



Report on competences needed to operate on board systems allowing for automation of inland navigation vessels D3.3

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Executive Summary

Within PLATINA3, policy makers, River Commissions, IWT sector representative organisations, knowledge institutes, education and training institutes, jointly identify means, measures and tools to promote inland waterway transport (IWT). Integration & digitalization of IWT in view of modal shift & synchronomodality; Zero-emission, automated & climate resilient fleet; Smart & climate resilient waterway and port infrastructure with clean energy hubs; and Skilled workforce anticipating to zero-emission & automation, are considered important topics that can lead to more use of IWT.

With the introduction of new energy carriers on inland vessels, along with more advanced levels of automation and digital tools for navigational assistance, comes the need for existing and future IWT personnel to anticipate to new innovations. This report is the result of activities in PLATINA3 Work Package 3.3, to propose standards for competence for on-board systems for automation on inland vessels, with a focus on identification of competences, detailed in knowledge and skills, in addition to the existing CESNI standards of the European Standard for Qualifications in Inland Navigation (ES-QIN)¹.

The findings of the CCNR inventory of projects of on-board systems allowing for automation of inland navigation vessels were taken as a base to assess the need to adapt, update or propose new standards for competence for nautical staff on inland vessels. Also developments in other transport sectors have been considered, such as maritime, rail, road and air transport. Representatives of employers, trade unions and river commissions, as partners in PLATINA Work Package 3, have been actively involved in the consultation and review process in view of practical and legal implementation processes. In parallel, leading initiatives, so-called frontrunners in the IWT sector bringing automated on board systems to the market, have been consulted for including practical experience. The assessment for competence standards allowing for more advanced automation in inland shipping, will be presented along three transition paths: (i) track guidance assistant systems in inland navigation (TGAIN); (ii) remotely operated or remotely supported vessels; and (iii) developments towards fully autonomous inland vessel concepts.

For track guidance assistant systems in inland navigation (TGAIN), the existing ES-QIN framework seems sufficient. Although it is recommended to introduce short courses to familiarise with the technical specifications and control of the on board systems. Since TGAIN systems are already taken up by the market and thus affect requirement of existing nautical staff, the need for upskilling of the IWT workforce in view of more advanced levels of digitalisation and automation of on board systems in inland shipping will be further analysed in Task 3.4. The use of e-learning platforms to introduce TGAIN short courses for familiarization with TGAIN systems, can be an interesting concept to research.

For developments towards fully automated (or autonomous) inland vessel concepts it is expected that, a transition is towards the need for more “soft skills” (communication and awareness), as has been a trend in maritime and air transport. As many existing initiatives are still in R&D phase, either advancing from TGAIN to higher levels of automation or following a different approach through machine-learning, more (practical) research is needed to understand the effects of this systems on required competences for nautical staff in inland shipping. It is suggested that as part of short-term R&D programmes for semi- or fully autonomous systems², attention shall be given to analyse impacts on required competences as a result of introduction of on-board systems as well as the confluence area of required competences and manning regulations.

For remotely operated or remotely supported vessels the need for new competences is more urgent. Existing initiatives are expected to advance from operations on national waterways of European waterways to cross-border

¹ <https://www.cesni.eu/en/standards-and-explanatory-notice/>

² Semi-autonomous here refers to automated control of the inland vessel with the presence by nautical personnel on-board or at a remote location, or both, to take over control manually on-board or from distance when or if needed.

pilots and market integration. Drafting of new standards for competence for nautical personnel in inland navigation involved in the remote operations is therefore considered to be a priority.

In proposing new competence standard for remote control operations, both existing (single vessel operator) and potential future operational models (multiple vessel operator supported by remote control supervisor) have been considered. The proposed competency framework involves competences for the following roles:

- **Remote control center operator (RCCO)** on Management Level, including additional competence³ for vessel and RCC familiarisation; conducting checks to ensure connectivity and navigational functionality with the RCC; emergency procedures; communication with onboard personnel and third parties; effects of man-machine interaction and limitations;
- **Remote control center supervisor** on Management Level (experienced RCCO), to anticipate for a potential situation with reduced experience requirements for the RCCO or operating multiple inland vessels simultaneously from one workstation in the RCC (under the condition of a supervisor monitoring the nautical operations), which includes more advanced competences of VTS equipment; traffic management and communication protocols; emergency and response management; personal attributes and administrative skills related to more advanced coordination tasks⁴;
- **Person (e.g. Able boatman) on a remote-controlled craft** on Operational Level, as the (assumed) sole person on board, which includes competences from Management Level (Boatmaster) to enable taking over navigational control of the inland vessel (as redundancy); advanced communication skills especially for emergency response; knowledge of on board system for remote control; and general operational knowledge of vessel and stability. Similar to a boatmaster operating under conditions that have to obtain competence for special authorisations sailing with LNG, radar or on inland waterways with a maritime character, the person on board, who could be referred to as the able boatman in remote control operations should obtain additional competence for remote control operations under these conditions (if allowed).

As of next steps, the results of this work shall be integrated in a roadmap for adoption of new competences and content as discussed in the permanent working group of the European Committee for drafting standards in inland navigation (CESNI), more precisely in the CESNI Working Group on Professional Qualifications⁵, known as CESNI/QP⁶. As remote-control operations are expected to evolve quickly from fixed route on national waterways of European Member States to cross border operations, CESNI/QP should consider prioritising the review and adoption process to kick-start the work on introducing of competence-based education and training programmes to allow of special authorisations for nautical staff involved in remote control operations. Only after discussion of the required competences, further discussion on manning requirements can take place. This is in line with the decision of CESNI/QP Crew to start working on manning tables for European manning regulations that can be taken up by CCNR and the EU without focus on more automated vessel operation.

³ In comparison with the existing ES-QIN framework for Management Level (Boatmaster).

⁴ In addition to required RCCO competences and practical experience as RCCO.

⁵ European Committee for drawing up standards in the field of inland navigation (CESNI): <https://www.cesni.eu/en>

⁶ <https://www.cesni.eu/en/professional-qualifications/>

List of abbreviations

AIS	Automatic Identification System
ECDIS	Electronic Chart Display and Information System
GPS	Global Positioning System
ISPS	International Ship and Port Facility Security
RCC	Remote Control Center
RCCO	Remote Control Center Operator
RIS	River Information Services
TGAIN	Track Guidance Assistant for Inland Navigation
VTs	Vessel traffic services
VTT	Vessel Tracking and Tracing

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Figure 1: Overview of program outline of competence-based training for (future) crew members focussing on transition paths towards automation during the First PLATINA3 Stage Event _____ 10

1. Introduction

The Horizon 2020 PLATINA3 project⁷ provides a platform for the implementation of a future inland navigation action programme. The work programme of PLATINA3 has the objective to increase the impact of research and innovation in Inland Waterway Transport (IWT) and broaden the stakeholder engagement in the sector. Within PLATINA3, policy makers, River Commissions, IWT sector representative organisations, knowledge institutes, education and training institutes, jointly identify means, measures and tools to promote IWT.

PLATINA3 addresses priority topics for the success of IWT:

1. Integration & digitalization of IWT in view of modal shift & synchronomodality;
2. Zero-emission, automated & climate resilient fleet;
3. Skilled workforce anticipating to zero-emission & automation;
4. Smart & climate resilient waterway and port infrastructure with clean energy hubs.

PLATINA3 Work Package 3, Jobs & Skills, addresses new developments in the IWT sector faced by the IWT workforce, which are aligned with a joint vision by waterway managers and European IWT associations for a fit-for-future waterway system. The vision outlines developments paths and initiatives focus at:

1. Integration & digitalisation of IWT in view of modal shift & multimodal transport
2. A zero- emission, automated & climate resilient fleet
3. Smart & climate resilient waterway and port infrastructure with clean energy hubs

Such development paths will change requirements for skilled workforce. As new energy carriers and sources are introduced on inland vessels, along with more advanced levels of automation and digital tools for navigational assistance, the need for existing and future IWT personnel to anticipate to these innovations is evident. Therefore, as part of PLATINA3 Work Package 3, the focus lies on identifying knowledge and skills needed for the IWT workforce to anticipate to zero-emission technologies (Task 3.1) and automation (Task 3.3). Other tasks in Work Package 3 target to develop content for refresher classes for environmentally friendly vessel operation (Task 3.2) and refresher classes for operation of systems of automation (Task 3.4). All tasks should be integrated in a roadmap for adoption of new competences and content as discussed in the permanent working group of the European Committee for drafting standards in inland navigation (CESNI), more precisely in the CESNI Working Group on Professional Qualifications⁸, known as CESNI/QP⁹.

1.1. Main objective

This report provides the results of the work carried out in Task 3.3 with a proposal for standards for competence for on-board systems for automation on inland vessels. The main objective of task 3.3. concerns the identification of competences, detailed in knowledge and skills, for using on-board systems allowing for automation of inland vessels that can be proposed to update CESNI standards such as the European Standard for Qualifications in Inland Navigation (ES-QIN)¹⁰.

1.2. Methodology and approach

According to CESNI's rules of procedure¹¹ (Art. 6), CESNI shall adopt its work programme on the basis of proposed strategic guidelines prepared by the Secretariat of the CCNR and DG MOVE of the European Commission. These guidelines shall be reexamined after three years.

⁷ <https://PLATINA3.eu>

⁸ European Committee for drawing up standards in the field of inland navigation (CESNI): <https://www.cesni.eu/en>

⁹ <https://www.cesni.eu/en/professional-qualifications/>

¹⁰ <https://www.cesni.eu/en/standards-and-explanatory-notice/>

¹¹ <https://www.cesni.eu/en/overview-of-documents/rules-of-procedure-and-internal-regulations/>

The work programme of CESNI shall describe the work to be carried out and include general indications of deadlines to be met, the organisation of the activities, and the resources necessary for carrying out the work. It shall specify the priorities and propose any requirements as to research, analysis, preparatory studies or appropriate impact studies.

According to CESNI's rules of procedure (Art. 1), CESNI's mission shall include in particular:

- *“adopting technical standards in various fields, in particular as regards vessels, information technology and crew, to which the respective regulations at the European and international level, including those of the European Union (“the EU”) and the CCNR, may refer with a view to their application;*
- *deliberating on the uniform interpretation and application of the said standards, on the method for applying and implementing the corresponding procedures, on procedures for exchanging information, and on the supervisory mechanisms among the Member States;*
- *deliberating on derogations and equivalences of technical requirements for a specific craft;*
- *deliberating on priority topics regarding safety of navigation, protection of the environment, and other areas of inland navigation.”*

The CESNI work programme 2022-2024, adopted by CESNI Member States on 28 October 2021¹² provides for two tasks to draft an “Update of competence standards and draft standards for (practical) examination for operators, OL and ML crew members as well as draft standards for simulator approval for automated vessel operation (including e.g. remote vessel operation)” (QP5) and “Update of competence standards, draft standards for (practical) examination and draft standards on simulators for the use of the track guidance assistant for inland navigation (TGAIN)” (QP6).

These tasks are based on the Strategic Guidelines agreed between Director General Hendrik Hololei of DG MOVE and CCNR in April 2021 that call for joint action in the field. The reasoning for strategic guidelines on jobs and skills (professional qualifications – French acronym QP) indicates that the CCNR Secretariat and DG MOVE continue to strive for:

- an open and transparent elaboration of standards for professional qualifications in inland navigation;
- a harmonised implementation of requirements for professional qualifications that ensures level-playing field and maintains the high level of safety of inland navigation;
- an enhanced labour mobility and more quality jobs in inland waterway transport.

The elaboration of standards covers activities where CESNI shall prepare and adopt standards in the field of professional qualifications, actively promoting:

1. the regular revision of ES-QIN to maintain and guarantee the high level of safety in inland navigation and to follow the technical evolution;
2. **the development of competence-based standards for:**
 - **entrepreneurs, in particular for digitalisation and greening;**
 - working with new and innovative technologies including the use of relevant alternative fuels, batteries and electric propulsion systems;
 - **working with increasingly digitalised vessels, included automated vessels;**
 - eco-navigation;
 - modern training tools, including remote learning;
3. the establishment of modern manning requirements;
4. **electronic tools for recording and exchanging information on crew.**

¹² See https://www.cesni.eu/wp-content/uploads/2021/12/CESNI_work_prog_22_24_EN.pdf

As presented in the problem analysis for task QP-3¹³ work of Platina3 is part of this task, of which Task 3.3 focusses on elements of the CESNI work programme that affect competences needed to operate on board systems for automation of inland navigation vessels.

As a starting point for the analysis, the findings of CCNR inventory of projects of on-board systems allowing for automation of inland navigation vessels were taken to understand the need to adapt, update or propose new standards for competence for the boatmaster and crew members. These competences consist of knowledge and skills needed for all aspects related to the operation of on board systems for (more) automated vessels, relying also on experiences obtained in other platforms (like joint industry projects) and other transport modes.

Representatives of employers and trade unions, as partner in PLATINA3 Work Package 3, have been invited to check the list of competences and their concrete description in knowledge and skills with a view to practicability in vessel operation and correct attribution to management and operational level. The involved river commissions in PLATINA3 have a reviewing role and contribute with input on infrastructure use and regulatory framework in the respective river basins. The work and review do consider the CCNR proposal for international definition of levels of automation, which also provides for feedback from Member State experts.

In parallel, leading initiatives, so-called frontrunners in the IWT sector bringing automated on-board systems to the market, have been consulted and have provided their feedback on proposed competency frameworks (more information on sector' consultations is provided below). Please note that more specific methodologies on the proposed competences are provided in Chapter 2 and 3, which differ per the attribution to management or operational level.

1.3. Consultations with the IWT sector

1.3.1 Exchange during the PLATINA3 First Stage Event

As a preliminary step, to kick-start the work of Task 3.3, a presentation was given with an interactive discussion to showcase some future developments paths for automation with possible impacts on the workforce in the inland shipping sector.

During the session three transition paths related to automation were discussed with the participants of the PLATINA3 Stage Event, namely: (i) track guidance assistant systems in inland navigation (TGAIN); (ii) remotely operated or remotely supported vessels; and (iii) developments towards fully autonomous inland vessel concepts.

The interactive consultation during the First Stage Event provided three main insights from the IWT industry representatives present:

1. The introduction of TGAIN in the sector seems underestimated. While the majority of the participants vote for a limited market introduction of 10%; developments and initiatives of TGAIN provides indicate a higher degree of market penetration of these navigational support systems.
2. Despite the limited market share that is expected, the general opinion is that the transition towards fully autonomous inland vessel concepts will go fast; the majority thinks that based on developments of frontrunners, a significant share of the fleet will navigate fully automated (or autonomous) before 2030.
3. Regardless of the considered transition path, the far majority expects that automation will affect required competences in terms of knowledge and skills of the IWT workforce (including a small, not representative, group of vessel owners present); which could consist of both nautical staff and specialised engineers to manage, operate and maintain a more advanced level of vessel automations.

¹³ See CESNI document CESNI/QP (21) 87 – Com. Secr.

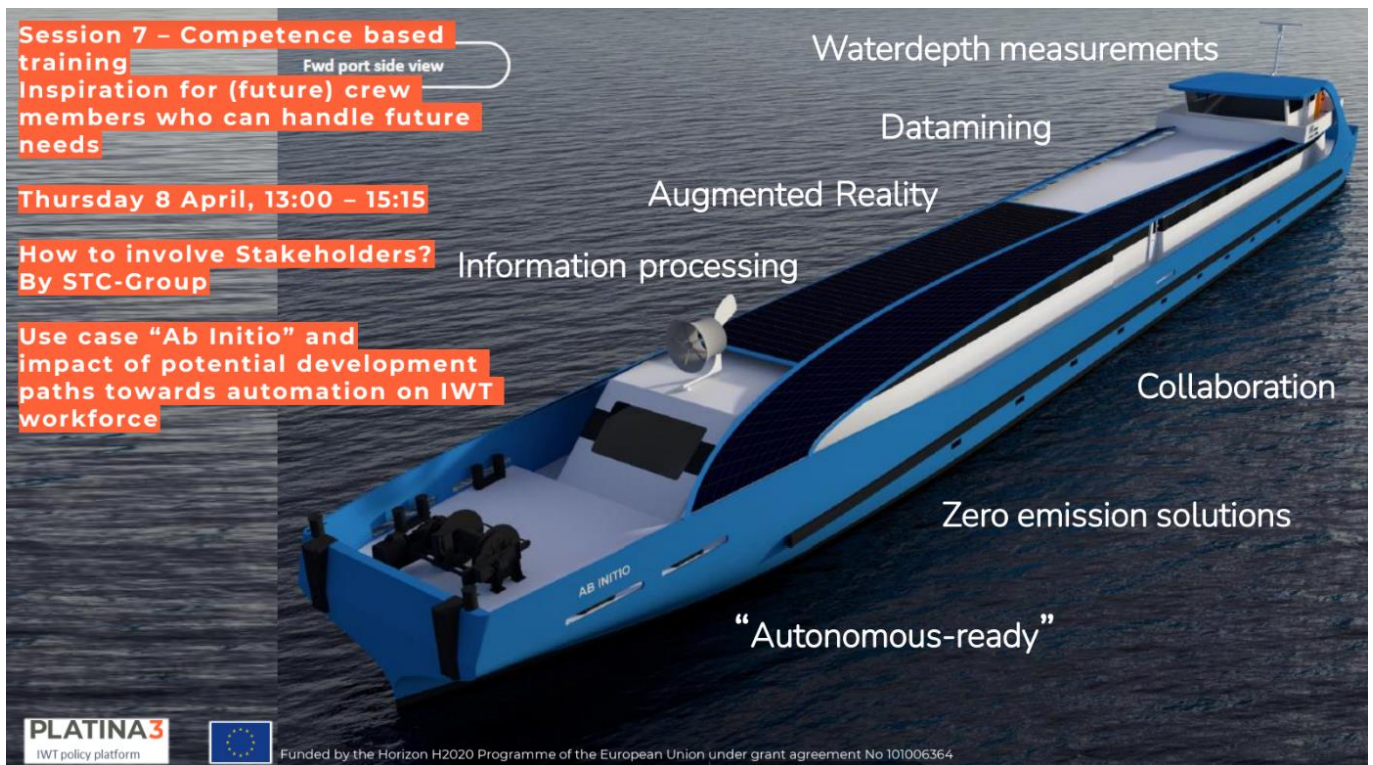


Figure 1: Overview of program outline of competence-based training for (future) crew members focussing on transition paths towards automation during the First PLATINA3 Stage Event

1.3.2 Meetings with technology providers and barge operators

Also, the interactive session pointed out the need to further discuss with technology providers/frontrunners directly about the potential impacts of the introduction of more advanced automation levels on professional qualifications. Information discussions were held with technology providers covering each transition path above, which led to the following insights summarised below.

(i) TGAIN:

- The existing ES-QIN framework seems sufficient to manage and operate existing track guidance systems introduced to the market;
- Familiarisation of technical specifications is required but can be implemented through video instructions as part of a familiarisation or short course. This could typically be integrated in an e-learning environment;
- Discussion is ongoing on whether familiarisation is the responsibility of the technology provider;
- Short course or e-learning module for existing and new IWT nautical personnel should not be formalised as a specific authorisation; yet should be integrated by education institutes as part of up-to-date curriculum on the basis of innovative market developments.

The introduction of TGAIN affects not only new IWT personnel entering the sector, but especially also the existing IWT workforce. Therefore, further activities should target in particular the upskilling of existing nautical personnel active in the IWT sector. Content for upskilling existing personnel will be addressed in Task 3.4.

(ii) Remotely operated or remotely supported vessels

- Existing initiatives of remotely operated or remotely supported vessels are (still) based on fixed trajectories, where the vessels are operated from a Remote Control Center (RCC, also referred to as Shore-Based Control Center or Shore Control Center);

- The Remote Control Center Operator (RCCO) currently operates one vessel remotely from the workstation in the RCC, either to replace the presence of the boatmaster on the vessel or to extend the operational hours of the vessel when the nautical staff present on the vessel have reached their threshold based on manning regulations. In the current situation, the RCCO operating the vessel from the RCC is still supported by a boatman that is physically present on the vessel itself (i.e. to provide support for passing bridges and locks, and for (un)mooring operations). A next step in the development roadmap is to add the role of supervisor that provides traffic management support, enabling the RCCO to control multiple vessels from one workstation;
- The role of RCCO requires a more advanced knowledge and skillset than prescribed in the existing ES-QIN framework. Initially, the RCCO needs to get familiar with the vessel operated remotely and redundancy systems, but also relying on nautical support systems and communication systems for remote control seem to go beyond the status quo operations on board of the vessel. Communicative skills become more important, in order to coordinate actions with supporting crew on the vessel itself (if any) and with relevant authorities providing Vessel Traffic Services;
- The familiarisation and training is currently organised by the operator of the RCC, whereas in the (near) future a standard for competences for remote control operations for nautical inland shipping personnel will be required; In addition (standardised) training and educational programmes could be developed, along with requirements for authorisation to work as RCCO (as part of manning requirements).

Based on the current initiative involving remote control operations and expected scale-up and acceleration of operations, the work on standards for competence for nautical inland shipping personnel involved in the remote operations is considered to be a priority to be addressed in Task 3.3.

(iii) developments towards more or fully autonomous inland vessel concepts

- R&D projects and initiatives towards fully or semi-autonomous inland vessel concepts¹⁴ are ongoing, and exemptions for pilot tests in both confined environmental as in real-time operations have been granted by a number of waterway authorities of CESNI Member States for national territories;
- The various initiatives are characterised by a difference in approach. Where some follow a more traditional research method building on expanding track guidance systems step-by-step towards a higher level of automation, others follow a different approach on the basis of Artificial Intelligence and big data to learn from the existing behaviour of nautical crew on board of inland vessels;
- Regardless of the research approach, the technological enhancement towards autonomous sailing limits the need for nautical crew in the wheelhouse to continuously handle the pilot control, while at the same time continuous awareness is needed to be aware of the location of the vessel with respect to its direct navigational situation and environment. This requires attention in terms of training and education, to understand characteristics of autonomous support systems, risks and redundancies, for which potentially new or adjusted competences could be the basis. Non-technical competences, so-called “soft skills” are likely to become more dominant as a similar development is recognised in maritime and air transport.

As current initiatives are planned and conducted while nautical personnel is on board of the vessel, the need to prioritise the work on new competences for fully or more-autonomous inland vessel concepts is not evident. Moreover, in case of fully autonomous inland vessel operations, a combination with remote control operations for certain nautical encounters (bridges, locks, quays) or as redundancy seems logical. Hence, therefore work on competences for remote control should be prioritised. As a result, further views on competences and training content will be part of the analysis of Task 3.4.

¹⁴ By semi-autonomous operations an advanced level of navigation support is meant, where the nautical crew does not control the vessel manually, but remains on board in the wheelhouse to intervene and take manual control as necessary. In case of full autonomous concepts intervention in the navigational control of the vessel, if any, is organised detached from the vessel itself.

1.3.3 Other consultations

In addition to initial consultation with representative of the IWT sector during the PLATINA3 First Stage Event and more in-depth discussion with a number of leading technology providers and barge owners towards more advanced levels of automation in inland shipping, two other consultation rounds have been conducted.

In May 2022, meetings of the working group on professional qualifications (CESNI/QP) and the temporary working group on manning requirements (CESNI/QP/Crew) were held in Berlin. The task of CESNI/QP is to draft standards for minimum manning requirements and tables according to the CESNI work programme 2022 – 2024. As part of the work programme, draft standards for automated vessel operation is recognised as priority III. Therefore, the opportunity to inform and consult CESNI/QP members on the progress of PLATINA3 Task 3.3, could not be missed. An abstract of the draft competency tables prepared under Task 3.3 was shared prior to a selection of CESNI/QP members and a presentation was given on the vision, outline and progress of the work.

The fact that a complete draft of the competency table was not shared with CESNI/QP member yet, relates to the principle that first approval of the content should be discussed within the PLATINA3 consortium and more specifically with other partners of Work Package 3. In June 2022 a reality check was conducted with a number of social partners part of the Work Package 3 team, which led to recommendations to expand the competency tables for remote control operations with expansion of the responsibilities and additional roles to be expected in light of the ongoing research and developments. Moreover, a RCCO operating a single inland vessel is not considered as a viable business case for the (near) future, as opposed to adding the function of supervisor/coordinator to the RCC to allow for control of more inland vessels per RCCO. Evidently, the scope of the analysis in Task 3.3 is not to discuss configurations on manning regulations and technical requirements in relation to competences with the objective to improve the business case for RCC operations. The impact of possible amendments as well as the related financial perspective of RCC operations, will be reflected by the market players and authorities. However, at the same time, ongoing developments cannot be neglected, and certain experiences with RCC operations may further influence the need to update regulations. Consequently, looking ahead on what may become normal practice, additional functions as part of remote-control operations have been considered (see paragraph below).

1.4. Outline of report

Based on the aforementioned paragraph, the work in Task 3.3 has been focussed on preparing draft standards for competence for remote control operations on inland vessels. For this a distinction has been made between the various nautical roles involved in remote control operations.

The following functions have been considered in this report:

- On Management Level:
 - Remote-control center operator (RCCO);
 - Remote-control center supervisor.
- On Operational Level:
 - (Able) Boatman on a remote-controlled craft.

The draft standards for competence for the functions on Management Level are presented in Chapter 2. Subsequently, Chapter 3 includes the draft standard for competence for Operational Level.

1.5. Next steps

This version of PLATINA3 D3.3 consists of proposed draft standards for competence for remote-control operations for nautical personnel in inland shipping. The draft standards have been the result of IWT sector consultation rounds and literature reviews. In order to come to a final version in August 2022, the draft version went through the internal PLATINA3 quality review process.

On top, in order to come to broadly accepted draft standards to feed into the work of CESNI/QP, this draft report will also be shared with a selected number of technology providers, barge owners and waterway authorities, that have expressed interest and are willing to participate in the finalisation of this deliverable.

Feedback from both the PLATINA3 advisory board, from Work Package 3 partners and from specific external stakeholders, was used to finalise the standards for competence for remote-control operations for nautical personnel in inland navigation.

Further recommendations (i.e. need for further alignment with ES-TRIN: specifications for RCC's and vessel equipment) have been included in order to be addressed in Task 3.6, which foresees in a roadmap outlining the required steps for integration of proposed competences for on-board systems for automation in the CESNI/QP framework.

2. Standards for competence for remote-control operations – Management Level

2.1. Remote-control center operator

2.1.1 Introduction to competences for the remote-control center operator

With reference to the introductory chapter of this report, based on existing RCC configuration and operations in inland shipping, the role of the RCCO requires additional knowledge and skills compared to the existing ES-QIN framework. The proposed competency table, as provided in the next paragraph, covers additional elements to address in the training, education and work of a RCCO, like:

- Vessel and RCC familiarisation;
- Working with RCC checklists to test connectivity and navigational functionality of primary and redundancy systems;
- Emergency handling and resource management within the environment of the RCC;
- Communication with on board personnel and third parties;
- Understanding of man-machine interaction and limitations.

Besides CESNI and CCNR (working) documents, for the proposed competency table, primarily, the following sources have been used:

- DNV - Class guidelines for autonomous and remote-controlled vessels: <https://rules.dnv.com/docs/pdf/DNV/cg/2018-09/dnvgl-cg-0264.pdf>
- DNV - Competence of remote control centre operators: <https://rules.dnv.com/docs/pdf/DNV/ST/2021-08/DNV-ST-0324.pdf>
- Bureau Veritas - Guidelines Autonomous ships: https://rules.veristar.com/dy/data/bv/pdf/641-NI_2019-10.pdf

Especially the guidelines / reports of DNV provided a good base to adapt competences for remote-control center operators for the maritime sector, to the situation of IWT sector in accordance with the ES-QIN framework. For the interpretation of the proposed competency standard, it is important to highlight that the suggested competences are considered additionally to the existing ES-QIN competence framework for Boatmaster (Management Level).

Competence-based standards as mentioned in the strategic guidelines for CESNI follow the example of part 1 of the European Standard for Qualifications in inland navigation (ES-QIN). ES-QIN is used as a reference by both Directive (EU) 2017/2397¹⁵ and the new RPN 2022 of CCNR.

According to art. 3(15) of Directive (EU) 2017/2397, competence means “the proven ability to use the knowledge and skills required by the established standards for the proper performance of the tasks necessary for the operation of inland waterway craft”.

The competence itself is listed in column 1. Column 2 contains theoretical elements (knowledge) and practical elements (abilities, referred to as skills in the title of column 2). Unlike in maritime transport (STCW-Convention¹⁶), where knowledge and ability are addressed together, CESNI standards always differentiate between knowledge and skills in competence standards. The advantage of the CESNI system is that the distinction between practical

¹⁵ References to CESNI standards have been included in Annex IV of Directive (EU) 2017/2397 by Commission delegated regulation 2022/184 of 22 November 2021, see <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32022R0184>

¹⁶ See for a definition *article 1(21) of Directive 2008/106/EC* of the European Parliament and of the Council

and theoretical elements facilitates the elaboration of CESNI standards for practical examination that provide a detailed list for elements that are subject to practical assessment and listed in part 2 of ES-QIN¹⁷.

2.1.2 Proposed competence table

1. Navigation

1.1 The remote-control operator shall be able to assess the situation of the remotely operated or remotely supported vessel before casting off.

The remote-control operator shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. start-up and check status of vessel systems;	<ol style="list-style-type: none"> 1. Knowledge of how the operation technology of remotely operated or remotely supported vessels functions and how signals from sensors are transferred between the automation and communication systems onboard and the RCC. 2. Knowledge of expected human interaction and how the function behaves if expected/required human input or intervention is not available (e.g. due to degradation of the communication between the vessel and RCC). 3. Knowledge of alerts, visual interactions and possible interference of remotely operated or supported vessel which may affect the remote set-up integrity and their consequences/system failures. 4. Ability to perform all checks in accordance with the RCC's specific check list. 5. Ability to check redundant systems and to communicate status with crew onboard of the remotely operated or supported vessel.
2. assess weather and environmental conditions;	<ol style="list-style-type: none"> 1. Knowledge of internal and external sources of information for weather data and environmental conditions. 2. Knowledge of which actions the boatmaster can take in response to the weather and environmental conditions that the remotely operated or remotely supported vessel may face. 3. Ability to interpret incoming information on weather and environmental conditions in the present position of the remotely operated or remotely supported vessel in order to start or continue the voyage.
3. assess traffic situation;	<ol style="list-style-type: none"> 1. Knowledge of geographic surroundings and actual traffic situation on planned sailing route for the remotely operated or supported vessel. 2. Knowledge of how to access planned maintenance or interventions on the European inland waterway network and assess how this affects operations in the RCC for the remotely operated or support vessel itself and potential interaction with other vessels. 3. Ability to interpretate changes in the traffic situation and actively communicate operational changes to the VTS operator from the (inland) port, pilots and/or RIS operators for the remotely operated or support vessel itself and interaction with other vessels. 4. Ability to understand and implement instructions regarding the vessels'

¹⁷ The definitions and principles mentioned apply to all of the proposed competences included in this report.

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
	<p>navigation, position, course and speed (given by VTS operator from the (inland) port, pilots and/or RIS operators).</p> <p>5. Ability to evaluate the reliability of data about the traffic situation received from the remotely operated or remotely supported vessel's sensors and other external sources.</p>
<p>4. determine vessel ready for departure.</p>	<p>1. Knowledge of all items to be inspected in order to establish that the remotely operated or remotely supported vessel is ready for sailing.</p> <p>2. Ability to determine whether vessel is ready for departure</p>

1.2 The remote-control operator shall be able to sail and manoeuvre ensuring the safe operation of the remotely operated or remotely supported vessel.

The remote-control operator shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
<p>1. understand and interpret perception of remote control systems;</p>	<p>1. Knowledge of the elements relating to human perception, attention, awareness, and focus in relation to the remotely operated or remotely supported vessel operation.</p> <p>2. Knowledge of perceptual differences in monitoring and manoeuvring a vessel on board versus monitoring a remotely operated or remotely supported vessel from an RCC.</p> <p>3. Knowledge of automation awareness and trust in automation (knowledge of gap: no direct feeling of the behaviour of the vessel on the waterway. Dependent on installations/telemetry/cameras in the RCC and, potentially, able boatman on board).</p> <p>4. Knowledge of data source, understanding of telemetry/system and knowing limitations, example ECDIS vs. Radar.</p> <p>5. Knowledge of influence of transfer of data on the decision-making process (knowledge of delay of transmission).</p> <p>6. Knowledge of the potential errors between the sensory system used for the remotely operated or remotely supported vessel and the actual perception of the RCCO.</p> <p>7. Knowledge of the potential and limitations of human perception.</p> <p>8. Ability to indicate possibilities and sources of incorrect perceptions.</p>
<p>2. understand and interpret human and remote control system interaction correctly.</p>	<p>1. Knowledge of elements of resource management in the light of the RCC and remotely operated or remotely supported vessel operation: challenge and response; communication; assertiveness; complacency; vigilance; trust - and mutual trust; trust in automation; automation awareness; fatigue and stress management.</p> <p>2. Knowledge of emergency situations to call support from crew on board.</p> <p>3. Ability to demonstrate decision making techniques in remote control situations.</p> <p>4. Ability to co-ordinate the crew on board.</p>

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
<p>3. situational awareness in a remote environment;</p>	<ol style="list-style-type: none"> 1. Knowledge of sufficient situational awareness to provide a firm basis for analysing the state of remotely operated or remotely supported vessels and for planning and executing actions. Knowledge of how automation can have a detrimental effect on real-time situational awareness (delay is depending on type of system used for connection (GPS, Satellite, X-G or other) 2. Ability to establish remote situational awareness with the means available in the RCC (while only a few own senses can be used).
<p>4. analyse information supplied, assess reliability and take appropriate actions in case of doubt;</p>	<ol style="list-style-type: none"> 1. Knowledge of the data communication carriers used between the RCC and remotely operated or remotely supported vessel and of the data communication redundancy. 2. Ability to evaluate the quality (precision) and reliability (integrity) of data received from remotely operated or remotely supported vessels. 3. Ability to verify the data link between the RCC and remotely operated or remotely supported vessel. 4. Knowledge of the consequences of not having sufficient bandwidth and latency. 5. Ability to verify bandwidth and latency. 6. Ability to demonstrate how to verify that bandwidth and latency are sufficient. 7. Knowledge of the steps to be taken to restore data communication systems or activate fallback options between the RCC and the remotely operated or remotely supported vessel. 8. Knowledge of the effect of shallow water and other environmental conditions on the remotely operated or remotely supported vessel (in combination with knowledge of journey planning and real time data interpretation). 9. Knowledge of interaction of own remotely operated or remotely supported vessel with other vessels (knowledge of data interpretation and understanding when to stop). 10. Ability to monitor and intervene when necessary in remotely operated or remotely supported vessel operations in a safe and efficient manner.
<p>5. use modern electronic navigation aids;</p>	<ol style="list-style-type: none"> 1. Knowledge of operational condition of all navigational and safety equipment being used or likely to be used during operation (e.g. Doppler log, Weather station/wind indicator, Rate of Turn, steering systems, radar, ECDIS, cameras, VHF, AIS, GPS, engine control units). 2. Knowledge of navigational equipment and installations of the remotely controlled or remotely supported vessel (checklist). 3. Knowledge of RCC technical guidelines. 4. Knowledge of proper use of ECDIS, AIS, radar and weather routing applications to ensure the safety and efficiency of remotely operated or remotely supported vessel 5. Knowledge of the interaction of the remotely operated or remotely supported vessel with other vessels and waterway infrastructure (knowledge of interaction of passing other vessels, motions felt on board normally cannot be felt in the RCC. Heeling of vessels is a potential risk; navigation through small canals is complex). 6. Ability to operate advanced navigational and safety equipment for the remotely operated or remotely support vessel during all operational conditions (f.i. Doppler log, Weather station/wind indicator, Rate of Turn, steering systems, Radar, ECDIS, cameras, vhf, AIS, GPS, engine control units).

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
<p>6. moor and unmoor the vessel.</p>	<ol style="list-style-type: none"> 1. Knowledge of potential limitation of navigational and systems used for (de-)berthing operations with the remotely operated or remotely supported vessel. 2. Ability to prepare a (de-)berthing plan for the remotely operated or remotely supported vessel. 3. Ability to monitor the vessel position and movement against the (de-)berthing plan. 4. Ability to implement two-way communication with VTS operator from the (inland) port, pilots and/or RIS operators to assure safe and secure mooring operations with the remotely operated or remotely supported vessel and follow-up directions when needed. 5. Ability to implement two-way communication with other parts of the remotely operated or remotely supported vessel's organization when required. 6. Ability to demonstrate safe mooring and unmooring operations.

1.3 The remote-control operator shall be able to set up emergency and damage control plans and handle emergency situations of the remotely operated or remotely supported vessel.

The remote-control operator shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
<p>1. apply legislation and procedures;</p>	<ol style="list-style-type: none"> 1. Knowledge of procedures for managing alerts. 2. Knowledge of emergency protocols and responsibilities of the RCCO. 3. Ability to explain pre-defined emergency scenarios and protocols. 4. Knowledge of situations when the crew on board has to take over the control of the vessel and communicate. 5. Ability to recognize situations to hand over the control of the remotely operated or remotely supported vessel to the crew on board. 6. Ability to initiate emergency protocols for remotely operated or remotely supported vessel operations. 7. Ability to communicate effectively with other vessels and with (relevant) authorities on any safety issue on the remotely operate or remotely supported vessel.
<p>2. take appropriate actions in case of degradation of communication between the RCC and the remotely operated or remotely supported vessel's systems;</p>	<ol style="list-style-type: none"> 1. Knowledge of how data are pre-classified regarding importance in communication and connectivity systems. 2. Knowledge of vessel-based and land-based communication systems beyond GMDSS and their advantages and limitations (e.g. Iridium, 4G, 5G, LTI, and other land-based communication infrastructure that can be utilized by the RCC). 3. Knowledge of safe states of the remotely operated or remotely supported vessel after degradation of communication. 4. Knowledge of measures to be taken to improve/re-establish a communication link between the RCC and the remotely operated or remotely supported vessel. 5. Ability to evaluate the impact of the degradation of communication systems between the RCC and remotely operated or remotely supported vessel - the consequences of latency, coverage and bandwidth degradation.

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
	<ol style="list-style-type: none"> 6. Ability to state which pre-defined actions are taken by the systems in the case of reduced connectivity between the RCC and the remotely operated or remotely supported vessel. 7. Ability to explain the procedure to follow in the case of reduced connectivity between the RCC and the remotely operated or remotely supported vessel. 8. Ability to explain by which land-based means the RCC can obtain information on the remotely operated or remotely supported vessels' movements.
<p>3. organize emergency response actions on the autonomous, remotely operated or remotely supported vessel;</p>	<ol style="list-style-type: none"> 1. Knowledge of the layout of firefighting systems on board of the remotely operated or remotely supported vessel. 2. Ability to state the sensors and other means available in the RCC to verify and locate emergencies fire in the remotely operated or remotely supported vessel. 3. Ability to initiate and coordinate firefighting actions with crew on board of the remotely operated or remotely supported vessel, the RCC and authorities.
<p>4. take appropriate actions in case of a remotely operated or remotely supported vessel not under command;</p>	<ol style="list-style-type: none"> 1. Knowledge of system control features and performance 2. Ability to verify system control failures between the RCC and the remotely operated or remotely supported vessel. 3. Ability to analyse system control failures between the RCC and the remotely operated or remotely supported vessel. 4. Ability to decide on mitigating actions in line with RCC company policies, procedures, and applicable legislation. 5. Ability to communicate system control failures with waterway authorities or with other fairway users.
<p>5. organize emergency anchoring;</p>	<ol style="list-style-type: none"> 1. Knowledge of the remotely operated or remotely supported vessel's system of automated emergency anchoring within minimum risk conditions. 2. Ability to coordinate and initiate mitigation measures for emergency anchoring operations with a remotely operated or remotely supported vessel with crew on board and relevant authorities.
<p>6. take appropriate actions in case of collision and grounding;</p>	<ol style="list-style-type: none"> 1. Knowledge of the remotely operated or remotely supported vessel's systems, sensors and other sources of information that support the detection of a collision or grounding. 2. Knowledge of RCC protocols as a response to a collision or grounding of the remotely operated or remotely supported vessel. 3. Ability to explain the alerts in the RCC that point to a collision or grounding. 4. Ability to state actions that can be taken from the RCC in response to a collision or grounding. 5. Ability to state the available remotely operated or remotely supported vessel's systems, sensors, and other sources of information for evaluating damage to the vessel and other vessels or objects in the case of a collision or grounding. 6. Ability to operate available cameras to support the evaluation of damage to own remotely operated or remotely supported vessel and other vessel or objects in case of a collision. 7. Ability to state the available sensors and sources of information to evaluate environmental damage in the case of a collision or grounding.
<p>7. take appropriate actions in case of distressed sailors;</p>	<ol style="list-style-type: none"> 1. Knowledge of the procedures and checklists in the RCC aimed at supporting search and rescue operations.

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
	2. Ability to apply resources and equipment available in the remotely operated or remotely supported vessel that can support search and rescue operations.
8. take appropriate actions in case of a cyber-attack.	<ol style="list-style-type: none"> 1. Knowledge of RCC cyber security protocols and system for the remotely operated or remotely supported vessel. 2. Ability to explain the abilities and vulnerabilities of the remotely operated or remotely supported vessel's systems regarding the prevention of cyber-attacks (built-in protection). 3. Ability to state various ways and connection systems/lines that are used for communication between the RCC and the autonomous, remotely operated or remotely supported vessel. 4. Knowledge of alerts in the RCC in relation to cyber security situations. 5. Ability to detect a cyber-attack and to undertake risk mitigating measures.

1.4 The remote-control operator shall be able to respond to navigational emergencies of the remotely operated or remotely supported vessel.

The remote-control operator shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. take appropriate actions if collision is imminent.	<ol style="list-style-type: none"> 1. Knowledge of the performance and limitations of the equipment used to avoid collisions (anti-collision warning systems) and monitor the surroundings of the remotely operated or remotely supported vessel. 2. Knowledge of identifying sightings, signals, and lights relating to collision avoidance 3. Ability to interact with Inland ECDIS, radar, visuals of cameras for interpretation of signs, signals and markings.

2. Operation of craft

Related to the operation of craft, no additional competences are suggested in addition to the existing ES-QIN standard of competence for Management Level = Boatmaster.

3. Cargo handling, stowage (and passenger transport)

3.1 The remote-control operator shall be able to plan and ensure safe loading, stowage, securing and care of cargoes of the remotely operated or remotely supported vessel.

The remote-control operator shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. understand regulations concerning port operation of transporting cargoes;	<ol style="list-style-type: none"> 1. Knowledge of terminal and port requirements 2. Ability to check terminal and port requirements, including moorings and release mechanisms that may affect remotely operated or remotely supported vessels.

2. compose stowage plans including knowledge of loading cargoes and ballast systems;	<ol style="list-style-type: none"> 1. Knowledge of the construction and limitations of the remotely operated or remotely supported vessel in relation to cargo handling. 2. Ability to describe how bunkers shall be entered into the ballast plan for the remotely operated or remotely supported vessel. 3. Ability to coordinate a visual inspection of de-ballasting operations to prevent pollution.
3. control loading and unloading procedures with regard to safe transport.	<ol style="list-style-type: none"> 1. Knowledge of procedures and limitations to control cargo systems from the RCC. 2. Ability to complete the vessel-shore safety checklist from the RCC. 3. Ability to review and amend the cargo plan against the specific and legal requirements that (potentially) apply to the remotely operated or remotely supported vessel. 4. Ability to assess if (sudden) changes in the loading (or discharge) sequence on the remotely operated or remotely supported vessel are safe and acceptable. 5. Ability to coordinate and communicate changes in the cargo plan to all the parties involved. 6. Ability to verify that the remotely operated or remotely supported vessel is correctly (un)loaded.

3.2 The remote-control operator shall be able to plan and ensure the stability of the craft of the remotely operated or remotely supported vessel.

The remote-control operator shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. respect the effect on trim and stability of cargoes and cargo operations.	<ol style="list-style-type: none"> 1. Knowledge of control of stability of cargoes and cargo operations of a remotely operated or remotely supported vessel. 2. Ability to verify the reliability of stability and trim sensor data received from the remotely operated or remotely supported vessel. 3. Ability to recognize and evaluate cargo induced changes to the stability and trim and if they are critical to the stability of the remotely operated or remotely supported vessel. 4. Ability to demonstrate how to solve stability problems. 5. Ability to process rolling and heaving information of the remotely operated or remotely supported vessel to evaluate the vessel's stability and launch mitigation measures if required.

4. Marine engineering and electrical, electronic and control engineering

4.1 The remote-control operator shall be able to monitor the main engines of the remotely operated or remotely supported vessel.

The remote-control operator shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
<p>1. maintain overall supervision of propulsion and machinery systems.</p>	<ol style="list-style-type: none"> 1. Knowledge of onboard machinery equipment, navigation equipment, sensors, automation, and control systems of the remotely operated or remotely supported vessel and RCC, and their limitations (vessel familiarization). 2. Knowledge and understanding of the remote-control system 3. Knowledge of the distinctive levels of autonomy and autonomous systems 4. Knowledge of the level of automation and autonomy of various machinery systems of the remotely operated or remotely supported vessel. 5. Knowledge of the systems of alerts as applied in the RCC. 6. Knowledge and understanding of system errors and apply mitigation measures to keep or maintain control of the remotely operated or remotely supported vessel or commence redundancy protocols in the RCC or on board. 7. Knowledge and understanding of RCC protocols in case of system errors. 8. Ability to recognize system errors and apply mitigation measures to keep or maintain control of the remotely operated or remotely supported vessel or commence redundancy protocols in the RCC or on board. 9. Ability to calibrate RCC system sensors used as input to situational awareness (make use of checklist). 10. Ability to operate cameras effectively. 11. Ability to interpret observations via visual and electronic control systems. 12. Ability to operate visual control systems (cameras, infrared systems). 13. Ability to operate electronic lookout systems (Radar). 14. Ability to operate the communication systems (ability to communicate with able boatman at critical sections on the voyage). 15. Ability to take measures to restore the functionality of RCC equipment. 16. Knowledge and understanding of the redundant systems for monitoring and controlling the remotely operated or remotely supported vessel. 17. Knowledge of where and what kind of intervention by the remote control operator is possible for the various machinery systems of the remotely operated or remotely supported vessel. 18. Knowledge of the potential consequences if alerts are not adequately followed up. 19. Ability to carry out root cause analysis on essential remote control systems in the RCC and on board (by means of instruction to crew on board) for the navigational remote operation of the vessel.

5. Maintenance and repair

5.1 The remote-control operator shall be able to organise safe maintenance and repair of the craft and its equipment.

The remote-control operator shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. organize maintenance and repairs.	<ol style="list-style-type: none"> 1. Knowledge of safe and effective maintenance and repair procedures on a remotely operated or remotely supported vessel. 2. Ability to communicate effectively with crew on board doing maintenance and repairs on the remotely operated or remotely supported vessel.

6. Communication

6.1 The remote-control operator shall be able to perform human resource management of the remotely operated or remotely supported vessel.

The remote-control operator shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. instruct crew in case of distress.	<ol style="list-style-type: none"> 1. Knowledge and understanding of communication protocols in the RCC and of the RCCO and the vessel crew on board. 2. Knowledge and understanding of communication protocols between the RCC and the VTS in (inland) ports or RIS operators along waterways. 3. Ability to react to specific distress safety and security calls applicable to the remotely operated or remotely supported vessel.

7. Health and safety, passenger rights and environmental protection

7.1 The remote-control operator shall be able to monitor legal requirements and take measures to ensure the safety of life aboard of the remotely operated or remotely supported vessel.

The remote-control operator shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. assess risk factors;	<ol style="list-style-type: none"> 1. Knowledge of the importance of assessing risks related to the distinctive levels of autonomy and, more specifically, for the remotely operated or remotely supported vessel. 2. Ability to identify and discuss risks due to an increased level of autonomy. 3. Ability to identify and discuss risks in remotely operated or remotely supported vessel operation that may cause incidents. 4. Knowledge of the relevant international and national legislation and rules governing the operations of remotely operated or remotely supported vessels. 5. Knowledge of the regulation relating to the legal position of the RCC and the crew on board. 6. Ability to distinguish the RCCO's role and responsibilities from the crew on board and responsibilities. 7. Ability to state the legal risks associated with operating an remotely operated or remotely supported vessel.

<p>COLUMN 1 COMPETENCE</p>	<p>COLUMN 2 KNOWLEDGE AND SKILLS</p>
	<ol style="list-style-type: none"> 8. Ability to identify the legal liabilities of the remotely operated or remotely supported vessel's owner and manager. 9. Ability to record and report both routine and non-routine events in compliance with RCC's internal and external legal requirements. 10. Ability to perform a risk assessment for RCC operations. 11. Ability to adapt existing risk assessment to changing conditions that affect the RCC operation.
<p>2. take appropriate actions in terms of contingency;</p>	<ol style="list-style-type: none"> 1. Knowledge of contingency plans for RCC operations. 2. Ability to describe the defined functionality of the system for normal operation and remote-control mode sequences and timing man-machine interfaces with degraded/limited functionality safe state(s). 3. Ability to take action to avoid identified possible incidents. 4. Ability to differentiate the various RCC specific alerts used in the case of emergencies. 5. Ability to discuss the immediate actions to be taken when an emergency occurs. 6. Ability to discuss and evaluate communication protocols for emergencies in the RCC or for RCC operations.
<p>3. take appropriate actions in order to maintain safety and security.</p>	<ol style="list-style-type: none"> 1. Knowledge of the safety systems in the RCC and on board of the remotely operated or remotely supported vessel. 2. Ability to interpret safety related information received from the remotely operated or remotely supported vessel, including video streams to verify the vessel's operational safety. 3. Ability to explain ISPS and other applicable regulations regarding the security of the remotely operated or remotely supported vessel. 4. Knowledge of the cyber security risks to the RCC. 5. Ability to explain cyber security mitigating equipment and systems.

2.2. Remote-control center supervisor

2.2.1 Introduction to competences for remote-control center supervisor

Existing initiatives for remote control operations already anticipate adding a supervisor role to the RCCO team in the RCC. The overall coordination, communication and experience, could add value to the team's performance and could positively affect the business if operations of the RCCO could be extended to operating multiple vessels at the same time. Additionally, the experience of the Supervisor, including special authorizations, could also potentially affect requirements of the RCCO to sail on certain waterway sections. This all is of course part of further discussion in the various CESNI workgroups. Nevertheless, the importance of preparing draft standards for the role of Remote-control center supervisor is evident.

The proposed competency table, as provided in the next paragraph, covers additional elements to address in the training, education and work of the Supervisor, like:

- Profound knowledge of VTS equipment;

- Advanced traffic management to communicate changes to navigational plans as a result of (un)expected events;
- Respond to emergency situations in the RCC and with remotely operated or supported vessels from the RCC;
- Additional personal attributes, such as: effective communication, leadership, stress and fatigue management;
- Administrative functions related to the work of Supervisor and coordinator of a team of RCCO’s.

Besides CESNI and CCNR (working) documents, for the proposed competence table, primarily, the following sources have been used:

- DNV - Class guidelines for autonomous and remote controlled ships: <https://rules.dnv.com/docs/pdf/DNV/cg/2018-09/dnvgl-cg-0264.pdf>
- DNV - Competence of remote control centre operators: <https://rules.dnv.com/docs/pdf/DNV/ST/2021-08/DNV-ST-0324.pdf>
- Bureau Veritas - Guidelines Autonomous ships: https://rules.veristar.com/dy/data/bv/pdf/641-NI_2019-10.pdf
- IALA Model Course V103.1 for VTS Operator: <https://www.iala-aism.org/product/c0103-1/>
- IALA Model Course V103.2 for VTS Supervisor: <https://www.iala-aism.org/product/c0103-2/> (IALA Guideline 1115)
- IALA Vessel Traffic Services in Inland Water R0120 / V-120: <https://www.iala-aism.org/product/r0120/>
- ICAO Manual on Air Traffic Safety Electronics Personnel Competency-based Training and Assessment: https://www.icao.int/MID/Documents/2018/CBT%20ATCO%20and%20ATSEP%20Wksp/Doc%2010057_en.pdf (Doc 10057)
- ICAO Procedures for Air Navigation Services Training: http://icscc.org.cn/upload/file/20210408/20210408134300_23488.pdf (Doc 9868, Third Edition, 2020)

The proposed competence table is based on a combination of abovementioned sources, with a focus on VTS model courses of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA), and the specification for Air Traffic Supervisor as outlined by the International Civil Aviation Organization (ICAO).

2.2.2 Proposed competence table

- 1. The remote-control supervisor shall monitor and manage vessels under control from the Remote Control Centre to ensure the safety and efficiency of ship movements and respond to developing unsafe situations to assist the Remote Control Operators’ decision-making process.**

The remote-control supervisor shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
<ol style="list-style-type: none"> 1. understand and use VTS equipment; 	<ol style="list-style-type: none"> 1. Knowledge of Inland VTS systems/equipment and in particular the technical specifications as outlined in the Directive 2005/44/EC mentioned VTT standard. 2. Knowledge of Inland AIS, including both functional and technical requirements as well as key characteristics of AIS messages and limitations. 3. General knowledge of the IALA Vessel Traffic Services Manual; The IALA/IMPA/IAPH World VTS Guide; and the IALA Recommendations relevant to VTS. 4. Knowledge of traffic monitoring and management techniques, including normal performance of (VTS) and subsystem redundancy arrangements.

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
	<ol style="list-style-type: none"> 5. Ability to apply traffic monitoring and management techniques. 6. Ability to determine that the VTS equipment is operating satisfactorily and, when necessary, to take appropriate action to ensure that the service is maintained at an operational level, and any defects are rectified, and relevant documentation is kept up to date.
<p>2. monitor available data sources to comprehend the current operational situation and anticipate for future events;</p>	<ol style="list-style-type: none"> 1. Knowledge of possibilities and limitations of tactical and strategical traffic information systems and other available information systems. 2. Ability to monitor and scan traffic in the area of the remotely operated or remotely supported vessels from the RCC to assess the current situation and apply to anticipate for future events. 3. Ability to provide information to the RCO at fixed times and intervals or at the request of the RCO, about the identity and intentions of other traffic; waterway conditions; conflicting and complex navigation patterns; difficult hydrographical, hydrological and meteorological elements; shifting shoals and other local hazards; environmental considerations; interference by vessel traffic with other waterborne activities; or any other factors that may influence navigational decisions of the remotely operated or remotely supported vessel. 4. Ability to provide traffic organisational information to the RCO for the forward planning of vessel movements to prevent congestion and dangerous situations, particularly in times or at locations of high traffic density or when the movement of special transports may affect the flow of other traffic in the area of the remotely operated or remotely supported vessel.
<p>3. maintain overall supervision and awareness of the traffic situation and provide directions.</p>	<ol style="list-style-type: none"> 1. Knowledge of possibilities and limitations of overall supervision of remote-controlled vessels. 2. Ability to generate a comprehensive overview of the remotely operated or remotely supported vessels under supervision in relation to all traffic influencing factors and traffic situations, such as: vessel positions, movements, identities and intentions with respect to manoeuvres, destination and routing; 3. Ability to identify and act upon potential threats that may compromise the safety of the remotely operated or remotely supported vessels from the RCC or the environment, such as collisions, grounding, damage, malfunction or breakdown, flooding or shifting of cargo, any defects in the hull or structural failure. 4. Ability to issue result-oriented instructions to RCCO's in control of the remotely operated or remotely supported vessel(s) on the basis of accurate data, leaving the details of execution, such as course to be steered or engine manoeuvres to be executed, to the RCO of the vessel(s).

- 2. The remote-control supervisor shall provide concise, accurate and unambiguous information to the Remote Control Operator, other fairway users and authorities to ensure safe and efficient navigation.**

The remote-control supervisor shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. communicate effectively in all operational situations;	<ol style="list-style-type: none"> 1. Knowledge of effective communication techniques in high stress situations. 2. Knowledge of RCC communication protocols and communication systems 3. Ability to listen actively to the RCCO by asking relevant questions, verify accuracy of information and providing feedback or correction as necessary. 4. Ability to speaks clearly, accurately and concisely, apply plain language or standardised (VHF) communication phrases and verbalise concerns and intentions as necessary.
2. ensure RCCO's communicate with the VTS and other vessels in accordance with established procedures;	<ol style="list-style-type: none"> 1. (Detailed) knowledge of communication procedures with the VTS and other vessels, in particular for situation where a communication concerns intended manoeuvres. 2. Ability to monitor and check whether RCCO's adhere to governing rules and regulations, maintain a continuous watch on the assigned communication systems, report deviations from the agreed sailing plan as necessary and report to the VTS centre any observed dangers to navigation or pollution of the environment. 3. Ability to support, or take over control of, all communications with other communication tools in case of a complete failure of the remotely operated or remotely supported vessel's appropriate communication equipment. 4. Ability to inform the VTS centre and other vessels in the vicinity by any other available means of communication of the remotely operated or remotely supported vessel's inability to communicate in the appropriate manner.
3. manage coordination between personnel in operational positions in the RCC and with external stakeholders	<ol style="list-style-type: none"> 1. General knowledge of coordination methods and techniques based on circumstances, including urgency of coordination, status of facilities and prescribed procedures. 2. Knowledge of contingency plans and procedures relating to distress, pollution and special circumstances affecting the operation of the RCC and remotely operated or remotely supported vessel(s), other vessels or other external stakeholders. 3. Knowledge of pre-determined procedures concerning emergency situations and support authorities in coordinating their implementation from the RCC. 4. Ability to Encourages team participation and open communication in the RCC. 5. Ability to coordinate with RCCO's and other stakeholders, in a timely manner, in case of emergency situations. 6. Ability to coordinate changes of status of operational RCC facilities such as equipment, systems and functions. 7. Ability to exercise decisive leadership when required. 8. Ability to develop and coordinate training exercises related to RCC emergency situations. 9. Ability to conduct effective briefings during position handover.

- 3. The remote-control supervisor shall support with managing the Remote Control Centre and staff to ensure operations are in accordance with minimum health and safety standards and manning requirements.**

The remote-control supervisor shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
<p>1. maintain available resources and workload capacity;</p>	<ol style="list-style-type: none"> 1. Knowledge of cultural differences and language challenges in navigational functions. 2. Knowledge of reporting requirements related to manning regulations, stress and fatigue management techniques as well as health and safety standards, in particular for RCC operations. 3. Ability to prepare administrative reports for RCC operations in line with procedures and regulations as necessary. 4. Ability to manage cultural difference and language challenges of RCCO's effectively. 5. Ability to manage available resources for navigational functions in the RCC efficiently to prioritize and perform tasks in a timely manner under all circumstances. 6. Ability to offer and accept assistance, delegate when necessary and asks for help early 7. Ability to manage environmental stress, interruptions, distractions, variations and failures of RCCO's effectively. 8. Ability to reviews, monitor and crosscheck actions conscientiously 9. Ability to familiarise (new) RCC staff in rules and responsibilities of RCCO's.
<p>2. exercise decisive leadership when required;</p>	<ol style="list-style-type: none"> 1. Knowledge of responsibility of boatmasters on board and in RCC. 2. Ability to receive and provide both positive and negative feedback constructively 3. Ability to manages interpersonal conflicts to maintain an effective team environment 4. Ability to use negotiating and problem-solving techniques to help resolve unavoidable conflict when encountered 5. Ability to raise relevant concerns in an appropriate manner to RCC management. 6. Ability to take control over control of the remotely operated or remotely supported vessel(s) in case of any emergency or incident that affects the navigational safety of the vessel(s) or their direct environment.

3. Standards for competence for remote-control operations – Operational Level

3.1. (Able) boatman on a remote-controlled craft

3.1.1 Introduction to competences for able boatman on a remote-controlled craft

Although the minimum experience level for nautical crew of remote-controlled vessels have not yet been defined, existing initiatives currently show operations with a crew consisting of one RCCO in the RCC combined with a boatman per remotely-controlled vessel. In this crew composition, the boatman in this crew composition is the sole person on board of the vessel (unless manning regulations prescribe the need for additional crew members to be on board as a result of inland vessel size and operational hours). Based on the nature of the work and responsibilities, it is recommended define requirements to the experience level of the boatman on board during remote-controlled operations, as the boatman is an essential element of the redundancy system if connection between the RCC and remotely-controlled vessel is lost.

The function of boatman can be achieved directly e.g. by means of an approved educational / training programme. Practical experience is especially gained thereafter, and with 180 days of approved sailing time (as recorded and validated in the Service Record Book), the function of Able Boatman is reached, which illustrates that the boatman has gained practical experience on board of an inland vessel for typically one calendar year. Consequently, it is advisable to set minimum requirements for on board personnel to enrol in an approved educational / training programme to obtain a special authorisation for being a boatman on a remote-controlled vessel. As per suggestion in this report, considering the aforementioned requirements for RCCO's and Supervisors in RCC's, the suggested minimum requirement to enrol in such an approved programme is to have obtained the function of Able Boatman on an inland vessel. This requirement has been taken as a base for drafting a competence table for crew on board of a remotely-controlled vessel, also considering the knowledge and skills of an Able Boatman as defined in the existing ES-QIN framework.

The proposed competency table, as provided in the next paragraph, covers additional elements to address in the training, education and work of the Able Boatman on a remote-controlled vessel, like:

- Taking over navigational control of the inland vessel in case of emergency situations and navigate safely to the nearest berth or anchorage;
- Communication skills in order to explain the situation on the vessel in case of an emergency, with personnel in the RCC, VTS or other stakeholders;
- Knowledge and ability to monitor various systems on board, such as various pump systems and pumping operations, as not all systems can be controlled from the RCC (just yet);
- Technical knowledge about the vessel and stability.

Besides CESNI and CCNR (working) documents, for the proposed competency table, primarily, the following sources have been used:

- Standards of competence for the management level (Resolution CESNI 2018-II-4, Chapter 2): <https://www.cesni.eu/wp-content/uploads/2019/03/Page-de-garde-EN.pdf>;
- Proposed standards of competence for Remote-control center operators (see Paragraph 2.1.2).

The proposed competence table is based on a combination of abovementioned sources, with a focus the competence table to obtain the level of Boatmaster, complemented with some adjusted competences for RCCO to check and maintain specific remote-control equipment and systems.

3.1.2 Proposed competence table

1. Navigation

- 1.1 The able boatman shall be able to navigate on inland waterways to reach the nearest berth or anchorage in a safe manner taking into account the applicable traffic regulations and agreed set of rules applicable in inland navigation.**

The able boatman shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. take over navigational control of the craft in case of an emergency situation;	<ol style="list-style-type: none"> 1. Knowledge of the specific technical and operational characteristics of the remotely operated or remotely support vessels. 2. Ability to familiarise with potential technical malfunction resulting in the need to take manual control and navigate the vessel to the nearest berth or anchorage. 3. Ability to communicate with RCC, other (deck) personnel, other vessels and authorities, e.g., by means of communication systems and hand signals, in order to receive support to safely navigate the vessel.
2. respect and apply traffic regulations applicable to navigation on inland waterways to avoid damage;	<ol style="list-style-type: none"> 1. General knowledge of the rules of the road such as the agreed set of rules applicable in inland navigation for the inland waterway which is being sailed to avoid damage (e.g. collision). 2. Ability to apply relevant traffic regulations applicable to the waterway which is being sailed.
3. take account of technical structures and profiles of the waterways, and use precautions;	<ol style="list-style-type: none"> 1. Knowledge of the influence of engineering structures, waterway profiles and protection works on navigation. 2. Ability to navigate passing through various types of locks and the locking procedures, various types of bridges, profiles of canals and rivers and to make use of "safe harbours" and overnight ports.
4. work with up-to-date charts or maps, notices to skippers or mariners and other publications;	<ol style="list-style-type: none"> 1. Knowledge of navigation aids. 2. Ability to use navigation aids as applicable e.g. satellite position system. 3. Ability to use nautical charts considering factors relating to accuracy 4. and chart reading such as chart date, symbols, soundings, bottom description, depths and datums (WGS84) and to use international charts standards such as Inland ECDIS. 5. Ability to use nautical publications such as notices to skippers or mariners in order to collect necessary information required for safe navigation, finding height of tide at any time, information on ice, high or low water levels, berths and port directory.
5. use relevant traffic supervision tools and be able to apply them.	<ol style="list-style-type: none"> 1. Knowledge of signals. 2. Ability to use day and night signs such as lights to guide craft. 3. Knowledge of Inland AIS, Inland ECDIS, electronic reporting and notices to skippers or mariners, RIS, surveilled and non-surveilled vessel traffic services (VTS) systems and its components. 4. Ability to use traffic information tools.

- 1.2 The able boatman shall be able to sail and manoeuvre ensuring the safe operation of the craft in all conditions on inland waterways, including in situations that involve high traffic density or where other craft carry dangerous goods and require basic knowledge of the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN).**

The able boatman shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
<p>1. navigate and manoeuvre taking into account geographical, hydrological, meteorological and morphological characteristics of the main inland waterways;</p>	<ol style="list-style-type: none"> 1. Knowledge of the hydrological and morphological characteristics of the main waterways, e.g. catchment area and watershed, types of rivers by water source, the slope and course of a river, flow velocity and current pattern, human intervention in the course of a river. 2. Knowledge of the meteorological effects on the main inland waterways, e.g. weather forecast and warning services, scale of Beaufort, district division for wind and storm warnings with factors such as air pressure, wind, high and low pressure areas, clouds, fog, types and passage of fronts, ice warning and high water warning. 3. Ability to apply geographical, hydrological, meteorological and morphological information.
<p>2. give order to moor and unmoor craft and to haul towage operations;</p>	<ol style="list-style-type: none"> 1. Knowledge of technical requirements and documents on mooring and hauling operations. 2. Ability to initiate procedures of mooring and unmooring manoeuvre and to ensure that equipment on different types of craft complies with requirements of craft certificate. 3. Ability to communicate with RCC and other (deck) personnel, e.g., to use communication systems and hand signals.
<p>3. use modern electronic navigation aids;</p>	<ol style="list-style-type: none"> 1. Knowledge of functions and operation of navigation aids. 2. Knowledge of operating principles, limitations and sources of error of navigation aids. 3. Ability to use nautical sensors and indicators providing navigation information, e.g. (D) GPS, position, heading, course, speed, distance, depth, Inland ECDIS, radar. 4. Ability to use River Information Services (RIS) and technologies, e.g. Inland AIS, Inland ECDIS, Electronic Reporting and notices to skipper, FIS (Fairway Information Services), TIS (Traffic Information Services), TMS (Traffic Management Services), CAS (Calamity Abatement Services), ITL (Information for Transport Logistics), ILE (Information for Law Enforcement), ST (Statistics), WCHD (Waterway Charges and Harbour Dues) distance, depth, also in connection with radar. 5. Ability to detect misrepresentation of information and apply methods of correction.

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
<p>4. consider effects of current, waves, wind and water-levels in relation with interactions of crossing, meeting and overtaking craft as well as ship-shore (canal effect) in order to navigate the craft to the nearest berth in a safe manner;</p>	<ol style="list-style-type: none"> 1. General knowledge of the influence of waves, wind and current on sailing, manoeuvring or stationary craft, including the effect of wind e.g. cross wind when manoeuvring, also at nautical superstructures or when entering or leaving ports, locks and secondary waterways. 2. Knowledge of the influence of current on sailing, manoeuvring, and stationary craft on waterways used by inland navigation such as the effect of current, e.g. when manoeuvring upstream and downstream or with empty or loaded craft and when e.g. entering and leaving ports, locks or secondary waterways. 3. Knowledge of the influence of water movement during sailing, manoeuvring and when stationary such as the influence of water movement regarding draught subject to water depth and the reaction to shallow water effects e.g. by decreasing sailing speed. 4. Ability to respect interaction effects when sailing, manoeuvring and when stationary in a narrow fairway and to recognise the interaction effects relating to empty or loaded craft. 5. Knowledge of the effect of cargo handling and stowing conditions during sailing, manoeuvring and when stationary relating to stability. 6. Ability to take into account trim, angle of heel, down flooding, lever principle, points of gravity.
<p>5. use of propulsion and manoeuvring systems as well as appropriate communication and alarm systems in order to navigate the craft to the nearest berth in a safe manner;</p>	<ol style="list-style-type: none"> 1. Knowledge of propulsion, steering and manoeuvring systems and their influence on manoeuvrability. 2. Ability to use propulsion, steering and manoeuvring systems 3. Knowledge of anchoring devices. 4. Ability to use anchor in various circumstances. 5. Knowledge of communication and alarm systems. 6. Ability to give instructions if necessary in the case of an alarm.

1.3 The able boatman shall be able to respond to navigational emergencies on inland waterways.

The able boatman shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
<p>1. take precautions in an emergency when intentionally beaching a craft in order to prevent greater damage;</p>	<ol style="list-style-type: none"> 1. Knowledge and ability to adequately use machines or anchoring devices if beaching becomes necessary.
<p>2. take appropriate actions if collision is imminent;</p>	<ol style="list-style-type: none"> 2. Knowledge and ability to navigate the craft when in an unavoidable collision situation in such a way that damage will be minimal to persons, e.g. passengers and crew members, the colliding craft and other craft, the cargo and the environment.
<p>3. take appropriate actions after a collision and assessment of damage.</p>	<ol style="list-style-type: none"> 3. Knowledge and ability to take the appropriate measures in the event of damage, collision and running aground, including assessment of the damage, communication with the competent authority and obtaining permission to sail to a position of recovery.

2. Operation of the craft

Related to the “operation of craft”, no additional competences are suggested in addition to the existing ES-QIN standard of competence for Operational Level.

3. Cargo handling, stowage and passenger transport

Related to “cargo handling, stowage and passenger transport”, no additional competences are suggested in addition to the existing ES-QIN standard of competence for Operational Level.

4. Marine engineering and electrical, electronic and control engineering

4.1 The able boatman shall be able to monitor and operate the pump and the pump control system to navigate the craft in a safe manner.

The able boatman shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. monitor routine pump works, ballast and loading pump systems;	1. Knowledge of pump systems and pumping operations. 2. Ability to ensure monitoring of safe operation of bilge, ballast and cargo pump systems including adequate instructions to the crew, taking into account free surface effects on stability.

4.2 The able boatman shall be able to organise the safe use and application, maintenance and repair of the electro-technical devices of the craft.

The able boatman shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. prevent potential damage to electric and electronic devices on board;	1. Knowledge of electro-technology, electronics and electrical equipment and safety devices e.g. automation, instrumentation and control systems to prevent damage. 2. Ability to apply safe working practices.

<p>2. test control systems and instruments to recognise faults and at the same time take actions to repair and maintain electric or electronic control equipment;</p>	<ol style="list-style-type: none"> 1. Knowledge of the craft’s electro-technical testing devices. 2. General knowledge of alerts, visual interactions and possible interference of remotely operated or supported vessel which may affect the remote set-up integrity and their consequences/system failures. 3. Ability to operate, test and maintain control systems and take appropriate measures. 4. Ability to perform all checks in accordance with the RCC’s specific check list under the direction of the RCCO or RCCO supervisor. 5. Ability to check redundant systems and to communicate status under the direction of the RCCO or RCCO supervisor. 6. Ability to operate, test and maintain communication and control systems on the craft for remote operations.
<p>3. give instructions before and follow-up activities to connect or disconnect technical facilities of remotely operated or remotely supported vessel systems.</p>	<ol style="list-style-type: none"> 1. Knowledge of safety requirements for working with electrical systems. 2. Knowledge of the construction and operational characteristics of shipboard electrical systems and specific equipment for remote operations. 3. Ability to recognise dangerous situations with regard to systems used for remote operations.

4.3 The able boatman shall be able to control the safe maintenance and repair of technical devices.

The able boatman shall be able to:

<p>COLUMN 1 COMPETENCE</p>	<p>COLUMN 2 KNOWLEDGE AND SKILLS</p>
<p>1. ensure appropriate use of tools to maintain and repair technical devices;</p>	<ol style="list-style-type: none"> 1. Knowledge of the maintenance and repair procedures for technical devices. 2. Ability to organise and instruct on safe maintenance and repair using appropriate procedures (control), equipment and software.
<p>2. assess characteristics and limitations of materials as well as necessary procedures used to maintain and repair technical devices;</p>	<ol style="list-style-type: none"> 1. Knowledge of characteristics of maintenance and repair material for technical devices. 2. Ability to apply maintenance and repair procedures on devices according to manuals.
<p>3. apply technical and internal documentation.</p>	<ol style="list-style-type: none"> 1. Knowledge of construction specifications and technical documentation. 2. Ability to apply checklists for maintenance and repair of technical devices.

5. Maintenance and repair

Related to “maintenance and repair”, no additional competences are suggested in addition to the existing ES-QIN standard of competence for Operational Level.

6. Communication

6.1 The able boatman shall be able to manage and control the information and communication systems on board the craft.

The able boatman shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. operate information- and communication systems on board;	<ol style="list-style-type: none"> 1. Knowledge of information- and communication systems available on board. 2. Ability to apply the craft's communication, media and IT systems.
2. collect, save and manage data.	<ol style="list-style-type: none"> 1. Knowledge of the use of all the craft's computer systems.

6.2 The able boatman shall be able to ensure good communication at all times, which includes the use of standardised communication phrases in situations with communication problems.

The able boatman shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. describe circumstances by using relevant technical and nautical terminology;	<ol style="list-style-type: none"> 1. Knowledge of the correct use of relevant technical and nautical terms. 2. Ability to master communication.
2. retrieve, evaluate and use information with relevance to safety on board as well as nautical-technical issues.	<ol style="list-style-type: none"> 1. Knowledge of procedures to follow in all distress, emergency and safety communication. 2. Ability to use the standard communication phrases.

6.3 The able boatman shall be able to foster a well-balanced and sociable working environment on board.

The able boatman shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. organise provisioning and preparation of meals on board.	<ol style="list-style-type: none"> 1. Knowledge of principles of healthy nutrition. 2. Ability to instruct crew members in planning and preparing meals. 3. Ability to instruct and supervise crew members regarding hygienic standards. 4. Ability to instruct crew members in planning purchasing possibilities.

7. Health and safety, passenger rights and environmental protection

7.1 The able boatman shall be able to maintain safety and security for persons on board including direct assistance to disabled persons and persons with reduced mobility in accordance with the training requirements and instructions of Annex IV to Regulation (EU) No 1177/2010.

The able boatman shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. apply procedures for fire prevention, personal protection equipment, methods, firefighting material, respirators and possible application of these devices in emergencies;	1. Ability to control the monitoring and maintenance of fire detection and extinguishing systems and equipment.
2. monitor effective on-board system to control life-saving appliances and correct application of personal protection equipment.	1. Ability to maintain and perform periodic checks of operational condition of lifesaving, fire-fighting and other safety equipment and systems.

7.2 The able boatman shall be able to set up emergency and damage control plans, and handle emergency situations.

The able boatman shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. perform rescue plans of different types of emergencies;	<ol style="list-style-type: none"> 1. Knowledge of different types of emergencies which may occur such as collision, fire, flooding, sinking. 2. Ability to apply shipboard contingency plans for response to emergencies including monitoring and control.
2. train on methods to prevent fire, recognition of origin of fire and firefighting according to the different skills of crew members;	<ol style="list-style-type: none"> 1. Knowledge of fire-fighting procedures with particular emphasis on tactics and command. 2. Knowledge of the use of water for fire-extinguishing with regard to the effect on vessel stability, and ability to take appropriate measures. 3. Ability to communicate and coordinate during fire-fighting operations including communication with external organisations and to actively take part in rescue and fire-fighting operations.
3. train on the use of life saving appliances.	<ol style="list-style-type: none"> 1. Knowledge of particular characteristics and facilities of rescue devices. 2. Ability to launch and recover a ship's boat.

3.2. Able boatman on a remote-controlled craft sailing on inland waterways with a maritime character

3.2.1 Introduction to additional requirements for able boatman on a remote-controlled craft sailing on inland waterways with a maritime character

Similar to competences for boatmaster on “conventional” inland vessels, able boatmen on a remote-controlled vessel operating on a waterway with a maritime character, should acquire additional knowledge and skills to operate typical conditions on these waterways. As a consequence, taking the competence table for boatmaster operating on inland waterways with a maritime character as a base, additional competences are suggested for able boatmen operation in inland vessels that (occasionally) sail on inland waterways with a maritime character.

For the proposed competency table, primarily, the following source has been used:

- Standards of competence for sailing on inland waterways with a maritime character (Resolution CESNI 2018-II-6, Chapter 4): <https://www.cesni.eu/wp-content/uploads/2019/03/Page-de-garde-EN.pdf>;

3.2.2 Proposed competence table

- The able boatman sailing on inland waterways with a maritime character shall be able to work with up-to-date charts and maps, notices to skippers and mariners and other publications specific to waterways with a maritime character in order to navigate the craft to the nearest berth or anchorage in a safe manner.**

The able boatman shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. use information supplied from specific nautical information sources and rules applicable for inland waterways with a maritime character	1. Knowledge of use of nautical charts and maps of inland waterways with maritime character. 2. Ability to use and correctly apply charts and maps of inland waterways with maritime character for considering factors relating to accuracy of chart reading such as chart date, symbols, soundings, bottom description, depths and datum's and international charts standards such as ECDIS. 3. General knowledge of terrestrial and satellite navigation for determination of dead reckoning, piloting, coordinates, geodetic latitude and longitude, horizontal geodetic datum, difference of latitude and longitude, distance and speed over ground, directions on the earth, course, course over ground, compass course corrected with the drift as the result of wind direction and force, heading and bearing, determination of the course, determination of the course with wind and current effect, determination of the course with effect of current and plotting position sailing on route and bearings.

- The able boatman sailing on inland waterways with a maritime character shall be able to use tidal datums, tidal currents, periods and cycles, the time of tidal currents and tides and variations across an estuary.**

The able boatman shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. respect tides, tidal, weather forecast and conditions in order to navigate the craft to the nearest berth or anchorage in a safe manner.	1. Knowledge and ability to determine the impact of tidal level, current, weather conditions and waves, on the planned voyage for safe navigation.

- The able boatman sailing on inland waterways with a maritime character shall be able to use SIGNI (Signalisation des voies de navigation intérieure) and IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities) for safe navigation on inland waterways with a maritime character.**

The able boatman shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
<p>1. use SIGNI (Signalisation des voies de navigation intérieure), IALA (International Association of Marine Aids to Navigation and Lighthouse Authorities) or other local marking and signal systems.</p>	<p>1. Functional knowledge of buoyage, IALA, region A, marking and signal systems such as buoyage direction, numbering, marking of objects and superstructures, lateral and cardinal markings, bifurcations buoys, supplementary marks, marking of danger points and obstacles, marking the course of the fair way as well as channel, entrances of harbours, buoyage and illumination and characteristics of illumination.</p> <p>2. Ability to use the marking and signal systems to determine the appropriate crafts position in the waterway with respect to local circumstances and conditions.</p>

3.3. Able boatman on a remote-controlled craft sailing with the aid of radar

3.3.1 Introduction

Similar to competences for Able Boatmen working on a remotely controlled inland vessel navigation on inland waterways with a maritime character, able boatmen should also acquire knowledge and skills to sail with the aid of radar. As a consequence, taking the competence table for boatmaster operating on with the aid of radar as a base, additional competences are suggested for able boatmen operation in inland vessels that (occasionally) sail on inland waterways under conditions that require sailing on radar in order to reach the nearest berth or anchorage in a safe manner. Such a person could be considered as a person with a certain competence in the use of radar as provided for by some police regulation. A specific authorisation to sail with the aid of radar is, under the current ES-QIN system, only foreseen for boatmasters. Deliverable 3.6 could investigate if the competence needed for the specific authorisation should also be applied for the person on board the remote-controlled vessel.

For the proposed competency table, primarily, the following source has been used:

- Standards of competence for sailing on inland waterways with a maritime character (Resolution CESNI 2018-II-6, Chapter 5): <https://www.cesni.eu/wp-content/uploads/2019/03/Page-de-garde-EN.pdf>;

3.3.2 Proposed competence table

- The able boatman sailing with the aid of radar shall be able to take appropriate action in relation to navigation with the aid of radar in order to navigate the craft to the nearest berth or anchorage in a safe manner.

The able boatman shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
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<p>1. use of navigational radar installations and rate-of-turn indicators for navigation especially in reduced visibility conditions</p>	<ol style="list-style-type: none"> 1. General knowledge of radio waves and knowledge of the principles of radar operation and more specifically: <ul style="list-style-type: none"> • the propagation velocity of radio waves, • reflection of radio waves, • key parameters of navigational radar installations (operating frequency range, transmission power, pulse duration, rate of antenna revolutions, characteristics of the antenna, display dimensions and range scales, minimum range, radial resolution and azimuthal resolution etc.). 2. General knowledge of the working principle of rate-of- turn indicators and their application. 3. Ability to switch on, adjust and control navigational radar installations such as Tune, Gain, Brilliance, On/Standby, Range and to use rate-of-turn indicators in inland navigation and assure correct use.
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2. The able boatman sailing with the aid of radar shall be able to interpret radar display and analyse the information supplied by radar in order to navigate the craft to the nearest berth or anchorage in a safe manner.

The able boatman shall be able to:

<p>COLUMN 1 COMPETENCE</p>	<p>COLUMN 2 KNOWLEDGE AND SKILLS</p>
<p>1. interpret the radar display correctly with respect to own and other craft positions;</p>	<ol style="list-style-type: none"> 1. Ability to interpret the radar display by correctly identifying the <ul style="list-style-type: none"> • position of the antenna on the screen and heading line, • setting of position, course and turning direction of the own craft, • determining distances and reach. 2. Ability to interpret the behaviour of other traffic participants (stationary craft, oncoming craft and craft heading in the same direction).
<p>2. analyse other information supplied by radar.</p>	<ol style="list-style-type: none"> 1. Ability to analyse the information supplied by radar such as heading line (HL), electronic bearing line (EBL), range rings and variable range marker (VRM), target trails, decentering, parallel lines (P-Lines) and to explain the radar picture. 2. Knowledge of the limitation of information supplied by navigational radar installations. 3. Ability to interpret stationary and moving objects displayed on the radar.

3. The able boatman sailing with the aid of radar shall be able to reduce interference of varying origin.

The able boatman shall be able to:

<p>COLUMN 1 COMPETENCE</p>	<p>COLUMN 2 KNOWLEDGE AND SKILLS</p>
<p>1. identify and reduce disturbances coming from the own craft;</p>	<ol style="list-style-type: none"> 1. Functional knowledge of possible disturbances coming from own craft. 2. Ability to take action to reduce disturbances coming from own craft.

2. identify and reduce disturbances coming from the environment;	<ol style="list-style-type: none"> 1. Functional knowledge of disturbances from rain or waves, scattered fields (e.g. bridges), multiple reflections, false/ghost echoes, power transmission lines, radar shadowing and multipath propagation effects. 2. Ability to take action to reduce disturbances coming from the environment (by using Anti-Rain Clutter (FTC) and Anti-Sea Clutter (STC)).
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- 4. The able boatman sailing with the aid of radar shall be able to navigate by radar taking into account the agreed set of rules applicable to inland navigation in order to navigate the craft to the nearest berth or anchorage in a safe manner.**

The able boatman shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. apply rules governing the use of radar.	<ol style="list-style-type: none"> 1. General knowledge of specific rules for radar use in the agreed set of rules applicable in inland navigation and in applicable police regulation (e.g. sailing in situations with reduced visibility, use of radar when visibility is not reduced and mandatory radar use when sailing), use of VHF, sound signals and agreements on course to steer. 2. Ability to use correctly navigational radar installation, rate-of-turn indicators and Inland ECDIS combined with radar.

4. Conclusions and recommendations

IWT sector' consultation and desk research on automation projects have resulted in a proposal for more advanced competency standards on management and operational level for professional qualification standards in inland shipping.

For track guidance assistant systems in inland navigation (TGAIN), the existing ES-QIN framework seems sufficient. However, it is recommended to introduce short courses to familiarise with the technical specifications and control of the on board systems. Based on the fact that TGAINs are market-ready and actually installed on both existing and new inland vessels on a large scale, the need for familiarisation directly affects existing nautical staff on management level active in the IWT sector. It is therefore recommended to address a framework for introduction of short courses in Task 3.4, which explicitly focusses on upskilling of the IWT workforce in view of more advanced levels of digitalisation and automation of on board systems in inland shipping. It is advised to look into the possibility to use e-learning platforms for TGAIN short courses, such as INeS Inland Navigation eLearning System, on which also harmonized lesson material developed under i.e. the COMPETING project is accessible for all members of EDINNA.

For developments towards more or fully autonomous inland vessel concepts it is expected that, considering there is still nautical crew on board, as in the present situation, more attention in educational and training programmes shall be given to characteristics of autonomous support systems, risks and redundancies. A transition is expected focusing on more "soft skill" elements in terms of communication and awareness, similar to developments as witnessed in maritime and air transport. As many existing initiatives are still in R&D phase, either planning a stepwise approach from TGAIN to higher levels of automation or following a different approach through machine-learning, more (practical) research is needed to understand the effects of these systems on required competences for nautical staff in inland shipping. As autonomous systems may further influence the discussion on the flexibilization of manning requirements, a more flexible composition of nautical staff may affect the requirements for competences of nautical personnel on board. Moreover, autonomous systems could also go hand in hand with remote control systems as redundancy, for which the proposed competency framework for remote control operations on management and operational level could be sufficient. It is suggested that as part of short-term R&D programmes for semi- or fully autonomous systems (the latter not necessarily without crew on board), attention shall be given to research impact on manning regulations and the relation with competence requirements.

For remotely operated or remotely supported vessels the need for new competences is more urgent. Existing initiatives are expected to advance from operations on national waterways to cross-border pilots and market integration. Consequently, drafting new standards for competence for nautical inland shipping personnel involved in the remote operations is considered to be a priority to be addressed.

Looking at existing initiatives of remotely operated or remotely supported vessels, the operations are still single vessel-based, carried out from a workstation in a remote or shore control centre (RCC). An experienced (able) boatman on board supports the remote-control operations from the operator in the RCC and is also still responsible for regular activities on board (such as mooring and unmooring, maintenance and repair jobs, etc.).

However, from the business case perspective this is not considered as an economically viable and sustainable solution. Both existing and potential future operational models have been considered in the context of Task 3.3 of proposing competences for remotely control operations. The proposed competency framework involves competences for the following roles:

- **Remote control center operator (RCCO)** on Management Level, including additional competences¹⁸ for vessel and RCC familiarisation; conducting checks to ensure connectivity and navigational functionality with the RCC; emergency procedures; communication with onboard personnel and third parties; effects of man-machine interaction and limitations;
- **Remote control center supervisor** on Management Level (experienced RCCO), to anticipate for a potential situation with reduced experience requirements for the RCCO or operating multiple inland vessels simultaneously from one workstation in the RCC (under the condition of a supervisor monitoring the nautical operations), which includes more advanced competences of VTS equipment; traffic management and communication protocols; emergency and response management; personal attributes and administrative skills related to more advanced coordination tasks¹⁹;
- **Able boatman on a remote-controlled craft** on Operational Level, as the (assumed) sole person on board, which includes competences from Management Level (Boatmaster) to enable taking over navigational control of the inland vessel (as redundancy); advanced communication skills especially for emergency response; knowledge of on board system for remote control; and general operational knowledge of vessel and stability. Similar to a boatmaster operating under conditions that have to obtain competence for special authorisations sailing with LNG, radar or on waterways with a maritime character, the able boatman in remote control operations should obtain additional competences for remote control operations under these conditions (if allowed).

The proposed standards for professional qualification on Management and Operational Level shall be considered according to the CESNI framework and adoption process, with the necessary consultation steps. As a result, the proposed standards may be adjusted based on the legislative framework of manning requirements/crew composition; different views on minimum experience levels for remote control operations; and the introduction of technical requirements for remote control operations from remote control centres (possibly to be included in ESTRIN).

Before the development of educational and training programmes for existing and future nautical staff, it is recommended to accelerate the adoption process in CESNI along with technical requirements for remote operations. This in order to develop and implement competence-based educational and training programmes in a cost-effective manner. It is only after a full picture of the required competence for qualifications related to remote vessel operation have been fixed that a discussion on the exact functions, especially with a view to the person on board can take place. Experts in the competent for a (e.g. CESNI/QP Crew) should take into account that feedback to this report highlighted that some competence of the remote control supervisor may have to be made more precise. This because it is seen to be crucial (see knowledge 3.1.1 and ability 3.1.4 with a view to communication) and it has to be considered carefully how OL functions can be prepared to perform ML competence (e.g. ability to use charts, to sail and manoeuvre including use of propulsion and to respond to nautical emergencies, see for these examples competence items 1.1.4.3, 1.2, 1.3).

¹⁸ In comparison with the existing ES-QIN framework for Management Level (Boatmaster).

¹⁹ In addition to required RCCO competences and practical experience as RCCO.



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