1System 4 IWT learning: upskilling pathways

- Skills gaps research and gaps in legislation implementation -

UPDATED LIST OF JOBS ONBOARD IWT VESSELS AND THEIR CORRESPONDING PROFESSIONAL COMPETENCES AND JOB DESCRIPTIONS

D 2.4

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The ERASMUS+ project **"1System 4 IWT learning: upskilling pathways"**- 1S4IWT, aims to build a learning system that will act as a solution for ensuring and sustaining continuity of education & training for IWT students and workers and generate a „personalized learning experience". Furthermore, the project will focus on developing common resources, which meet the needs of nowadays trends and challenges for (incoming) staff in the IWT sector.

WP 2 - Skills gaps research and gaps in legislation implementation, deals with the creation of a resilient, easily accessible and future-proof education & training system for the IWT sector.

The present Deliverable 2.4. "**Updated List of Jobs Onboard IWT Vessels and their corresponding Professional Competences and Job Descriptions**" under Task 2.4 " Jobs & Skills" is based on the results of ***Task 2.2 "Revision of standards for competences and corresponding knowledge and skills (ES-QIN)",*** i.e. an updated inventory of current standards for competences, adopted by the ***Directive (EU) 2017/2397 of the European Parliament and of the Council of 12 December 2017 on the recognition of professional qualifications in inland navigation*** and ***Commission delegated Directive (EU) 2020/12 of 2 August 2019 supplementing Directive (EU) 2017/2397 of the European Parliament and of the Council as regards the standards for competences and corresponding knowledge and skills, for the practical examinations, for the approval of simulators and for medical fitness*** as well as on ***Task 2.3 "Gradual implementation of automation in IWT sector"*** , where a methodology for gradual implementation of automation in IWT was developed as a tool for each country to be able to evaluate their state of play periodically or when obvious/significant changes are considered to be brought to the IWT environment, especially regarding the permanent adaptation of professional competencies of personnel from IWT sector taking into consideration the continuous changes in the transport sector, in particular those relating to automation and digitalisation in order to support the work of CESNI, committed to regularly revise existing standards and to adopt new standards while following closely technical evolutions and supporting innovation, as a permanent priority according to its Work Program.

The present document focuses on **remote controlled** and **remotely assisted vessel operation** and the corrsponding skills and competences crew members at **entry level** (i.e. deckhand and apprentice) and at **operational level** (i.e. boatman) need to possess. Furthermore, we are considering the IWT stakeholders and decision makers' interest in investing in remote vessel operation and starting to train their personnel in the domain of cooperation between remote control center and crew on board remotely assisted or remotely controlled vessels.

This document provides as well a brief outlook on **modern training methods and techniques**. Legislators will have to decide if the proposed options for such training will be established and what preconditions will have to be considered. This will largely depend on the judgement of CESNI Member States, if the person(s) onboard a remotely operated or remotely assisted vessel can be a deckhand or apprentice to work with a(n) (able) boatman and/or boatmaster who needs to have specific additional skills and competence (Situation Awareness,).

LIST OF ABBREVIATIONS

AIS	Automatic identification system
CAS	Calamity Abatement Services
CCNR	Central Commission for the Navigation on the Rhine
CESNI	European Committee for drawing up standards in the field of inland navigation
ECDIS	Electronic Chart Display and Information System
EDINNA	Education in Inland Navigation, the educational network of inland waterway navigation schools and training institutes
ES-QIN	European Standards-Qualification in Inland Navigation
ETA	Estimated time of Arrival
EU	European Union
FIS	Fairway Information Services
E & T	Education & Training
FP 7	Framework Programme for Research
ICT	Information and communications technology
ILE	Information for Law Enforcement
IT	Information technology
ITL	Information for Transport Logistics
IWT	Inland Waterway Transport
OL	Operational level
PLATINA	Platform for the implementation of a future inland navigation action programme
RCC	Remote Control Center
RIS	River Information Services
ST	Statistics
TGAIN	Track guidance assistant for inland navigation
TIS	Traffic Information Services
TMS	Traffic Management Services
VDES	VHF Data Exchange System
VHF	Very high frequency
WCHD	Waterway Charges and Harbour Dues

LIST OF DEFINITIONS

Deckhand/ Apprentice	a member of the deck crew and performs the entry-level functions
Malware	or “malicious software,” is an umbrella term that describes any malicious program or code that is harmful to systems.
Water holing	a targeted attack designed to compromise users within a specific industry or group of users by infecting websites they typically visit and luring them to a malicious site
Scanning	a logical extension (and overlap) of active reconnaissance that helps attackers identify specific vulnerabilities.
Typosquatting	a type of social engineering attack which targets internet users who incorrectly type a URL into their web browser rather than using a search engine
Denial of service	a cyberattack on devices, information systems, or other network resources that prevents legitimate users from accessing expected services and resources
Phishing	an attack by sending scam emails (or text messages) that contain links to malicious websites
Cybersecurity	the practice of protecting systems, networks, and programs from digital attacks
Threat	a malicious act that seeks to damage data, steal data, or disrupt digital life in general
Remote Control Center	a central location where a team of operators can monitor and control critical infrastructure and coordinating operations across multiple locations and systems.
Remote controlled vessel	a vessel where the activities of the onboard operation are transferred to a location other than the vessel

1. INTRODUCTION

1System 4IWT aims to build a learning system that will act as a solution for ensuring and enduring continuity of education & training for IWT students and workers and generate a „personalized learning experience". Furthermore, considering the current situation of refresher classes in European inland navigation in general and more specifically of refresher classes for more automated vessel operation in inland navigation in Europe, the project focuses on developing common resources that meet the needs of nowadays trends and challenges for (incoming) staff in the IWT sector.

The present document focuses on remote controlled and remotely assisted vessel operation and the corrsponding skills and competences crew members at entry and operational levels need to possess. Furthermore, we are considering the IWT stakeholders and decision makers' interest in investing in remote vessel operation and starting to train their personnel in the domain of cooperation between remote control center and crew on board remotely assisted or remotely controlled vessels.

1.1. EU Policy and regulatory context

Since 2008 key stakeholders in the IWT sector are cooperating towards the harmonization and modernization of professional qualifications in inland navigation. A formal network of IWT education & training (E&T) institutes has been founded in February 2009 under the name "EDINNA" (www.edinna.eu).

Since the start, EDINNA has pledged for "one language" and "one standard" in the IWT sector. EDINNA and FP7 project PLATINA proposed to develop so called "***Standards of Training and Certification in Inland Navigation***" in order to develop a level playing field in the IWT E&T system.

Directive (EU) 2017/2397 of the European Parliament and of the Council of 12 December 2017 on the recognition of professional qualifications in inland navigation and repealing Council Directives 91/672/EEC and 96/50/EC, which came into force in January 2022, lays down the conditions and procedures for the certification of the qualifications of persons involved in the operation of a craft navigating on Union inland waterways, as well as for the recognition of such qualifications in the Member States.

The harmonisation of legislation in the field of professional qualifications in inland navigation in Europe is facilitated by close cooperation between the Union and the CCNR, and by the development of **CESNI Standards - ES-QIN**- published by Commission **Delegated Directive (EU) 2020/12** of 2 August 2019 supplementing Directive (EU) 2017/2397 of the European Parliament and of the Council as regards:

- the **standards for competences** and **corresponding knowledge and skills**, that establish the

minimum competences required for the safe operation of the craft, for the crew members at operational and management levels, for the Boatmasters authorised to sail with the aid of radar and those authorised to sail on waterways with a maritime character, for the passenger navigation experts and for the liquefied natural gas (LNG) experts. Each required competence was defined with its corresponding required knowledge and skills;

- the **standards for the practical examinations** which define, for each practical examination, the specific competences and the assessment situations, including a specific scoring system and technical requirements for craft and onshore installations;

- the **standards for the approval of simulators** that cover the technical and functional requirements for vessel-handling and radar simulators as well as the procedure for the administrative approval of those simulators and ensure that the simulators used for an assessment of competence are designed in such a way as to allow for the verification of the competences as prescribed under the standards for practical examinations, and

- the **standards for medical fitness** that specify the tests that medical practitioners need to carry out and the criteria they are to apply to determine the fitness for work of deck crew members. They cover eyesight, hearing and physical and psychological conditions which may lead to temporary or permanent unfitness for work, as well as possible mitigation measures and restrictions.

With reference to professional qualifications, within work programme 2022-2024, CESNI has prepared and adopted **standards in the field of professional qualifications**, actively promoting:

- the regular revision of ES-QIN to maintain and guarantee the high level of safety in inland navigation and to follow the technical evolution,
- 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,
- the establishment of modern manning requirements,
- electronic tools for recording and exchanging information on crew

CESNI supports proper implementation of standards in the field of professional qualifications, including:

- maintenance of quality standards and guidelines,
- preparation of explanatory notices for the major standards or amendments,
- deliberation on the uniform interpretation and application of the standards.

During the workshop "**Autonomous shipping and Inland Navigation**" held on 14 February 2018, at the fifty-second session of the Working Party on the Standardization of Technical and Safety Requirements in Inland Navigation, organized jointly by UNECE and De Vlaamse Waterweg nv, the

focus was on introducing smart and autonomous shipping on inland waterways, advantages and implications, possibilities for synergy with maritime transport and a selection of items for further consideration with a view to supporting member States that intend to guide the inland waterway sector towards more automatization and propose possible activities toward the sound legislation and regulation in support of innovative transport such as autonomous shipping and building a framework which enables the commercial use of autonomous ships in a safe way.

Automated means of navigation are developing at a rapid pace in inland navigation. For this reason, during the European Committee for drawing up Standards in the field of Inland Navigation (CESNI) meeting in Strasbourg (France) on 10 April 2024, a **brochure on the use of Track Guidance Assistants for Inland Navigation (TGAIN)** was adopted. The Track Guidance Assistant for Inland Navigation is a system for automatically steering the vessel along a pre-defined track; its purpose is to support the boatmaster and reduce the steering tasks. TGAIN only meets automation level 1 or 2, which means that the boatmaster remains solely responsible at all times for the control of the craft - including track adjustment to avoid collision, if necessary.

Drafted by the CESNI in cooperation with EDINNA, the brochure contains important information for the safe use of TGAIN. It is primarily intended for training institutes and manufacturers. It is relevant to inland navigation:

- as basic lesson material for training institutes;
- for training of crew members, both at operational level (boatman) and management level (boatmaster);
- as a basis for the development of working instructions for TGAIN;
- as a catalyst for discussion on the subject of TGAIN among nautical experts.

Having in view, the proposed **Sustainable and Smart Mobility Strategy 2020,** aimed to transform the EU transport sector and align it with the European Green Deal, by making it green, digital and resilient, the **European Commission Digital Strategy, 2022** which supports the harmonised development of automated navigation via a holistic and technologically neutral approach, the **Digital Education Action Plan (2021-2027) Resetting education and training for the digital age, 2020, The European Skills Agenda, 2020** which supports the acquisition of skills for the green and digital transitions etc.**,** as well as the **Commission Recommendation (EU) 2024/236 of 29 November 2023 on means to address the impact of automation and digitalisation on the transport workforce** in order to help with identifying future skills needs and gaps at national level and help individuals to identify future career paths and learning opportunities, the **CCNR's vision to support the harmonised development of automated navigation** allowing a proper implementation of automation in light of safety and sustainability, ***new standards of competence, knowledge and skills for inland navigation crew members working on remote controlled and remotely assisted vessels at entry and operational levels need to be developed.***

1.2. Proposed Levels of Automation in IWT sector

Automation is finding its way in our daily life and certainly in our ways of transport. These kind of innovations have the possibility to radically alter our movements. In order to stay competitive towards other modes, innovation in inland navigation is crucial.

In inland navigation, **international definition of level of automation** (*Explanatory note related to the international definition of automation in inland navigation,* CCNR 2022) can be found at (https://ccr-zkr.org/files/documents/AutomatisationNav/Note_explicative_en.pdf).

Automated navigation covers a very wide range of technical solutions and use cases - ranging from simple navigation assistance to fully automated navigation. With a purpose of establishing a comprehensive internationally accepted definition of automation levels and support further works such as an analysis of regulatory needs, during its plenary session in December 2018, the CCNR adopted the first international definition of the various levels of automation in inland navigation, which are given in Table 1 below.

	Level	Designation	Vessel command (steering, propulsion, wheelhouse, ...)	Monitoring of and responding to navigational environment	Fallback performance of dynamic navigation tasks	Remote control
BOATMASTER PERFORMS PART OR ALL OF THE DYNAMIC NAVIGATION TASKS	0	**NO AUTOMATION** the full-time performance by the human boatmaster of all aspects of the dynamic navigation tasks, even when supported by warning or intervention systems *E.g. navigation with support of radar installation*				No
	1	**STEERING ASSISTANCE** the context-specific performance by a steering automation system using certain information about the navigational environment and with the expectation that the human boatmaster performs all remaining aspects of the dynamic navigation tasks *E.g. rate-of-turn regulator* *E.g. trackpilot (track-keeping system for inland vessels along pre-defined guiding lines)*				
	2	**PARTIAL AUTOMATION** the context-specific performance by a navigation automation system of both steering and propulsion using certain information about the navigational environment and with the expectation that the human boatmaster performs all remaining aspects of the dynamic navigation tasks				
SYSTEM PERFORMS THE ENTIRE DYNAMIC NAVIGATION TASKS (WHEN ENGAGED)	3	**CONDITIONAL AUTOMATION** the sustained context-specific performance by a navigation automation system of all dynamic navigation tasks, including collision avoidance, with the expectation that the human boatmaster will be receptive to requests to intervene and to system failures and will respond appropriately				Subject to context specific execution, remote control is possible (vessel command, monitoring of and responding to navigational environment and fallback performance). It may have an influence on crew requirements (number or qualification).
	4	**HIGH AUTOMATION** the sustained context-specific performance by a navigation automation system of all dynamic navigation tasks and fallback performance, without expecting a human boatmaster responding to a request to intervene *E.g. vessel operating on a canal section between two successive locks (environment well known), but the automation system is not able to manage alone the passage through the lock (requiring human intervention)*				
	5	**AUTONOMOUS = FULL AUTOMATION** the sustained and unconditional performance by a navigation automation system of all dynamic navigation tasks and fallback performance, without expecting a human boatmaster responding to a request to intervene				

Table 1. *Automation levels proposed by CCNR*

The CCNR considers it necessary to work on minimum requirements and/or recommendations for inland navigation guidance aids corresponding to level 2 of the definition (**automated navigation** system for both steering and propulsion). In parallel with the automation itself, the CCNR also intends to work on the conditions for operating an automated vessel from a central facility for the **remote control** and monitoring of vessels. In the medium term, work could start on systems that fall under level 3 of the definition.

An **automated craft** may achieve different levels of automation during its voyage. Indeed, during a voyage with an automated craft, the level of human intervention may change so that for the same craft on some stretches of waterway the automated navigation system may play a big role in the control of the craft while in another context (confined navigations), the human will operate the craft.

In a **remote control craft** navigation decisions are taken by a human or a machine external to the craft. In other words, “Remote control” is understood as a mean to perform part or all the needed navigation tasks from shore or from another place than from the craft (e.g., craft command, monitoring of and responding to navigational environment and fallback performance of dynamic navigation tasks). These tasks executed remotely could be performed from a technical point of view by a human or by a machine. Therefore, remote control is not in itself automation even if both are linked.

Even if **remote controlled vessel operation** is not necessarily automated vessel operation, **remote controlled vessel operation** is in the focus due to practical relevance of new competences of remote vessel operators and personnel on board remotely controlled or remotely assisted vessels as described in Deliverable 3.3 in Platina 3 project and currently discussed in CESNI, i.e. on a level of automation 2 and 3 which is the most common practice when looking at the most comprehensive overview of pilot projects on automation as permanently updated on the CCNR website.

The present document proposes some concrete skills and competences for updating CESNI standards for competence at **entry level** (i.e. deckhand and apprentice) and at **operational level** (i.e. boatman) with regard to modern technology for remotely controlled and/or remotely assisted vessels operation.

1.3. Human factors causes of accidents and ways to reduce or prevent inland navigation accidents

Today, inland navigation is one of the most important modes of transport in many regions, with its low cost and low environmental impact. However, little is known about the working and living conditions of the crews on board the vessels in the inland navigation sector. The fact that many inland navigation vessels cross borders almost on a daily basis means that crews may be subject to different laws and regulations, and sometimes may even fall through the gaps in the laws and regulations that protect onshore workers from other sectors. Furthermore, the COVID-19 pandemic with its global economic and financial crisis led to new trends and developments in this sector which necessitates special consideration of the working and living conditions of these men and women.

The amount of accidents and number of claims related to inland navigation has risen every year since 2014, just like the amount of the claims. Several sources reveal that 70-80% of these accidents are related to human factors as a primary cause.

In 2019 CESNI organized a workshop on this item. The reason for this was the proposal by the German delegation to make regulations for bridge height detection systems to prevent / reduce the number of collisions with bridges. The NL delegation believes that this issue should be placed in a broader context and that the cause of accidents should first be investigated before it can be determined which solution(s) / measure(s) could be effective. The IVR and the international inland waterway transport sector (EBU / EBU) are also looking for ways to prevent such accidents.

The Dutch Ministry of Infrastructure and Water Management, IVR and EBU / ESO want to have research done on the human factor in relation to accidents in inland navigation that is described as follows:

- Investigate which processes occur in the wheelhouse during sailing including navigation.
- Investigate the effects of these side-processes on the human brain and assess whether these are human factors root causes of accidents in inland navigation in Europe.
- Accidents might include ship-ship collisions, ship-object allisions and groundings, including all kinds of vessels (dry cargo, tanker, passenger, tug/push boat, barge) in the geographical area of the Netherlands, Germany and Belgium.
- Apply a mixed method approach of analysis (triangulation) of available statistical data from IVR, meta-analysis of existing related studies and analysis of empirical evidence from experts in the field.
- Verify the results with relevant stakeholders for shared awareness and decision making.

As a result, a study **'Human factors root causes of accidents in inland navigation'** was initiated and funded by The Dutch Ministry of Infrastructure and Water Management, the insurers united in IVR and the IWT Platform. In the first stage of this study, various databases from France, Germany and the Netherlands were examined.

The findings of the analysis of the root causes were grouped in five topics:

- The impact of human factors in incidents.
- Processes within the vessel/wheelhouse.
- Organisational processes.
- Infrastructural issues.
- Environmental factors.

The following elements were considered: *communication, time of a day, bad Human-Machine-Interfaces (HMI), organisational culture, safety awareness, fatigue, quality and quantity of personnel* and *quality of infrastructure*. The report '**Human factors root causes of accidents in inland navigation'** is available online[1]. One of the main findings of the study was that '*Human system integration is hardly being applied in the IWT sector. This leads to bad human-machine interfaces'*. Hence, there is an urgent need for more in-depth investigation into the Human-Machine Interface (HMI) in the wheelhouse.

The European inland shipping industry wants to use the study results to provide a practical, valuable input to contribute to the reduction and prevention of incidents and accidents in inland shipping. **This is very important for safety on board inland vessels, as well as for the image of inland shipping industry as a safe mode of transport.** The outcomes of the study should lead to

[1] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.ivr-eu.com/wp-content/uploads/2022/02/English_Article_Report_Phase_2b_Organisational-Aspects_updated.pdf

development and introduction of proper measures in future for prevention in inland navigation, such as **awareness campaigns**.

On 6 July 2021, the European Commission's services published the latest edition of the **Employment and Social Developments in Europe (ESDE) review[2].**

The main findings of the ESDE review are:

- Employment grew in jobs that are critical, can be carried out from home and require low social interaction;
- The geographical impact of the COVID-19 crisis has been uneven and may widen regional inequalities that already existed before the pandemic;
- The regions that proved to be more resilient to the shock of COVID-19 tend to share characteristics such as high regional productivity, high level of skilled population levels, big investment in research and development, quality local public institutions and solid digital infrastructure. Overall, well-performing labour markets proved to be better protected against the economic downturn;
- The impact of the crisis on national social dialogue and collective bargaining varied across EU countries;
- The decline in the EU employment rate was slightly higher for men than for women. However, the effect of the crisis on gender inequalities depends on various dimensions, and the pandemic highlighted long-standing gender inequalities;
- Teleworkers are satisfied with working from home when they receive the IT and other equipment they need to do their work, when they do not have to work considerably longer hours and when work does not interfere with family time.

1.4. Inventory of potential benefits and risks of increased onboard automation with the reduction and/or removal of onboard crew

In 2021, the Social & Education Committee was looking forward to finalise the roadmap of CESNI/QP/Crew and was hoping to start working on the new European Manning Regulation very soon. The Committee intended to involve the sector as closely as possible in all discussions in order to get the best results for practice and to provide feedback on crucial issues.

An important task was to develop the proposals in field of social security for an assignment to a social security system that would meet the interests of both employers and employees.

Keeping in mind the date of 17 January 2022, when the transposition deadline of the Professional Qualifications Directive ended, it was created a digital brochure informing the sector in detail about the European training standards, professional qualifications and various ways to obtain them, training and education opportunities in the EU Member States.

[2] https://ec.europa.eu/commission/presscorner/detail/en/ip_21_3384

The introduction of TGAIN on board inland navigation crafts should not jeopardise the health and safety of the vessel crew, not impair the vessel's integrity and safety, nor interfere with any other information and navigation systems.

The following major risks must always be kept in mind when using a TGAIN:

- Improper installation, maintenance and/or replacement
- Insufficient track accuracy due to traffic and water conditions
- Incorrect input of vessel data
- Gaps in GPS coverage, for example under bridges
- Human factors, such as distraction caused by administrative tasks or "on-board TV"

Personnel

Reducing crews and increasing shipboard automation have potentially negative effects on the crew, including **sensor over-reliance, decreased situational awareness**, and **increased complacency**, while providing no reduction in onboard duties or fatigue. Changes in navigational, manning, and liability regulation must be addressed by inland navigation authorities first. The shipping industry's mindset is slow to change, but with this inevitable technology, the inland navigation crew members will adapt.

Oongoing technical developments in terms of larger IN vessels and investments in IN vessels with new capacity mean a **need for extra personnel** in all areas of activity covered by inland navigation. In the long-term there is likely to be a slight increase in transport volume, here too implying an ongoing need for extra personnel.

Age Structure

The age structure is an important determining factor affecting future demand for workers in a given sector of industry. This is all the more relevant for inland navigation since its demographics are rather unfavourable when compared to other branches of industry.

In examining the age structure in IWT transport, there is a lack of comprehensive statistics. For example, in Germany and Belgium data are restricted to those workers paying into the social security, meaning most, though not all inland navigation employees are caught by the statistics.

For the Netherlands the reference parameter was statistics on holders of registers of service. The problem is that not all inland navigation employees active in the Netherlands have a Dutch register of service. This applies especially to Eastern European operators. In addition, some holders of registers of service are no longer active in the sector.

Significant differences exist in the age distribution of mobile workers and the self-employed. The aging problem is seen more clearly in the self-employed than in mobile workers who, in general, tend to be younger. The self-employed are usually also the boatmasters. The self-employed also stay longer in the IWT sector compared to the mobile workers, even after 65 years of age.

Foreign Personnel

A factor which has a key bearing on the future need for labour force in inland navigation is the participation of foreign personnel. On the one hand they are required to react to a sudden short-term need for employment. On the other hand, a consistently high or steadily increasing participation of foreign personnel may mean there is less incentive to organise training and ongoing education in inland navigation.

Various sources can be analysed in order to estimate the proportion of foreign personnel. For example, the data for Belgium are based on figures for Flanders provided by the Department for Labour and Social Affairs of the Flemish Government. Since Flanders accounts for the vast majority of employment in the Belgian inland navigation sector, these data are a very solid indicator for the country as a whole. For Germany the employment statistics of the Federal Labour Agency the Bundesagentur fur Arbeit yield information on workers covered by the social security system broken down by nationality and sector of the economy, including inland navigation. In the Netherlands the nationality of the personnel is recorded indirectly by the Ministry of Transport through the number of registers of service. Nonetheless, not all boatmasters are compelled to hold a Dutch register of service, especially if they hold a Rhine Patent.

Inland navigation personnel from Central and Eastern Europe such as Poland, the Czech Republic, Romania, Bulgaria and Hungary are at the forefront in Germany and this tallies with the estimates of the Federal Agency for the Transport of Goods, the Bundesamt fur Guterverkehr. Among the foreigners from outside the EU, the Turks take first place, followed by the Ukrainians and Asians – mainly from the Philippines - who play a great role in maritime navigation and inland navigation in the Netherlands.

For example, the number of foreign EU mobile workers in the IWT sector in the Netherlands and Germany has followed an increasing trend during the past years. A decline in the registered IWT employment in most of the Eastern European countries could partly be the result of the migration of Eastern European workers to Western Europe. In addition, as of 1 January 2014, a work permit for employees from the EU member States of Bulgaria and Romania was no longer required. This made it easier for Dutch companies to hire personnel from these countries.

Training and New Entrants

The organisation of training and the means of accessing work on an inland navigation vessel differ between the various countries and indeed within these countries which have different education systems.

These jobs are: **boatman, helmsman** and **boatmaster.**

The course to become a **boatman** is the basic training underpinning the other two stages. The course to become a **helmsman** requires further theoretical knowledge as well as practical experience in the tasks performed on an inland navigation vessel. As well as gaining a deeper grasp of nautical and technical aspects, the further training also demands knowledge of economics. The number of

graduates per annum is of especial interest for the labour market and is derived from estimates based on surveys carried out by the CCNR Secretariat among the school heads and course leaders.

In **Belgium** there are two schools of inland navigation, one for each part of the country: a ***vocational training college in Wallonia, in Huy*** near Liège where the pupils begin their training at age 15 and take their sailor's exam after two years. After a further two years they may take their boatmasters's exam. At 18 they must accumulate greater practical experience in order to take the exam to gain a Rhine Patent.

In ***the vocational school in Flanders*** training begins at age 12 and finishes at 18. In the first two years the emphasis is placed on core competences (maths, geography, languages, etc) and only later does the focus switch to skills specific to inland navigation (seamanship, nautics, technology, etc). After four years of training the student can take the boatman's exam and it is possible, after another two years, to take the helmsman's exam.

The sticking point is that many graduates fail to become boatmen since the job does not pay enough in Belgium.

In the **Netherlands** there are currently three schools providing training in the various inland navigation professions.

There are various paths to becoming a boatman in the Netherlands. One involves attending what is known as a "***secondary school***" lasting four years and ending at 16. For example, is the training unit in Harlingen where 200 pupils are learning to be boatmen. Only once they reach 16 do pupils familiarise themselves with the day-to-day tasks onboard ship.

The second path is provided by a ***vocational training college*** in IJmuiden attended from age 16 and lasting two years. This differs from a "secondary school" in that a twin-track approach is taken whereby the pupils actually work on a vessel during their course as well as attending theory classes.

Around 70% of the boatmen trained in Ijmuiden and Harlingen work in the navigation on the Rhine, 20% work in the ARA ports and 10% are employed exclusively in the Netherlands. Thereafter once further theoretical training and practical experience is acquired, the pupils can take the test to become a boatmaster and so be entitled to set up their own company.

Alongside the schools presented above, there is a central exam centre, the CBR Examencentrum in Rijswijk where anyone, regardless of the qualifications they have gained previously can take both the boatman and boatmaster's exam.

In **Germany**, the course to become a boatman lasts three years and follows the twin-track system. The requisites for promotion to boatmaster are to be at least 21, have at least four years' experience on an inland navigation vessel and to pass various patent exams at a waterways and navigation directorate.

Theory training takes place in the two ***inland navigation schools***: the Schifferberufskolleg Rhein in Duisburg or/and in the Berufsschule für Binnenschifffahrt in Schönebeck near Magdeburg.

Attractiveness of the IWT profession

The IWT sector attracts a growing but still limited number of young people with or without a family background in inland waterway transport. The main reason for **choosing a career in inland waterway** transport are **personal interest in the sector** and **idealism**. For most people the desire for an IWT career begins during their childhood. However, the **feeling of freedom**, the **wish to travel**, the **desire for adventure, a better paid job** and the **challenges of a career as an independent entrepreneur** are important factors.

Two main reasons can be distinguished as to why people **choose to continue a nautical career in the IWT sector**. A positive reason is that they **like the job and the life on board**. They **experience a high level of satisfaction**, whether as an independent entrepreneur or as an employee with a certain level of responsibility and a good salary.

2. PROPOSED STANDARDS OF COMPETENCE FOR IWT CREW MEMBERS AT ENTRY AND OPERATIONAL LEVELS ON REMOTE CONTROLLED VESSELS

A **deckhand** is a member of the deck crew and performs the entry-level functions. This means that he/she does not (yet) have the operational level qualification, because he/she does not yet have the navigation time required for the boatman qualification, and/or has not yet passed the examination required for the operational level.

Apprentices in inland navigation - similar to deckhands - work at the entry-level. In order to be able to take-up activities on board, both need a service record book, in which the qualification of deckhand and apprentice is entered. The apprentices can only get this position on board an inland navigation vessel if they follow an educational program to become an boatmen.

Further requirements for the qualification at the entry-level are set out in Annex I to the Directive.

The **deckhand or/and the apprentice** on a remote controlled vessel or remote assisted vessel need to have some level of understanding—basic knowledge about all the systems on-board, understanding control systems, be able to respond to alarms. They must know enough to help the boatmaster handle an emergency when things are not working anymore.

They should have the **ability to interact efficiently**. So, if something happens, then they will have to be able to handle/help the boatmaster handle the situation. They will need to **have technical insight** in knowing what is happening with the ship and its systems from the RCC, but also be able to locate where the problem is and whom they are going to call to solve any issues that arise.

They must have **a higher understanding of how computers and communications systems work**.

They must have a **basic level of knowledge of** aspects of the technical systems on board, including **navigation, communication and cargo handling**. They should have **good knowledge of control center systems, both the decision-making systems and the communication systems**.

They need to **know the rules of the waterway road, radar and/ or ECDIS functions**.

They should have **knowledge of seamanship** of how a rope is used for *berthing, anchoring operation and ship movements tension, anchoring and ship drifting with winds, currents and other environmental conditions*.

They should **understand the parameters of a particular propulsion system and how it operates**. Furthermore, a **basic understanding of the fire-fighting system** will also be required. They should **be able to recognize alarms** and understand what significance they have.

They should **have moderate IT knowledge** because if something breaks down, it will be the technology and they will know how to help re-establish the system.

The **boatman** is responsible for the **safe and efficient operation of vessels**. They are **responsible for navigation, operation of the craft, maintenance and repair of the vessel**, as well as **providing passengers and crew with a safe journey**.

2.1 Proposed Standards of Competences for IWT Crew Members at Entry level – deckhand/ apprentice

2.1.1. Non-technical competencies for operating levels 1 and 2 remote-controlled vessels

2.1.1.1. The deckhand or/and the apprentice on a remote controlled vessel shall be able to develop cognitive skills related to spatial orientation, critical thinking, and assertiveness

The deckhand and/or the apprentice on a remote controlled vessel shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. Demonstrate spatial orientation on board vessels – be able to identify own position, or the position of an object, in relation to the environment	1. have a good perception of the surroundings and comprehension of spatial arrangements; 2. ability to know where someone is in relation to their environment; 3. ability to tell where a specific object is in relation to him/her;

	4. ability to handle information relating to where one is coming from, where one is at a specific moment, where one is heading to, etc.
2. Critical thinking	1. ability to analyse, interpret evaluate and arrive at a solution to help solving the problem
3. Be proactive and ready to meet the IWT industry's modern-day demands.	1. ability to speak up about safety concerns, report incidents promptly, and take immediate action when needed.

2.1.1.2. The deckhand or/and the apprentice on a remote controlled vessel shall be able to have basic operational skills on how to use new technologies that have been accepted and validated by IWT authorities;

The deckhand/apprentice on a remote controlled vessel shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. Demonstrate basic knowledge of functions of modern electronic navigation aids	1. Understand the basic functions and operation of navigation aids. 2. Ability to understand the basic knowledge of operating principles, limitations and sources of error of navigation aids. 3. Ability to identify and use nautical sensors and indicators providing navigation information, e.g. (D) GPS, position, heading, course, speed, distance, depth, Inland ECDIS, radar. 4. Ability to understand and use River Information Services (RIS) and technologies, e.g. Inland AIS, Inland ECDIS, VHF, distance, depth, also in connection with radar. 5. Ability to report simple navigation information using modern electronic navigation aids

2.1.1.3. The deckhand or/and the apprentice on a remote controlled vessel shall be able to develop teamwork and work ethic skills.

The deckhand/apprentice on a remote controlled vessel shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. Demonstrate teamwork skills	1. Ability to work well with others to achieve common goals; 2. Ability to teamwork to accomplish assigned roles; 3. Ability to understand and demonstrate mutual trust and respect;
2. Demonstrate work ethic skills	1. Ability to comply with everyday programme and working schedules; 2. Ability to maintain focus and self-control; 3. Ability to show dedication and perseverance on the job to improve the speed and quality of work; 4. Ability to maintain standards of conduct and behaviour for a positive and motivated working environment;

2.1.1.4. The deckhand or/and the apprentice on a remote controlled vessel shall be able to develop communicative and communication skills (ask questions, share information, listen, and respond to concerns, give feedback**).**

The deckhand/apprentice on a remote controlled vessel shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. exchange information, ideas, and feelings effectively	1. Knowledge how to convey messages in a straightforward and understandable manner; 2. Ability to avoid unnecessary information and get to the point; 3. Ability to pay attention to the speaker and understand their message; 4. Ability to provide constructive responses and ensure mutual understanding;

	5. Ability to use body language, facial expressions, and tone of voice to complement verbal messages; and 6. Ability to adapt communication to different situations
1. communicate with harbour authorities or other vessels	1. Demonstrate basic knowledge of how to use technology, such as VHF, radio or satellite equipment, to relay messages between their vessel and other entities; 2. Ability to use the correct language and communication tactics; 3. Ability to report an incident or an accident

2.1.2. Navigation

2.1.2.1. The deckhand/apprentice shall be able to assist with steering, berthing and unberthing operations

The deckhand/apprentice on a remote controlled vessel shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. Assist with berthing and unberthing	1. Ability to assist with mooring equipment operations to secure the vessel during berthing and unberthing; 2. Ability to use ropes or wires to maintain the position of the vessel on arrival; 3. Ability to use ropes or wires to release the vessel on departure
2. attend to monitor water depth and assist with steering the vessel	1. Ability to attend to water depth monitoring equipment to ensure that the vessel sails through water of adequate depth; 2. Ability to help with steering the vessel;
3. Keep watch for obstacles in the water	1. Ability to keep watch toward the front of the vessel to identify dangerous obstacles; 2. Ability to locate obstacles and adjust the course of the vessel
4. assist the boatman and follow the boatmaster's	1. Ability to assist the boatman in his/her typical duties;

orders	2. Ability to use the listening skills to follow instructions; 3. Ability to perform the duties as required.

2.1.3. Cargo Handling

2.1.3.1. The deckhand/apprentice shall be able to assist with loading, securing and unloading cargo or equipment

The deckhand/apprentice on a remote controlled vessel shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. assist with loading and unloading cargo, equipment and/or passengers	1. Ability to assist with loading and unloading cargo, equipment, and/or passengers
2. assist with operation and securing cargo on deck	1. ability to help to move items around the ship; 2. ability to assist with securing cargo; 3. ability to assist with operation of the cargo handling equipment

2.1.4. Maintenance

2.1.4.1. The deckhand/apprentice shall be able to assist with the operation and maintenance of the equipment on board a vessel and the vessel itself.

The deckhand/apprentice on a remote controlled vessel shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. assist with maintenance of the equipment and tools	1. Ability to take care of the vessel's mechanical and structural components; 2. Ability to assist with performing scheduled maintenance to the equipment and tools; 3. Ability to assist with performing emergency repairs
2. assist with maintaining the vessel itself	1. Ability to perform scheduled cleaning to the vessel to maintain its condition and assist with ensuring a safe environment for the

	crew and/or passagers on board

2.1.5. Safety

2.1.5.1. The deckhand/apprentice shall be able to assist with ensuring the safety of cargo, crew members and/or passengers

The deckhand/apprentice on a remote controlled vessel shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. maintain the well-being of passengers on board and other crew members	1. Good understanding of safety procedures and regulations; 2. Ability to assist with regular patrol or carrying out an inspection of the vessel for hazards; 3. Ability to promote safety and security onboard
2. assist with safe state of cargo	1. Ability to assist with the safe state of cargo and report immediately and damage;

2.2. Proposed Standards of Competence for the Operational level - Boatman on a remote-controlled craft

2.2.1. Situational awareness

2.2.1.1. The boatman shall be able to perform operation and control of the on-board dynamic systems and functions.

2.2.1.1.1. Short-range situational awareness

The boatman on a remote controlled vessel shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. understand the external environment in close proximity to the vessel	1. Ability to recognize static objects: shoreline, bridges, locks, buoys etc.;

	2. Ability to correctly recognize dynamic objects: vessels, humans, mobile parts of infrastructure etc. 3. Ability to understand data related to the course, speed and current position of the vessel and others in the vicinity; 4. Ability to comprehend the current situation, form a mental picture of it that will help understand the voyage plan data, course deviation and vessel manoeuvrability; 5. Ability to monitor and use of all available means, senses and tools to project a possible outcome in the near future.
2. Safely avoid collision	1. Ability to observe traffic/police rules, collision avoidance, and passing waterway infrastructure safely; 2. Ability to monitor warning systems; 3. Ability to monitor mechanical sensors: data on engine, propeller, rudder, bow thruster etc., motion detector, bathymetry, computer (IMU/GPU components), centralized PLC system, engines, rudder, positioning systems (RADAR), inland ECDIS, systems for signalling position to other users (AIS, VHF); 4. Ability to use all the senses (hearing, sight, smell, taste, touch) all the time to stay alert to unexpected smells, vibrations, noises, and ship movements

2.2.1.1.2. Long-range situational awareness

The boatman on a remote controlled vessel shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. monitor the wider external environment surrounding the vessel	1, ability to locate vessel's position, speed, direction with respect to the wider external environment; 2. Ability to monitor vessels and infrastructure many kilometres ahead to pass them safely; 3. Ability to anticipate challenging turn; 4. Ability to chart course to estimate trajectory and estimated time of arrival (ETA); 5. Ability to signal vessel position, direction, and intentions to other

	waterway users by multiple channels: VHF, visuals, etc..

2.2.1.1.3. On-board situational awareness

The boatman on a remote controlled vessel shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. monitor the situation on board the vessel via the instruments.	1. Ability to monitor sensors in the wheelhouse, on the upper deck, in the engine room, and any other area of the vessel which could compromise its safety (fire, fuel leak, flooding etc.); 2. Ability to manually intervene in case of failure of sensors

2.2.2. Communication

2.2.2.1. The boatman shall be able to communicate generally and professionally, which includes the ability to use standardised communication phrases in situations with communication problems and use innovative communication systems/tools.

All competences for the able boatman listed in ES-QIN under 6. **Communication**:

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

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. should be included plus the following:

The boatman on a remote controlled vessel shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. use information and communication systems for vessel-vessel communication	1. Ability to communicate with a boatmaster onboard; 2. Ability to maintain communication with other waterway users; 3. Ability to use the vessel communication systems to contact the desired waterway users in a transparent manner (AIS, VHF, VHF

	Data Exchange System (VDES);
2. maintain communication between the RCC and the vessel	1. Ability to maintain communication between the RCC and the vessel, even through an internet connection complemented with a low-orbit satellite connection as back-up;
3. manually control automated communication systems in case of communications failure or malfunction	1. Ability to manually control an installed automated communication system in case of communications failure or malfunction
4. monitor and maintain vessel-shore communication	1. Ability to monitor sensors in the wheelhouse, on the upper deck, in the engine room, and any other area of the vessel which could compromise its safety (fire, fuel leak, flooding etc.); 2. Ability to manually intervene in case of failure of sensors
5. understand standardised communication signals	1. Ability to receive and interpret vocal signals from multiple users - with varying phrasing, accents, and voice patterns in English.

2.2.3. Cybersecurity

3.1. The boatman shall be able to identify, mitigate and prevent external cyber security threats and vulnerabilities, understand risk exposure, protection and detection measures, respond to and recover from cyber security threats

The boatman on a remote controlled vessel shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. recognize ICT technological components vulnerable to cyber security attacks	1. Demonstrate basic knowledge of ICT technological components vulnerable to cyberattacks, which could potentially lead to navigational mistakes and accidents;
2. identify cyber threats	1. Ability to understand the external cyber security threats to the vessel (Malware, Water holing, Scanning, Typosquatting, Denial of service, Phishing, etc). 2. Ability to understand the internal cyber security threat posed by inappropriate use and poor cyber security practices.;

3. identify cyber vulnerabilities	1. Ability to Identify the onboard systems with direct and indirect communications links (Cargo and loading management systems, Bridge systems, Propulsion and machinery management and power control systems, Communication systems, etc); 2. Ability to understand the consequences of a cyber security threat on onboard systems with direct and indirect communications links; 3. Ability to understand the capabilities and limitations of existing protection measures
4. understand risk exposure	1. Ability to understand the likelihood of vulnerabilities being exploited by external threats; 2. Ability to understand the likelihood of vulnerabilities being exposed by inappropriate use; 3. Ability to understand the security and safety impact of any individual or combination of vulnerabilities being exploited
5. Understand protection and detection measures	1. Ability yo understand how to detect, block and alert. intrusions and infections; 2. Ability to understand how to detect and address the presence of malware in systems onboard
6. Respond to and recover from cyber security incidents	1. Ability to respond to and recover from cyber security incidents using the contingency plan; 2. Ability to assess the impact of the effectiveness of the response plan and re-assess threats and vulnerabilities.

3. TRAINING AND EDUCATION

As technology is becoming more and more advanced the present education system cannot give IWT crew members deep knowledge of every component and when the components are getting more and more advanced, a more blended training methodology will be required in comparison to today. Training needs to focus more on how to use remote-controlled/autonomous solutions, its weaknesses and possible failures.
The **deckhand or/and the apprentice** should learn and familiarize with the whole vessel, and with the technology that enables it. They should have to know the emergency planning for both RCC and the vessel.

These aspects will also have to be trained besides, given the theoretical background. They need to be kept simple, but also at the same time, it needs to be safe. It is better to add a little bit extra in the beginning, and then it's easier just to take away some of it later.

Simulator Training
Simulator training can be very useful as it is more live training so that the trainee will be trained on the systems to learn about the hull of the ship, perform different operations on the full synthetic environment. Also, trainers/teachers can put scenarios & treat the accidents. Consequently, trainers/teachers can compensate for the lack of inland navigation experience through simulation and simulator experience. Multitasking abilities in a case of operational emergencies need to be assessed through defined IWT model courses.

Trainee period at RCC
Since the remote controlled/autonomous solution enables things to be moved to the shore, deckhands, apprentices and even the boatmen need the hands-on training at RCC so that they understand what's going on at RCC and what the connection with the IWT vessel is.

4. CONCLUSIONS

Currently, there is no formal structure and/or culture for permanent education in the inland navigation sector. Equipment and technology used on inland navigation vessels are getting more and more complex and innovative. Therefore, inland navigation companies are looking to hire more specialized and qualified crew members.

Built upon the results of previous projects (i.e. Danube SKILLS project, Prominent, PLATINA 3, etc.), the needed competencies and permanent adaptation of professional competencies of crew members, due to implementation of innovative technologies (zero emission operation, new fuels, new engines, new propulsion systems, semi-automated mooring etc.) and digitalization in the IWT sector, new skills and competencies for IWT crew members at entry level (i.e. deckhand and/or apprentice) and at operational level (i.e. boatman) needed for operating remote controlled vessels have been taken into account. This was made in order to support the work of CESNI, committed to regularly revise existing standards and to adopt new standards while following closely technical evolutions and supporting innovation, as a permanent priority and common objective of safe and sustainable inland navigation.

The technology will have to be robust enough to ensure the safety of people and systems as well as the environment. Once the technology eventually matures, the next step will be to provide a regulatory framework under which remote-controlled/ autonomous and unmanned IWT vessels can operate. Even with a sound regulatory framework in place, the operation of remote-controlled/ autonomous IWT vessels will be proven profitable in the long run before shipowners decide to invest in building and operating them. Similarly, it is only when the safety standards are met that regulators will give the go ahead for the operation and marketing of remote-controlled, autonomous and unmanned ships.

From the overall perspective of the stakeholders, the IWT industry will witness an evolution in training That is, training will first be administered by the technology providers or vendors. As different variants of the remote-controlled/autonomous technology emerge, training will be provided in E&T providers through workshops, seminars, practical training. Currently, IWT providers are aware that something might need to change, but their preparations are hindered by uncertainties in terms of infrastructures and competencies that they will need for training future IWT crew members working on remote controlled vessels. As a result, they can only speculate on the future skills that will be needed. Only when the remote-controlled/ autonomous ship technology matures, E&T providers will know the exact skills to be trained.