while in charge of an engineering watch, shall not be assigned or undertake any task or duty which would interfere with their supervisory duty in respect of the ship's machinery system.

Note: Marine Order 28 (Operations standards and procedures) 2012 requires that, during watchkeeping in port, on all ships of 750 kW propulsion power and over there shall always be an officer in charge of the engineering watch.

Note: The STCW Code defines propulsion power as the total maximum continuous rated output power in kilowatts of all the ship's main propulsion machinery which appears on the ship's certificate of registry or other official document.

3. Norwegian operating regulations:

Chapter 3. Security systems in the engine room

§ 7. Main rule - manned engine room

The machine room should normally be continuously manned.

§ 8. Exception - Operation with periodically unmanned engine room

(2) Ships with a propulsion power exceeding 750 kW may not operate with periodically unmanned engine spaces under the following conditions:

- a) by maneuvering in and out of port
- b) within safety zone around offshore oil installations
- c) when the waters must be considered highly trafficy
- d) when visibility is impaired.

§ 9. United machine room - duration

(1) For passenger ships, the Norwegian Maritime Directorate determines how long the engine room may be unmanned in each case, depending on operating conditions, etc. The length of the unmanned period shall normally be limited to 2 hours duration.

(2) For ships other than passenger ships, operation with periodically unmanned machinery spaces shall be limited to periods determined by the relevant classroom rules. The period between each inspection shall not exceed 24 hours.

And the guard regulations must be completely erased - both for tires and machines.



Norway



Flag State

Samlet oversikt

Maritime muligheter
– blå vekst for grønn fremtid

Regjeringens maritime strategi



"Access to expertise is essential for maintaining and developing competitive and value creation skills in maritime industry."

Norway can not compete on price, only expertise.



.. then the skills must be built up - not down!

***Seafarers must raise the competence level
premised on the STCW standards***





25.05.2018, The Government will facilitate the sailing of autonomous ships by making changes to the Pilot's Act

The purpose of the proposed amendment is to remove legal obstacles to autonomous coastal sails while safeguarding maritime safety.

With autonomous coastal sails, this means sailing ships within the baseline, where navigation and maneuvering of the ship is not taken care of by a master located on the vessel's bridge. Navigation and maneuvering of the ship may be left to systems that automatically carry the vessel or to a master located elsewhere than the ship's bridge.



Autonomous and remotely operated ships**1 Introduction**

When new operational concepts enabled by novel technology are introduced, the solutions may not meet existing regulations and technical requirements. The technology may also be intended to perform a function that is traditionally performed by humans, and for which no performance requirements to the technology have been developed.

2.3.1 Concept of operation

Each operational task should be further broken down into sub-tasks to a level that enables a clear distinction between tasks where a human is in charge of decision making and tasks where a system is in charge of decision making.

2.3.2 Preliminary risk analysis

The risk analysis should include risks towards humans, the environment, the vessel itself, its cargo, and related off-ship systems.

2.4.1 Safety philosophy

Manning and competency: humans are typically a key and integral part of any safety system. The formal and informal requirements regarding competency for the humans involved with the operation and maintenance of an autoremote vessel should be described. Care should be taken to incorporate special competency needs related to remote supervision and control of the vessel operations.

4 Operational focus

As automatic control of functions replaces operations traditionally performed by humans, operational modes and scenarios in question should be thoroughly analysed to identify all relevant variations and potential hazards.

4.3 Senses

For the remote operation of a function, it should be considered as part of the risk analysis how the different human senses are contributing to the situational awareness for conventional local operation of the specific function. Substitutes for these contributing human senses should be provided by sensor technology, and the information presented to the remote operator in a logical way, ensuring that the total situational awareness for the remote operator will be equivalent to, or better than, compared to the conventional local situational awareness.

5.2 Independent supervision Independent safety systems are to a large extent implemented for certain functions (e.g. machinery functions) to ensure a safe state in case of failures in the automatic control of a function. For other functions that are conventionally operated by humans, the novel technology performing the function control may not be supported by equivalent independent safety systems. **This may result in the need for independent human supervision to ensure that the function is performed in a safe way.**

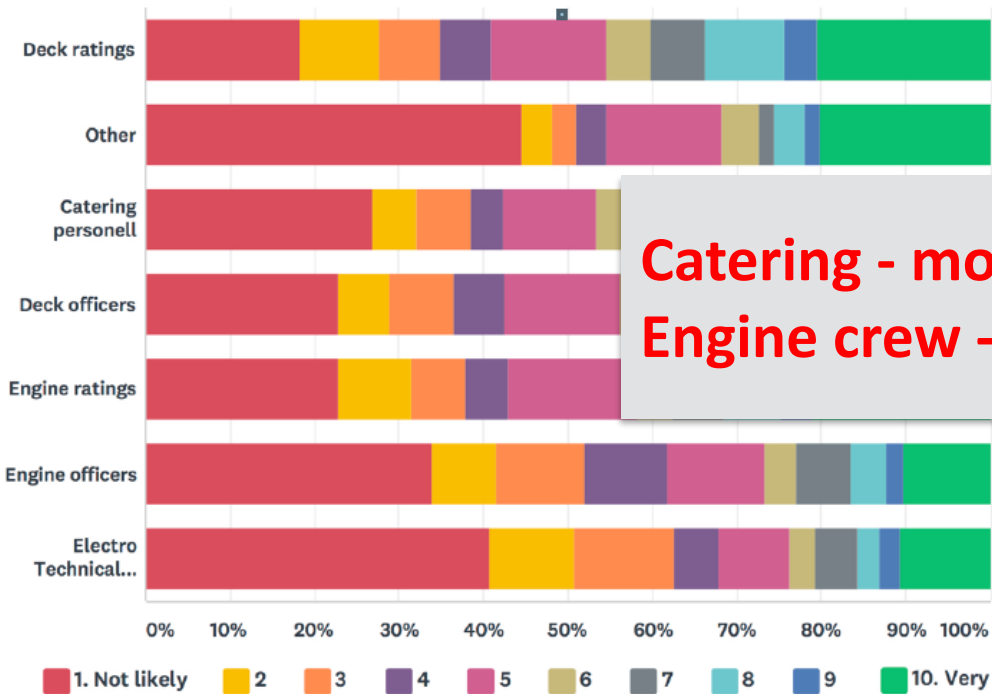


AUTONOMOUS SHIPS FROM SEAFARERS' POINT OF VIEW

The survey was published 25th of September 2017 and closed the 13th of October 2017

The personnel category deemed to be the most likely to become redundant with 27,9% of the respondents is catering personnel. The crew category least expected to be redundant is engine officers and electro technical personnel with 10,5% each as very likely.

Adjusted for some respondents who are not directly affected, only 15% of the seafarers see their job to be threatened by autonomy, while 85% of the respondents are not. With all respondents presented, including former or retired seafarers or persons active in different fields of the maritime sector, for example in the on-shore organizations, the result is fairly similar.



Catering - most redundant (30%)
Engine crew - least redundant (10%)

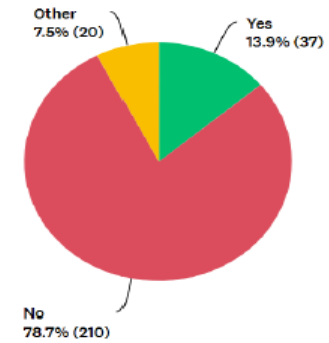


Figure 9 – Q8 How worried that you might lose your jobs due to autonomous shipping in the future?

The last question asked in the survey is whether seafarers are willing to work within the shipping segment even after autonomy is a reality, for example as a service engineer or operator in a shore control centre, where 48% is positive and 52% is negative. The question was not relevant for 16 respondents and they have been excluded from the results in this question.



Figure 10 – Q9 Would you like to work with autonomous shipping on the shore side, for example in a shore control centre or as a service engineer that embarks the vessels during port stays to service the engines and other equipment?



The Norwegian Union of Maritime Engineers (NUME) will contribute to the development of new technology that takes the human factor into account, that internal and external safety is protected and that the competence requirements in national and international regulations are sufficient for safety on board.

- **Forum for Autonomous Ships (NFAS)**
 - NFAS - Working Group Regulations IMO - Class (RO)
- **Norwegian Association for Automation**
- **Working Group** The GREEN CHANGE, NEW TECHNOLOGY - EXPERIENCING IN MARITIME EDUCATION
- **Collaboration for Security - Forum for Maritime Operations (FMO)**
- **ITF** Seafarer's Section, Maritime Safety Committee
- **ITF** Maritime Safety Committee Steering group
- **ITF** Automation working group
- **ITF** Seafarers' Section Automation Working Group (SSAWG)
- **IMO** Sub-committee on ship Design and Construction (SDC)
- **IMO** Sub-committee on Human element, Training and Watchkeeping (HTW)
- **IMO** Sub-committee on Ship Systems and Equipment (SSE)
- **IMO** Maritime Safety Committee (MSC)
- **IMO** Sub-Committee on Implementation of IMO Instruments (III)
- **ILO** 186 (MLC 2006) – 188 (Fish)
- **ETF** Maritime Transport Section
- **NTF** Maritime Transport Section



INTERNATIONAL REGULATIONS

SAFETY & SECURITY

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United Nations Convention on the Law of the Sea (UNCLOS)





United Nations Convention on the Law of the Sea (UNCLOS)

UNCLOS Article 94 Duties of the flag State

1. Every State shall effectively exercise its jurisdiction and control in administrative, technical and social matters over ships flying its flag.
2. In particular every State shall:
 - (b) that each ship is in the charge of a **master and officers who possess appropriate qualifications**, in particular in seamanship, navigation, communications and marine engineering, and that the crew is appropriate in qualification and numbers for the type, size, machinery and equipment of the ship;
5. In taking the measures called for in paragraphs 3 and 4 each State is required to conform to generally accepted international regulations, procedures and practices and to take any steps which may be necessary to secure their observance.



Maritime Labour Convention, 2006, as amended (MLC, 2006)

MLC Standard A2.7 – Manning levels

1. Each Member shall require that all ships that fly its flag have a **sufficient number of seafarers on board** to ensure that ships are operated safely, efficiently and with due regard to security. Every ship shall be manned by a crew that is adequate, in terms of size and qualifications, to ensure the safety and security of the ship and its personnel, under all operating conditions, in accordance with the minimum safe manning document or an equivalent issued by the competent authority, and to comply with the standards of this Convention.
2. When determining, approving or revising manning levels, the competent authority shall take into account the need to avoid or minimize excessive hours of work to ensure sufficient rest and to limit fatigue, as well as the principles in applicable international instruments, especially those of the International Maritime Organization, on manning levels.
3. When determining manning levels, the competent authority shall take into account all the requirements within Regulation 3.2 and Standard A3.2 concerning food and catering.





Maritime Labour Convention, 2006, as amended (MLC, 2006)

MLC Standard A2.8 - Career and skill development and opportunities for seafarers' employment

1. Each Member shall have national policies that encourage career and skill development and opportunities for seafarers, in or- to provide the maritime sector with a stable and competent workforce.
2. The aim of the policies referred to in paragraph 2. 1 of this Standard shall be to help seafarers strengthen their competencies, qualifications and employment opportunities. 3. Each Member shall, after consulting the ship owners' and seafarers' organizations con-, etacerned, establish clear objectives for the vocational guidance, education and training of sea- farers whose duties on board ship primarily to the safe operation and navigation of. the ship, including ongoing training.

Guideline B2.8 Guideline B2.8.1 Measures to promote career and skill development and employment opportunities for seafarers.

Measures to achieve the objectives set out in Standard A2.8 might include: agreements providing for career develop- and skills training with a shipowner or and organization of shipowners promoting employment Through the establishment and maintenance of registers or lists, by categories, of qualified seafarers; or promotion of opportunities, both on board and ashore, for further training and education of seafarers to provide for skill develop ferment and portable competencies in order to secure and retain decent work, to improve individual employment prospects and **meet the changing technology and labour conditions** of the maritime industry





The International Convention for the Safety of Life at Sea, as amended (SOLAS)

- **SOLAS Regulation II-1/38 Engineer's alarm** references are made to a periodically unmanned engine room, **not a permanently unmanned one.**
- **SOLAS Chapter II-1/E periodically unmanned engine spaces** are clearly written assuming that engineers are onboard however there are provisions for equivalencies.
- **SOLAS Regulation II-1/46 General** states that "The arrangements provided shall be such that the safety of the ship in all sailing conditions, including manoeuvring, is equivalent to that of a ship having the **machinery spaces manned.**"
- **SOLAS Regulation V/14 Ship's manning**

For every ship to which chapter I applies, the administration shall:

*.1 establish appropriate minimum safe manning following a **transparent** procedure, taking into account the relevant guidance adopted by the organization*; and*

.2 issue an appropriate minimum safe manning document or equivalent as evidence of the minimum safe manning considered necessary to comply with the provisions of paragraph

** Refer to the [Principles of Safe Manning](#) adopted by the Organization by Resolution A.1047(27)*



The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978, as amended (STCW)

- **[STCW Regulation VIII/2](#) *Watchkeeping arrangements and principles to be observed* states that officers in charge of an engineering watch shall be immediately available to attend the machinery space and, when required, shall be **physically** present in the machinery space during their periods of responsibility ([driftsforskriften](#)).**
- ***STCW Regulation I/13 Conduct of trials*** allows administrations to conduct trials to evaluate integrated or automated systems to perform functions prescribed by the code. These can be made permanent **after informing** the Maritime Safety Committee if the MSC approves.



The International Safety Management Code (ISM Code)

ISM Code Part A/6 Resources and personnel

- 6.2

The Company should ensure that each ship is:

- .1 **manned with qualified, certificated and medically fit seafarers** in accordance with national and international requirements; and
- .2 appropriately manned in order to encompass all aspects of **maintaining safe operation on board**.*

Refer to the [Principles of Safe Manning](#) adopted by the Organization by Resolution A.1047(27)





The International Regulations for Preventing Collisions at Sea 1972 (COLREG)

COLREG Part A Rule 2 Responsibility

(a) Nothing in these Rules shall exonerate any vessel, or the owner, master or crew thereof, from the consequences of any neglect to comply with these Rules or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.

(b) In construing and complying with these Rules due regard shall be had to all dangers of navigation and collision and to any special circumstances, including the limitations of the vessels involved, which may make a departure from these Rules necessary to avoid immediate danger.

COLREG Part A Rule 5 Look-out

Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision.





Maritime Safety Committee (MSC)

MSC98/20/2: Maritime Autonomous Surface Ships, Proposal for a regulatory scoping exercise, Denmark, Estonia, Finland, Japan, the Netherlands, **Norway**, the Republic of Korea, the United Kingdom and the United States. og **MSC98/20/13:** Maritime Autonomous Surface Ships, Proposal for a regulatory scoping exercise, Comments on **MSC 98/20/2, ITF, ble behandlet i MSC den 13.06.17**

About. 50 countries participated in the 2-hour debate on "Regulatory Scoping Exercise for Maritime Autonomous Surface Ships. There was no one who argued directly against putting this on the agenda, although Cook Island came close. This will be put on MSC's work program, and 4 meetings will be devoted to the theme (Finished June 2020).

Many supported the proposal without reservation. Many others used the phrase that they supported in principle - which is a common way of expressing support, but with a degree of reservation.

Quite a few referred to specific concerns, and many also supported the concerns expressed by **ITF 20/13, §7.**

The proposed outputs are narrowly focused on only the needed regulatory revisions to allow unmanned ships to engage in international voyages. This is based on acceptance of an unverified assumption that unmanned ships are equally as safe and reliable as manned ships. That assumption needs to be examined in the scoping exercise and include reliability, robustness, resiliency and redundancy of the underlying technical, communications, software and engineering systems.

Kilde S.dir.





Maritime Autonomous Surface Ships (MASS)

The Maritime Safety Committee 99 (MSC)

TEMPORARY DEFINITIONS

- 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.

More than 225 rules that must be checked out!

MARITIME SAFETY COMMITTEE
100th session
Agenda item 5

MSC 100/INF.3
9 August 2018
ENGLISH ONLY

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

Initial review of IMO instruments under the purview of MSC

Note by the Secretariat

SUMMARY

Executive summary: This document provides a consolidated report containing comments on maritime safety and security instruments based on documents submitted to MSC 99 related to the regulatory scoping exercise for the use of Maritime Autonomous Surface Ships (MASS)





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Transport Sectors Seafarers In Focus ITF and IMEC, working in partnership Maritime labour convention

Flags of convenience Help for seafarers Women seafarers The Black Sea project Container safety

Maritime Roundtable 2016 Maersk network Seafarers' Bulletin 2017 Day of the Seafarer 2016

Woman captain wins bravery award Calling all seafarers! Criminalisation Cabotage **Ship automation**



In 2016, the ITF seafarers' section recognised a need to focus on ship automation, and established the Seafarers' Section Automation Working Group (SSAWG). In February 2017, the Group commenced its active work based on these [terms of reference](#), which had been adopted by the ITF Maritime Safety Committee (MSC).

In March 2018, the SSAWG produced a [position paper, as explained in a policy statement, on ship automation](#) that was adopted by the ITF MSC. The position was passed on to the SSAWG and a [policy statement was formulated](#). The policy statement was adopted as the ITF's position on ship automation by the ITF seafarers' section committee (SSC) in May 2018.



ITF Maritime Safety Committee 2017



Background

Clearly distinguish between autonomous ships and unmanned or remote-controlled ships.

A) Autonomous ships use automation to complete decision-making on board. (Artificial intelligence)

B) Unmanned or externally controlled ships allow land-based operators to monitor and control automation on board.

General statements

Automation will continue to evolve from economic opportunity, acceptance of risk, regulatory and security.

Automation can continue the trend of crew reduction on board. It is assumed that ships in international waters will continue to have a crew according to regulations, while national speed can be reduced.

Changes in tasks and competencies are currently being assessed by academic institutions and companies.

Traditional tasks on board can be changed, requiring new skills and new training regimes.

Assumptions

The business model and age of today's world fleet suggest that in the future decisions and actions can be performed automatically with human supervision aboard ships. High impact decisions are implemented in a way that allows the crew to communicate and override.

- will require additional competence in navigation, mechanical engineering, electrical and electronics.
- Existing regulations must be considered for necessary changes.





Autonomous ship ‘Yara Birkeland’ – how far has the industry reached?

21. AUGUST 2018



The construction cost of the ship, according to the Wall Street Journal, was estimated at about **USD 25 million, about three times as much as a conventional ship of a similar size.** As an advantage, in accordance with the developer “it would save up to 90% in annual operating costs of the shipowner by eliminating both fuel and crew.”

Table 2 Categorized challenges manifest by autonomous ships (created by the author).

Challenges	Categories	Challenges				
		Technology reliability	Technical infrastructure	Policies & legislation	Social & societal impact	Cost effectiveness
1	Communications: ship-ship, ship-shore, shore-shore	X	X		X	X
2	batteries weight, recharge and feasibility for longer voyages	X	X			X
3	cooling and fire extinguishing	X	X	X		X
4	vessel maintenance on board and ashore	X	X	X		X
5	inspection			X		
6	classification			X		
7	ship certification			X	X	X
8	situation awareness reliability of artificial intelligence	X	X	X		X
9	integration of humans in the loop	X		X	X	X
10	national and international regulations	X	X	X	X	X
11	necessity of basic living facilities aboard while underway			X	X	X
12	education and training of personnel; crew qualification and certification	X	X	X	X	X
13	substantial career transition scheme which minimizes social-economic impacts			X	X	X
14	metamorphosis from conventional management strategies	X	X	X	X	X
15	proper harbor infrastructure and fee calculation		X	X		X
16	duplicated navigation equipment, from various suppliers, in the remote control centre	X	X	X	X	X
17	liability ratio in case of accidents, incidents and ship wrecks and insurance implications		X	X		X
18	cyber security	X	X	X	X	X



The world is changing fast, and so are the ways of producing and exchanging goods due in particular to the rapid advances in technology and the trends towards an increased automation in the workplace.

ETF and its affiliated unions are indeed prepared to step up their action as agent of change in support of a smooth transition that will result in improved safety and bring about high-quality employment and training for European maritime professionals.

Five guidelines for sustainable digital shipping;

1. No 'one-size-fits-all'
2. Safety first When contemplating
3. High standards
4. Life-long-learning
5. Digital shipping = Green shipping

Conclusion; The world is changing fast and although the pace and impact of technological developments will vary from one sector to another, **they will touch the lives of every single person and every single economic sector.**



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European Transport Workers' Federation
Fédération Européenne des Travailleurs des Transports
Europäische Transportarbeiter-Föderation
Federación Europea de los Trabajadores del Transporte

An ETF plea to the industry and regulators for a human-centred approach to automation in shipping

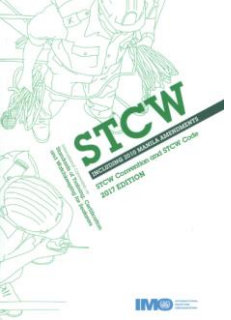
Brussels, 13 July 2018



Det norske maskinistforbund
Norwegian Union of Marine Engineers

SOLUTION PROPOSAL





Case 1

The 2010 Manila Amendments to the Seafarers' Training, Certification and Watchkeeping (STCW) Code PART A

Mandatory standards regarding provisions of the annex to the STCW Convention

[CHAPTER I](#) Standards regarding general provisions

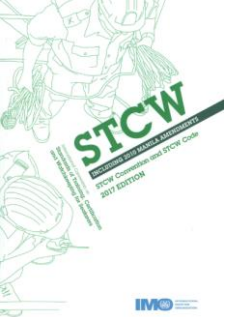
Section A-I/1 *Definitions and clarifications*

1 *The definitions and clarifications contained in article II and regulation I/1 apply equally to the terms used in parts A and B of this Code. In addition, the following supplementary definitions apply only to this Code:*

- .1 *Standard of competence means the level of proficiency to be achieved for the proper performance of functions on board ship in accordance with the internationally agreed criteria as set forth herein and incorporating prescribed standards or levels of knowledge, understanding and demonstrated skill;*
- .2 **Management level** means the level of responsibility associated with:
 - .2.1 **designated and assigned duties of persons** serving as master **or** chief mate **or** chief engineer officer or second engineer officer on board a seagoing ship, and
 - .2.2 ensuring that all functions within the designated area of responsibility are properly performed;
- .3 **Operational level** means the level of responsibility associated with:
 - .3.1 **designated and assigned duties of persons** serving as officer in charge of a navigational or engineering watch or as designated duty engineer for periodically unmanned machinery spaces or as radio operator **or electro-technical officer** on board a seagoing ship, and
 - .3.2 maintaining direct control over the performance of all functions within the designated area of responsibility in accordance with proper procedures and under the direction of an individual serving in the management level for that area of responsibility;
- .4 **Support level** means the level of responsibility associated with performing assigned tasks, duties or responsibilities on board a seagoing ship under the direction of an individual serving in the operational or management level;

Approved at ITF Congress, in Cape Town, in June 2017





Case 2

The 2010 Manila Amendments to the Seafarers' Training, Certification and Watchkeeping (STCW) Article III

STCW Article III Application

*The Convention shall apply to **PERSONAL** serving on board sea-going ships **OR PERSONAL OPERATING THE SHIP** entitled to fly the flag of a Party.*

***New text:** PERSONALS are employees who have completed education and training that have the appropriate competence to apply for a certificate in accordance with STCW regulations.*



SUMMARY



- No Autonomous Ship in the next 20 years in international shipping
- Some remote-controlled ships in the next 20 years in national shipping in EU
- Crew on Automated Ships - as of now
- Education / competence requirements, in particular, expanded operational and ICT competences in pursuant to the STCW 2010
- More students with maritime competence (more entertaining and family-friendly curricula)
- More employment opportunities
- New agreements for service on board/ ship-control rooms operators on shore to be developed



NEXT GENERATION ENGINE OFFICER



NO FOOD
NO DRINK'S
NO BED
NO EDUCATION
NO SALARY
NOT MEMBER
NO BRAIN !

IS IT YOU?



Det norske maskinistforbund
Norwegian Union of Marine Engineers

