1System 4 IWT learning: upskilling pathways

- Skills gaps research and gaps in legislation implementation -

Methodology
for gradual implementation of automation in IWT

D 2.3

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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 2.3. "**Methodology for gradual implementation of automation in IWT**" presents the results of ***Task 2.1 "Report on legislation gap at EU and national level in the Rhine and Danube riparian countries and the needs and challenges for EU legislation implementation regarding permanent adaptation of professional competencies according to the implementation of innovative technologies and digitalization in IWT sector",*** i.e. a gap analysis of EU legislation implementation in the Rhine and Danube riparian countries in terms of newly adopted Directives (EU) 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 and ***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***.

This methodology for gradual implementation of automation in IWT is 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.

This deliverable builds upon latest information received from EDDINA and stakeholders' interviews as well as the outcomes of the CESNI.

LIST OF ABBREVIATIONS

AAWA	Advanced Autonomous Waterborne Applications Initiative
AF	Application Form
CCNR	Central Commission for the Navigation on the Rhine
CESNI	European Committee for drawing up standards in the field of inland navigation
CESNI/QP	European Committee for drawing up standards in the field of inland navigation/ Professional Qualification
CESNI/PT	European Committee for drawing up standards in the field of inland navigation/ Technical Provisions
CESNI/TI	European Committee for drawing up standards in the field of inland navigation/ Information Technology
DC	Danube Commission
DG- MOVE	Department for Mobility and Transport
EBU	European Barge Union
EC	European Commission
EDINNA	Education in Inland Navigation
ES-QIN	European Standards-Qualification in Inland Navigation
ES-RIS	European Standard for River Information Services
ES-TRIN	European standard establishing the technical requirements for inland navigation vessels
EU	European Union
E & T	Education & Training
IMO	International Maritime Organization
ISO	International Organization for Standardization
FP 7	Framework Programme for Research
IWT	Inland Waterway Transport
OL	Operational level
ML	Management level
MoU	Memorandum of Understanding
PLATINA	Platform for the implementation of a future inland navigation action programme
PP	Project Partner
RIS	River Information Services
RCC	Remote Control Centre
RCCO	Remote Control Centre Operator
VET	Vocational Education and Training

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1. INTRODUCTION

1.1 Objective

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.

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, 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 Methodology aims to present the increased adaptability of IWT sector to new EU and national legislation/ better adapted IWT and VET organizations to EU and national legislation, considering the Sustainable and Smart Mobility Strategy who sets out a roadmap for putting transport in the Union firmly on the right track for a sustainable and smart future.

The strategy recognises that changes in the transport sector, in particular those relating to **automation and digitalisation**, are creating many new challenges as well as opportunities for the transport workforce.

1.2 Definitions of automation and other keys terms

Today there is a global contamination in definitions with inconsistent and interchangeable usage of the words '***autonomous'*** and '***automated'***. Several definitions are possible to define ***autonomous*** as '*fully automated' vessels*. Most of them originate from robotics literature and are here rephrased to fit inland vessels. We may consider '***autonomous'*** as *a vessel that is able to decide for itself without human intervention* while '***automation'*** *still requires human decision making or monitoring and intervention*. Several authors have defined automation and autonomous according different stages of development with autonomous being the final stage. Autonomous suggests here a developed form of artificial intelligence, while automation still needs human monitoring to solve extraordinary events where programming is perhaps not adequate and where the human creativity is still far more superior than any AI that is developed so far.

Not much literature is found for inland navigation specifically. To define '***autonomous vessels'*** Alami et al .[1] (1998:316), stresses the ability of the machine, robot or in this case vessel, to carry out actions and to refine or modify the task and its own behaviour according to the current goal and execution

[1] Alami R, Chatila R, Fleury S, Ghallab M, Ingrand F. *An architecture for autonomy*. International Journal of Robotics Research. 1998;17(4):315–337

context of its task. Parasuraman R, Sheridan TB, Wickens CD[2] (2000) define ***autonomous vessels*** as "*Device or systems that accomplishes (partially or fully) a function that was previously, or conceivably could be, carried out (partially or fully) by a human operator*".

Bekey[3] (2005:1) states that "***Autonomy*** refers to *systems capable of operating in the real world environment without any form of external control for extended periods of time*." Frequently used definitions are derived from the levels of autonomy as described by Sheridan[4] which is a 10-point scale categorizing higher **levels of automation** as representing increased autonomy, and lower levels as decreased autonomy, as presented in the table below:

Level	Description of levels of automation
1	The computer offers no assistance; the human must take all decisions and actions before turning the job over to the computer to implement
2	The computer offers assistance in determining the options; the human must take all decisions and actions.
3	The computer helps determine the options and suggests one which human need not follow
4	The computer selects options and human may or may not do it
5	The computer selects action and implements it if human approves
6	The computer selects action, informs human in plenty of time to stop it
7	The computer does whole job and necessarily tells human what it did
8	The computer does whole job and tells human what it did only if human explicitly asks
9	The computer does whole job and tells human what it did and the computer decides he should be told.
10	The computer does whole job if it decides it should be done, and if so tells human, if computer decides he should be told

Table 1. ***Levels of Decision Making Automation by Sheridan***

Because of safety uncertainties, especially in the initial phase, it is necessary that the system must be capable of operating in multiple levels without reducing the overall safety performance. Also, if remote control fails, an unmanned ship needs reliable emergency procedures to dock automatically and in a safe way. At that moment of system failure the ship needs to be fully automated or even autonomous, if necessary with backup systems.

Wooldridge M, Jennings NR[5] define ***autonomy*** as "*agents operate without the direct intervention of humans or others, and have some kind of control over their actions and internal states*."

[2] Parasuraman R, Sheridan TB, Wickens CD (2000), *A model for types and levels of human interaction with automation*, IEEE Trans Syst Man Cybern A Syst Hum. 2000 May; 30(3):286-297

[3] Bekey GA. *Autonomous Robots: From Biological Inspiration to Implementation and Control*. Cambridge, MA: The MIT Press; 2005.

[4] *Levels of Decision Making Automation* by Sheridan TB, Verplank WL. (1978), Human and computer control of undersea teleoperators (Man-Machine Systems Laboratory Report) Cambridge: MIT, p.168-170 http://www.dtic.mil/dtic/tr/fulltext/u2/a057655.pdf

[5] Wooldridge M, Jennings NR. *Intelligent agents: Theory and practice*. Knowledge Engineering Review. 1995;10:115–152

Another relevant study is the Finnish Advanced Autonomous Waterborne Applications Initiative (AAWA) in collaboration with Rolls-Royce, which brought together universities, ship designers, equipment manufacturers and classification societies to explore economic, legal, social, regulatory and technological factors.

This review leads to the following definition for **automation**: *the process of a growing variety of organizational, operational, and/or technological innovation initiatives, that is aimed to increase support or even to replace human tasks by a device, (or machinery) or an integrated system that in the end will be able to conduct all human tasks (continuously and unconditionally) and is programmed to accomplish (partially or fully) a growing number of functions that were previously, or conceivably could be, only carried out (partially or fully) by a human*.

Automation is currently impacting the different modes of transport, be it air, sea, road and rail freight. As with maritime or road transport, recent technological developments to do with automated navigation come in for particular scrutiny by the inland navigation sector. National and international inland navigation research projects, such as LAESSI, RAVEN or NOVIMAR are attempting to innovate by developing more automated navigation. Beyond evaluating the technical capabilities and associated advantages/disadvantages, these innovative projects should enable actual experience to be acquired.

With automated navigation also being developed in the maritime sphere, the specific requirements of inland navigation also need to be taken into account, such as:

- crew composition,
- navigation in enclosed and confined surroundings,
- passage through locks,
- water depth and bridge clearances,
- IN craft manoeuvrability.

Furthermore, automated navigation will significantly change shipboard responsibilities, mainly the boat master's responsibility, thereby will contribute to the competitiveness, safety and sustainability of inland navigation.

'***Autonomous'*** is considered as a vessel that is able to decide for itself without human intervention while 'automation' still requires human decision making or monitoring and intervention.

A definition for ***automation*** needs to explain different levels of automation which can be found in the classification table of Lloyd's Register (2016) of ship autonomy levels (Table 2).

Level of autonomy	Description
AL 0) Manual – no automation function.	All action and decision making is performed manually – i.e. a human controls all actions at the ship level.
AL 1) On-ship decision support	All actions at the ship level are taken by a human operator, but a decision support tool can present options or otherwise influence the actions chosen
AL 2) On and off-ship	All actions at the ship level taken by human operator on board the

decision support	vessel, but decision support tool can present options or otherwise influence the actions chosen.
AL 3) 'Active' human in the loop	Decisions and actions at the ship level are performed autonomously with human supervision. High impact decisions are implemented in a way to give human operators the opportunity to intercede and over-ride them. Data may be provided by systems on or off the ship
AL 4) Human on the loop – operator/ supervisory	Decisions and actions are performed autonomously with human supervision. High impact decisions are implemented in a way to give human operators the opportunity to intercede and over-ride them.
AL 5) High automation	Unsupervised or rarely supervised operation where decisions are made and actioned by the system
AL 6) Full automation	Unsupervised operation where decisions are made and actioned by the system

Table 2: *Classification table of ship autonomy levels*[6]

The following schematic (Table 3) is based on the identified stages of the conceptual autonomous vessel as described in the MUNIN project and shows a comparable evolution as the classification by Lloyd's Register.

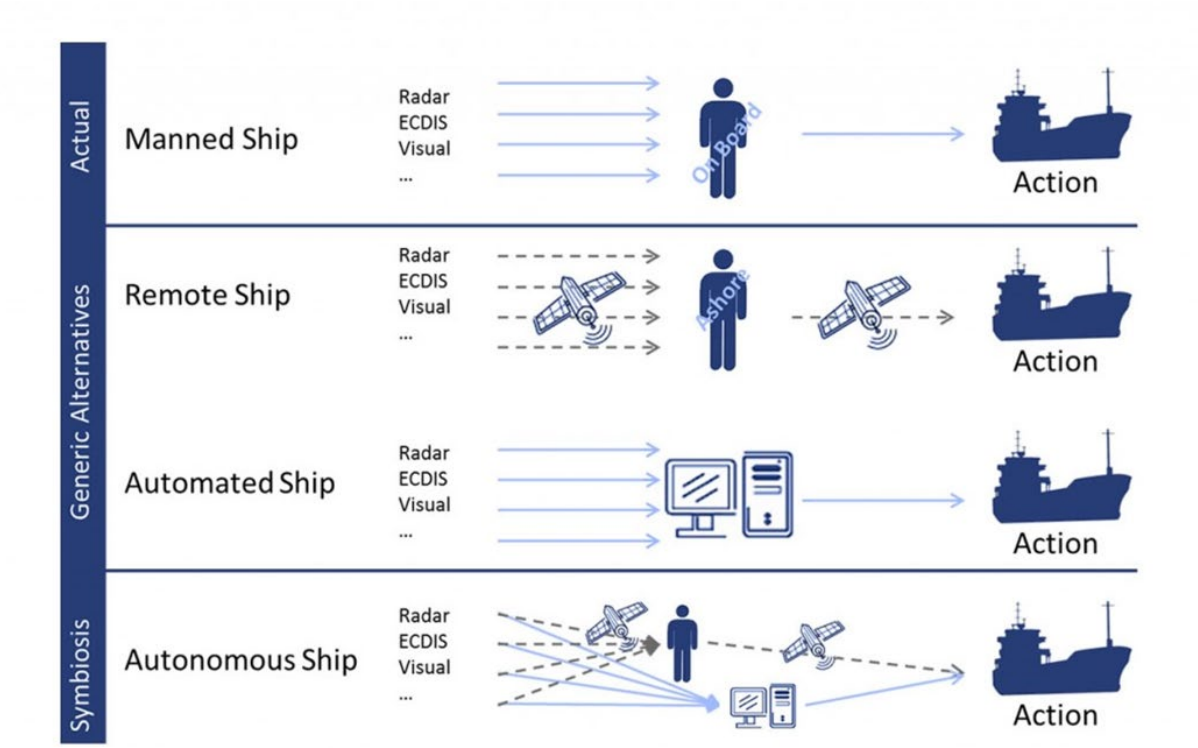

Table 3: *Autonomy stages adjusted from MUNIN 78*[7]

[6] Lloyd's Register (2016) Cyber-enabled ships, ShipRight procedure – autonomous ships, first edition, July 2016, A Lloyd's Register guidance document, p.2

[7] http://www.unmanned-ship.org/munin/about/the-autonomus-ship/

However, this has at least one problem:
1. An adaptive controller, e.g. an autopilot that adjusts its control laws to adjust for variance in the weather or the ship's loading condition, must it be defined as autonomous, as it certainly seems to be more than automatic?

The **IMO**, in the course of a recent regulatory scoping study of potential changes to regulatory requirements arising from this[8], divided MASSs (Maritime Autonomous Surface Ships) into four categories (referred to as "degrees"):

Degree	Level of autonomy	Description
Degree One	**Ship with automated processes and decision support**	Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated and at times be unsupervised but with seafarers on board ready to take control
Degree Two	**Remotely controlled ship with seafarers on board**	The ship is controlled and operated from another location. Seafarers are available on board to take control and to operate the shipboard systems and functions
Degree Three	**Remotely controlled ship without seafarers on board**	The ship is controlled and operated from another location. There are no seafarers on board
Degree Four	**Fully autonomous ship**	The operating system of the ship is able to make decisions and determine actions by itself

Table 4. *Autonomy degrees according to IMO*

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)*

Automation level and maximum level of automation
An automated craft may achieve different levels of automation during its voyage. "Maximum level of automation" is understood as the maximum level an automated craft can achieved 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.

[8] Published on June 3 2021 and available here: MSC.1-Circ.1638 - *Outcome Of The Regulatory Scoping Exercise For The Use Of Maritime Autonomous Surface Ships*... (Secretariat).pdf (imo.org) (last tested on 1 November 2021).

Remote control in relation to automated navigation

A priori, the remote control and monitoring of crafts is independent of a craft's level of automation.
Full automation means "*the sustained and unconditional performance by an automated navigation system of all dynamic navigation tasks and fallback performance, without expecting a boatmaster responding to a request to intervene*".

Remote control means that 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.

According to the Commission Recommendation (EU) 2024/236 of 29 November 2023 on means to address the impact of automation and digitalisation on the transport workforce, **automation** is part of a broader notion of digitalisation and is defined as 'the replacement of human input, in full or in part, by machine or software input. The broader notion of **digitalisation** is defined as '*the integration of digital technologies and digitised data into all aspects of life*'. Rather than replacing human input in full or in part, digitalisation therefore means the use of digital tools in the workplace.

Automation levels proposed by CCNR[9]

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, CCNR proposed for discussion the definitions of automation levels which are given in Table 5 below.

Although technology synergies are expected with the maritime sector, the CCNR considers that inland navigation has its own specificities that should be taken into account such as the composition of the crews, enclosed and restricted navigation, the passage of the locks, the height of water and bridges and some other features. This definition of levels of automation for inland navigation vessels is currently being finalised within CCNR bodies and its adoption was in December 2018.

[9] https://unece.org/DAM/trans/doc/2018/sc3/ECE-TRANS-SC3-2018-inf_06e.pdf

	Level	Designation	Vessel command (steering, propulsion, wheelhouse, …)	Monitoring of and responding to navigational environment	Fallback performance of dynamic navigation tasks
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 enhanced by warning or intervention systems *E.g. navigation with support of radar installation*			
	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			
	4	**High automation** the sustained context-specific performance by a navigation automation system of all dynamic navigation tasks and fallback operation, 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	**Full automation** the sustained and unconditional performance by a navigation automation system of all dynamic navigation tasks and fallback operation, without expecting a human boatmaster will respond to a request to intervene			

Table 5. *Automation levels proposed by CCNR*

1.3 Methodology: a step-by-step approach/roadmap

The methodological framework provides an overview of preconditions that are essential to a smooth transition (namely awareness of the social dimension; identification of future skills needs; constructive social dialogue; enabling legislative environment; positive attitude towards change) and enablers that will contribute to facilitate the transition.

Labour market developments will not only be influenced by technology, including its cost and acceptance, but also by other factors, such as globalisation, demographic change, the green transition, economic and other social trends, and the regulatory environment. In addition, the pace of automation will vary across countries and regions, modes of transport, types of occupation, and skills and competences.

2. GENERAL CONTEXT

Automation is an ongoing development that has already changed the inland waterway transport sector (IWT) fundamentally. Automated navigation and smart shipping have been a key focus of the inland water transport sector for several years now. It is highly desired by shipping companies as potentially beneficial for navigation safety and reliability, and as an option to resolve a growing shortage of the staff in the sector.

Nowadays, automated navigation covers a very wide range of technical solutions and use cases – ranging from simple navigation assistance to fully automated navigation.

Automated maritime or inland waterways feeder services are seen as the most promising applications where the feasibility and commercialisation of automated shipping can be proven. In particular, an autonomous waterborne feeder loop or shuttle service providing regular reliable, resilient and integrated supplies of freight with an ambition of zero emissions is likely to have many applications.

Autonomous waterborne feeder services are expected to disrupt logistics, remove freight from congested land infrastructures, increase safety by reducing the human factor in accidents and incidents, and make transport climate neutral.

Progressive automation, seen in numerous technical applications, including inland navigation, has increasingly important implications, which require changes to the existing social and legal frameworks.

Automated navigation now covers a wide spectrum of technical processes and there are numerous use cases, ranging from simple assistance to fully automatic navigation. The level of automation is therefore the variable that offers the best understanding of the concept of automation.

In principle, automating certain tasks makes for the potential replacement of man by machine. In inland navigation, automation does indeed make life easier for boatmen by lightening the load on the boatmaster, but also raises questions about maintaining safety levels and possible concerns about its scope, namely the level of automation.

The CCNR therefore started by defining levels of automation with a view to increasing prevalence of automation in inland navigation and to understanding the opportunity for adopting regulatory measures.

2.1 Policy and regulatory context

2.1.1 EU policy, strategies, programmes, recommendations

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 focused 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.

It was mentioned that the added value of autonomous shipping at a pan-European level would be a **harmonized approach and exchanges of best practices; fostering of innovations; making the sector more competitive and attractive; ensuring navigation safety and enhancing mobility** and the priorities and next steps for the development of autonomous shipping on inland waterways were: (**a) research and development in automated technology; pilot projects and tests; (b) development of the legislative base; (c) dissemination of information;** and **(d) development of insurance policies,** as well as, **international cooperation** for developing this concept.

On 17 October 2018, the inland navigation Ministers of the five CCNR Member States (Belgium, France, Germany, the Netherlands, Switzerland) adopted the **Mannheim Declaration** and called, inter alia, for the "*development of digitalisation, automation and other modern technologies in order to contribute to the competitiveness, safety and sustainable development of inland navigation*".

Sustainable and Smart Mobility Strategy 2020
The Commission has therefore proposed a strategy outlining how it wants 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** aims to make the digital transformation work for people and businesses, while helping to achieve its target of a climate-neutral Europe by 2050. The Digital Strategy sets a new vision, addressing digital transformation opportunities of a post-pandemic scenario, supporting the harmonised development of automated navigation via a holistic and technologically neutral approach and the delivery of the EU's strategic priorities by 2030.

The **Digital Decade policy programme 2030** has established digital targets, including for a digitally skilled population and highly skilled digital professionals, as well as for the digital transformation of businesses.

Digital Education Action Plan 2021-2027 (29) is to enhance digital skills and competences for the digital transformation, including by promoting high quality and inclusive computing education from an early age, and by encouraging women's participation in STEM- Science, Technology, Engineering and Mathematics. This could help, in the long term, address the difficulties faced by employers to recruit highly skilled workers, including in the transport sector.

The Digital Education Action Plan (2021-2027) Resetting education and training for the digital age, 2020 is a renewed European Union (EU) policy initiative that sets out a common vision of high-quality, inclusive and accessible digital education in Europe, and aims to support the adaptation of the education and training systems of Member States to the digital age.
The Action Plan, adopted on 30 September 2020, is a call for greater cooperation at European level

on digital education to address the challenges and opportunities of the COVID-19 pandemic, and to present opportunities for the education and training community (teachers, students), policy makers, academia and researchers on national, EU and international level.

The European Skills Agenda, 2020 supports the acquisition of skills for the green and digital transitions. One of its flagship actions is the Pact for Skills, which aims to strengthen collective action on skills development through partnerships.
The European Skills Agenda is a five-year plan to help individuals and businesses develop more and better skills and to put them to use, by:

- strengthening sustainable competitiveness, as set out in the European Green Deal;
- ensuring social fairness, putting into practice the first principle of the European Pillar of Social Rights: access to education, training and lifelong learning for everybody, everywhere in the EU;
- building resilience to react to crises, based on the lessons learnt during the COVID-19 pandemic.

Commission Recommendation (EU) 2024/236 of 29 November 2023 on means to address the impact of automation and digitalisation on the transport workforce
The transport sector has been identified as one of the sectors where the implementation of the European Green Deal (as well as relevant national strategies) will require new skills and labour, and where the skilled workforce is already scarce. In addition to shortages linked to the shift towards renewable energy sources and sustainable and energy efficient materials, products and modes of transport, significant labour shortages are already very visible in certain transport occupations.
Digital tools driven by artificial intelligence (AI) can also help with identifying future skills needs and gaps at national level and help individuals to identify future career paths and learning opportunities. These tools, which are already being piloted by some public employment services (28), can also offer opportunities for more systemic solutions across sectors.

The Council Recommendation of 16 June 2022 on a European approach to micro credentials for lifelong learning and employability asks Member States to put in place legal frameworks that facilitate records of learning outcomes (for example certificate or award) from small learning experiences (for example short online courses).

Last, but not least, 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. 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 is a system for automatically steering a craft along a predefined track, the purpose of this system being to support the operator and reduce his workload when steering the craft (CESNI, 2023). It is based on Grade 1 or 2 of the international definition of levels (see table 5) of automation, which means that the operator remains responsible at all times for the control of the craft, including track adjustment to avoid collisions (CESNI, 2023).

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.

2.1.2. CCNR vision

Summary of the CCNR's vision to support the harmonised development of automated navigation

CCNR has begun an analysis of its regulatory framework as well as discussing questions of principles for amendments that are necessary. The objective is to allow a proper implementation of automation in light of safety and sustainability. These questions of principle are not easily answered, but the answers are needed to form the basis for consensus between countries and for writing new or amending existing regulations. This regulatory work mostly concerns the rules for navigation and operation of the vessels.

Building on the current state of the art and on-going activities, proposals should address all of the following points in line with the expected outcomes above: develop an autonomous waterborne freight feeder loop service for inland or maritime transport suitable for specific commercial applications and which can provide an integrated, reliable, resilient, predicable fully automated service with a preference for zero GHG and pollutant emissions as well as supporting safer navigation (e.g. manoeuvring, situational awareness, collision avoidance, failsafe operations). Feeder service is to be understood to include Ro-Ro services.

As automation implies a fundamental change for inland navigation and will affect almost all aspects of inland navigation, the CCNR therefore takes a global approach, taking account of legal, ethical and social aspects.

With this in mind, the CCNR has drawn up a detailed Vision as an instrument for steering and coordinating the work to be carried out in the period 2022 to 2028 and beyond within the various committees.

The objective is to allow a proper implementation of automation in light of safety and sustainability.

Automation implies a fundamental change for inland navigation and will affect almost all aspects of inland navigation. The CCNR therefore takes a global approach, taking account of legal, ethical and social aspects. Automated navigation is indeed a challenge, as it involves the safe coexistence of automated vessels and "conventional" vessels.

Furthermore, this automated navigation will have to be integrated into the existing context of Rhine navigation. Similarly, automated navigation will have to be adapted to the existing physical infrastructure, which is likely to require the provision of additional information.

As a first step in fostering this development, the CCNR will create a framework for the authorisation of pilot projects which require temporary derogations from CCNR regulations. The aim of these pilot projects is to gather experience and to take this into account in future work on adapting the CCNR regulations. The CCNR also hopes that the procedure developed for authorising such projects will inspire its member states to examine projects on their national waterways or transnational projects and thus contribute to harmonisation on an international scale.

In order to face the specific challenges posed by automated navigation, the CCNR has revived its Small Navigation Committee (RN), originally established to tackle and coordinate innovative and cross-sectoral developments in Rhine navigation.

The Small Navigation Committee will process applications for approval of pilot projects and, in close collaboration with the other committees concerned, will direct and coordinate all work related to automated navigation.

Given the cross-sectoral nature of automation, the CCNR considers it necessary to develop simultaneously the requirements for the operation of vessels, the training of personnel and the composition of crews, as well as the technical requirements for vessels and those relating to information technology and liability. To this end, the CCNR will update its own regulations and also propose to the European Committee for drawing up Standards in the field of Inland Navigation (CESNI) the development of any standards it deems necessary to ensure the safety of navigation and to allow the harmonisation of regulations on a European scale. The CCNR has already made a start on the work required, in the knowledge that regulations to ensure the safety of navigation will also contribute to greater legal certainty for investments.

During its plenary session in December 2018, the CCNR adopted the first international definition of the various levels of automation in inland navigation. The CCNR believes that this definition will need to be amended to take account of new developments, and a revision of the definition is already planned. These different levels of automation offer a good starting point for the prioritisation of work. In the short term, 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.

With this in mind, the CCNR has drawn up this vision as an instrument for directing and coordinating the work to be carried out in the period 2022 to 2028 and beyond.

2.1.3. The International Maritime Organization and related developments

Technological innovation within the maritime industry is resulting in rapid developments that will see the commercial use of autonomous ships, whether they are controlled remotely or are fully autonomous. Such change requires robust regulation to ensure the safety of life at sea, as well as of cargo on board and of the vessel itself.
IMO aims to integrate new and advancing technologies in its regulatory framework - balancing the benefits derived from new and advancing technologies against safety and security concerns, the impact on the environment and on international trade facilitation, the potential costs to the industry, and their impact on personnel, both on board and ashore. IMO wants to ensure that the regulatory framework for Maritime Autonomous Surface Ships (MASS) keeps pace with technological developments that are rapidly evolving.

In 2021 IMO conducted a regulatory scoping exercise on Maritime Autonomous Surface Ships that was designed to assess existing IMO instruments to see how they might apply to ships that utilize varying degrees of automation. The regulatory scoping exercise (RSE) for safety treaties was finalized at the 103rd Session of the MSC in May 2021, and for treaties under the purview of the Legal Committee, at its 108th session in July 2021. The FAL Committee approved the outcome of the RSE of treaties under its remit at FAL 46 in May 2022.

Following the completion of the scoping exercise and work begun during the MSC's 105th session, the Committee's 107th session in June 2023 made further progress on the development of a goal-based instrument regulating the operation of maritime autonomous surface ships.

A MASS Working Group was established to progress the work on the MASS Code and to identify issues relevant to instruments under the purview of the Legal and Facilitation Committee. These will be considered by the Joint MSC/LEG/FAL Working Group on MASS.

The aim is to adopt a non-mandatory goal-based MASS Code to take effect in 2025, which will form the basis for a mandatory goal-based MASS Code, expected to enter into force on 1 January 2028.

The Joint MSC/LEG/FAL Working Group on MASS had developed a table – intended as a living document – to identify preferred options for addressing common issues, such as the role, responsibilities competencies required of the master and crew for MASS; and identification and meaning of term "remote operator" and their responsibilities.

As regarding the competences, one recent example is the European Maritime Safety Agency’s study on competences for operators of maritime autonomous surface ships from remote control centres, published in 2023.

2.2 Relevant outputs of European research projects

Many national and international research and pilot projects are pursuing innovation by developing higher level automation applications for inland navigation. Gaining experience with such applications is critical for the evaluation of technical solutions and expected advantages.

In 2018, the CCNR adopted an initial international definition of levels of automation in inland navigation (Resolution 2018-II-16) and charged its Police Regulations Committee to monitor developments in automated navigation (from navigation assistance to fully automated navigation) and consider the possible need for regulatory measures.

The CCNR Secretariat published a list of the relevant national and international of projects including the assessment of the specific level of automation. The inventory is available on: https://automation.ccr-zkr.org .

PLATINA 3 2021-2023[10]**.** The EU-funded PLATINA3 project will provide for targeted coordination and support activities to promote inland waterway transport (IWT) in Europe. Starting from January 2021, the project will run for 30 months. In this period the project will make the bridge towards future research, innovation and implementation needs within IWT in Europe.

The main objective is to provide the knowledge base for the implementation of the EU Green Deal in view of further development of the European Commissions' IWT action programme (NAIADES) towards 2030. The platform will be a catalyst for awareness, stakeholder engagement and uptake of outcomes from related national and European projects and initiatives. PLATINA3 will consolidate their findings, assess their impacts and gaps.

The outputs of this project are:

- Report on required competence for operation of vessels with zero or low emission D 3.1-2021
- Report on competences needed to operate on board systems allowing for automation of inland navigation vessels D3.3
- Report on required content and options to establish training and refresher classes for automated vessel operation D3.4

The European research project SKILLFUL 2016-2020[11] has identified the jobs and positions that are expected to be most affected by the present and future changes and developments of the European transportation system. Amongst the transport jobs that are likely to change are drivers, manual operators, ticket issuers and controllers, logistic centre staff, security controllers, and booking clerks and travel agents. Amongst those that are expected to become more relevant are logistics managers, logistics operators at terminals and delivery dispatchers, experts on artificial intelligence, digital transformation, big data, security and cybersecurity experts, legal services personnel and privacy protection specialists, and automated vehicle and drone operators.

[10] https://platina3.eu/competences-for-on-board-systems-allowing-for-automation

[11] www.skilfullproject.eu

The outputs of the project are:

- Future scenarios on skills and competences required by the Transport sector in the short, mid and long-term- Deliverable D 1.1
- Best practice on current and emerging training schemes, methodologies and tools in the transport sector and mapping to future training requirements and scenarios- Deliverable D 2.1

The European research project WE-TRANSFORM[12], 2020-2023

As new technologies and digital infrastructures transform the mobility sector, local authorities, operators and manufacturers require updated and fresh labour skills. From road transport to aviation and shipping, automation is rapidly changing the face of mobility. It is essential that policy making keeps apace of these shifts, encouraging and facilitating the adaptions required.

The outputs of WE-TRANSFORM project are:

- **Report on co-creation of knowledge**- Deliverable D 3.3 - analyzes the results of the discovery, discussion, formulation and ranking of a list of actions to address barriers, gaps and locate opportunities in relation to the impact of automation and digitalisation on the workforce.

- **Shaping the Skills Needed for the Future of Automated Mobility**- article by Laura Galante- Horizon Futures Watch magazine, 2023. In the fast-moving realm of mobility, one fact stands out: the road to success requires new skills. To meet evolving customer needs, embrace cutting-edge technologies, and fulfil environmental commitments, the transport sector is turning to automation for sustainable, cost-effective, and inclusive mobility solutions.

However, the interplay between automation, reskilling, and sustainability is more complex than meets the eye.

Other EU projects related to automation and digitalisation in inland navigation are:

LAESSI[13] - "*Guidance and assistance system for increasing the safety of navigation on inland waterways*" - deals with advanced assistance system with 4 features:

• The bridge collision warning system provides timely warning to the vessel's master in the event of a problem when passing beneath a bridge.
• The berthing assistant displays distance measurements and calculations relative to the quayside or other vessels, thereby assisting the boatmaster during a difficult berthing manoeuvre.
• The track control assistant assists the boatmaster by maintaining the vessel on a predetermined track when travelling through a sector.
• The control screen permanently displays all the vessel's movements, the rudder position and speed of the propeller.

[12] https://wetransform-project.eu/
[13] https://www.innovative-navigation.de

Shipping Technology (Shipping factory / Xomnia)[14] – deals with the use of (existing) nautical equipment for collecting on-board data and building a predictive model to enable automated navigation based on artificial intelligence (AI), a Black Box Pro which collects all the data from nautical systems such as radar, pilot, motor management, and GPS, and stores it in the Cloud. + storage of camera images and mariphone.

NOVIMAR[15] – deals with the reorganisation of navigation with ship trains (platooning): 1 lead vessel + accompanying vessels (remotely controlled and with a reduced crew). Areas of research interest are: business concept of the vessel train, waterborne transport system, composition and design of the vessel train, navigating and manoeuvring the vessel train, human factor, waterway infrastructure and operations, safety, regulations.

SEAFAR[16] – demonstrates the importance of inland barges being equipped with sensors for automated navigation on a predetermined course, taking account of the environment.

Captain AI[17] – develops a safe and fully autonomous shipping solution using high-fidelity simulation, cutting-edge sensors and state-of-the-art deep learning techniques.

Remote Control Tug[18] - Kotug can remotely control the RT Borkum. Studies the possibility of unmanned towing.

AURIS (*AUtonomous Remotely monitored Innovative Ship*) - The objective of this project is to research which sensors and analysis methods are required to achieve optimal situational awareness of the marine environment from a ship, and to interface an (autonomous) vessel with a Shore Control Centre. This will be done by developing and testing a modular intelligent situational awareness module (ISAM) on a 6m rigid-hulled inflatable boat.

AUTOSHIP[19] (*Autonomous Shipping Initiative for European Waters*) – is an EU funded (Horizon 2020) project aimed to test an unmanned vessel on Flemish inland waterways; the project began in June 2019 and ended in December 2022. The project speeded-up development of the Next Generation of Autonomous Ships with the technology package including for example autonomous navigation, situational awareness, remote monitoring, electronic route exchange, as well as communication technology enabling a prominent level of cyber security and integrating the vessel into upgraded e-infrastructure. In parallel, digital tools and methodologies for design, simulation and cost analysis were developed for the whole community of autonomous ships.

[14] (https://shippingtechnology.com
[15] https://novimar.eu
[16] https://www.seafar.eu
[17] https://www.captainai.com
[18] https://www.kotug.com
[19] (https://www.autoship-project.eu

SELECT[20] - *Smart decision-making support for inland navigation logistics chains based on ETA forecasts* - aims to develop an IT system for port operators and shipping companies that automatically and dynamically forecasts inland navigation vessel transport processes and thus their arrival times (ETA) at both inland and seaports and which, based on this, at system level, generates situationally specific recommendations for action for waterborne transport and port transshipments, and enables this information to be exchanged digitally between the players.

AutoBin[21] - *Autonomous inland navigation vessel – simulation and demonstration of automated driving in inland navigation* - will entail equipping an inland navigation vessel with all the necessary sensor and actuator technology. A first stage will see an artificial intelligence-based control system in a simulator developed through machine learning to the point of being able to steer the inland navigation vessel safely from a departure point to a destination having regard to the traffic situation and rules of the road. Learning in the simulator is followed by the testing and demonstration of the control system fitted in the inland navigation vessel on a preselected test stretch.

The Artificial Intelligence Strategy adopted by Germany included an action plan aimed to foster automated inland water transport, establish testing areas for smart shipping and digitalization and various autonomous shipping projects.

However, the practical implementation of automated navigation has not been sufficiently explored. To ensure this, the legal framework must evolve along with any technological developments, and lack of efforts must not hinder the use of new technologies. International coordination and agreement are particularly important for transboundary inland and international waterways. Furthermore, member States emphasized that more attention should be paid to the coastal infrastructure with a view to justifying the significant costs required for its upgrading. All working stages should be defined in a balanced manner and duly planned.

2.3 Relevant national regulations

ROMANIA
Ministry of Transport Order No.544/2009 for the modification of Ministry of Transport Order No.1447/2009 for the approval of technical requirements for inland navigation vessels, which transposes the EU Directive 2016/1629

Ministry of Transport Order No. 1057/2007 on the harmonisation of Romanian River Information Services (RIS) with those from EU, which transposes the EU Directive 2005/44/CE on harmonised river information services (RIS) on inland waterways in the Community.

EU Directive 2016/1629 https://eur-lex.europa.eu/legal-content/EN/NIM/?uri=CELEX:32016L1629
EU Directive 2005/44/CE https://eur-lex.europa.eu/legal-content/EN/NIM/?uri=CELEX:32005L0044

[20] https://www.tu.berlin/en/logistik/research/research-work/completed-research-projects/select
[21] https://www.uni-due.de/mechatronik/forschung/autobin_en

GERMANY

On the website of the EU Directive 2016/1629 for information regarding the national transposition in Germany, 17 (seventeen) measures appear, as follows:

- Saxony Shipping Regulation 2004-04-08
- Regulation amending the Saxony Shipping Regulation 2014-08-30;
- Regulation on maritime safety in inland navigation and amending other maritime legislation 2018-10-05;
- Sixth Regulation extending the period of application and amending legislation in the area of Ministerium für Wirtschaft, Energie, Transport and Land development, 2018-10-15;
- Provincial Regulation amending the Landesbinnensuntersuchungsverordnung 2018-10-25;
- Ordinance on the conduct of navigation in the waters and ports of Saxony-Anhalt (Landesschifffahrts- und Hafenverordnung – LSchiffHVO) 2018-11-09;
- Act amending the Bremen Act on Maritime Safety in Inland Navigation 2018-12-21;
- Regional act on the collection, delivery and acceptance of Waste from inland waterway and maritime shipping and amending the Regional Circular Economy Act and other waste legislation 2018-12-27;
- First Regulation amending the Water Transport Regulation 2019-01-18;
- Regulation of Lower Saxony on requirements for inland waterway vessels 2019-01-29;
- Regulation amending the Bavarian Port and Shipping Inspection Regulation (BayLHafSchUO) *2019-03-14* ;
- Fifth Regulation amending the Land Navigation Regulation Berlin 2019-03-19;
- Ordinance the adoption of a mooring ordinance and amending port and shipping legislation 2019-05-07;
- First Regulation amending the Thuringia Regulation regulating navigation 2019-06-07;
- Regulation amending the Land Navigation Ordinance 2019-10-01;
- Act amending the Water Association Acts due to the coronavirus pandemic 2020-06-02
- North Rhine-Westphalia Water Act (as amended by law amending the Water Association Acts due to the coronavirus pandemic) 2020-06-02

On the website of the EU Directive 2005/44/CE no information regarding the national transposition in Germany, 0 (zero) measures appear.

THE NETHERLANDS

On the website of the EU Directive 2016/1629 for information regarding the national transposition in the Netherlands, 1 (one) measure appears:

- Regulation of the Minister for Infrastructure and Water Management, of 7 September 2018, No IENW/BSK-2018/156621, amending the Inland Waterways Regulation in connection with the implementation of Directive (EU) 2016/1629 laying down technical requirements for inland waterway vessels, amending Directive 2009/100/EC and repealing Directive 2006/87/EC and implementing Protocols 2017-II-15 and 2017-II-20 of the Central Commission for Navigation on the Rhine adopted on 7 December 2017 and remedying certain omissions

On the website of the EU Directive 2005/44/CE for information regarding the national transposition in the Netherlands, 6 (six) measures appear:

- Law of 21 July 2007 amending the Maritime Traffic Act in relation to the implementation of

Directive 2005/44/EC of the European Parliament and the Council of the European Union of 7 September 2005 on harmonised river information Services (RIS) on inland waterways in the Community (OJ L 255);

- Order of the State Secretary of Traffic and Water Management designation of competent authority and the provision of data with relating to shipping in link with the Data Decree shipping 2007 (Provision Regulation) shipping data 2007);
- Decision of 2 October 2007 on determination of the time of entry into force of the Law of 21 July 2007, amending the Maritime Traffic Act in relation to the implementation of Directive 2005/44/EC of the European Parliament and the Council of the European Union of 7 September 2005 on harmonised river information Services (RIS) on inland waterways in the Community (OJ L 255) (Stb. (287);
- Decree of 2 October 2007 laying down rules concerning reception, storage and provision of data relating to the shipping by organisations and persons who: not engaged in maritime traffic, and with regard to the implementation of River Information services on inland waterways (Decree on shipping data 2007);
- Decree of 4 May 2012 laying down rules for shipping on reporting formalities and on the processing of data received by organisations and persons not engaged in maritime traffic (Decree on reporting formalities and data processing of shipping);
- Regulation of the Minister for Infrastructure and the Environment, of 27 April 2012, No IENM/BSK-2012/60134, laying down detailed rules for shipping and organisations and persons not engaged in maritime traffic as regards notifications and communications (Regulation on Notifications and Communications of Shipping).

AUSTRIA

On the website of the EU Directive 2016/1629 for information regarding the national transposition in Austria, 2 (two) measures appear:

- Marine Engineering Regulation (2018-10-03), and
- Amendment of the Ship Engineering Ordinance (2019-10-11)

On the website of the EU Directive 2005/44/CE for information regarding the national transposition in Austria, 1 (one) measure appears:

- 2005 amendment to shipping legislation- Federal Act amending the Navigation Act, the Federal Act of 27 January 1976 on the Competence of Authorities and the Punishment of Administrative Offences in Matters of Navigation on Lake Constance and on the Amendment of the Navigation Police Act and the Maritime Navigation Act (2005-06-09)

SLOVAKIA

On the website of the EU Directive 2016/1629 for information regarding the national transposition in Slovakia, 3 (three) measures appear:

- Act No 338/2000 on inland navigation and amending certain acts, as amended (consolidated version as amended by 284/2018);
- Act No 284/2018 amending Act No 338/2000 on inland navigation and amending certain acts, as amended, and amending certain acts;
- Slovak Government Regulation No 342/2018 on the technical competence of vessels operating on inland waterways.

On the website of the EU Directive 2005/44/CE for information regarding the national transposition in Slovakia, 5 (five) measures appear:

- Act No 628/2005 Coll. amending Act No 211/2000 Coll. on free access to information and on amending and supplementing certain acts (Freedom of Information Act), as amended by Act No 747/2004 Coll. and on amending and supplementing certain acts;
- Act No. 193/2007 Coll. amending Act No. 338/2000 Coll. on Inland Navigation and on Amendments and Additions to Certain Acts, as amended and on Amendments and Additions to Certain Acts;
- Act No. 179/2008 Coll. amending Act No. 338/2000 Coll. on Inland Navigation and on Amendments and Additions to Certain Acts, as amended;
- Act No. 211/2000 Coll. on Free Access to Information and on Amendments and Additions to Certain Acts (Freedom of Information Act);
- Act No. 338/2000 Coll. on Inland Navigation and on Amendments and Additions to Certain Acts.

3. SECTOR CONSULTATION RESULTS

3.1 Outcomes of the sector consultation through questionnaire on this project

Permanent adaptation of professional competencies of crew members due to the implementation of innovative technologies and digitalization in IWT sector - the questionnaire was designed in such a way to ensure that the questions would cover a wide area of effects and impacts associated with autonomous ships.

The innovation of an autonomous ship is still in a very early stage of the innovation process in inland navigation. Thus, the aim was to receive feedback on a broad overview of relevant aspects from IWT stakeholders' perspective. Going into more depth with regard to the most important and critical aspects will be possible only as soon as the innovation of autonomous IWT vessels evolve out of the current early conceptual status.

The approach used, for many questions, was meant to capture the opinion of the respondents via the Likert rating scale approach, so that either positive or negative response of the participants to a given statement (which reflects a key impact of autonomous IWT vessels) is measured. Items were designed in such a way as to ensure an equidistant presentation of answer options.

We used the format of five-level Likert items in the questionnaire as follows:

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

Therefore, the 20 questions related to the need of permanent adaptation of professional competencies of crew members due to the implementation of innovative technologies and digitalization in IWT sector, and are focused on the main important aspects:

- equipment and technology used on inland navigation vessels are getting more and more complex and inland navigation companies are looking to hire more specialized and qualified crew members;
- current and future workforce in IWT needs to be equipped with the right competences to deal with the green and digital transitions, cyber-security, synchro modality and the automation of vessels and infrastructure;
- in order to have a harmonised approach on the continuous training of workforce (upskilling) in the IWT sector, EU policies/strategies for lifelong learning need to be developed/revised;
- digitalisation and automation in the sector could also create new opportunities for attracting new entrants in the sector;
- standards for competences necessary at the moment and for the next 5 years taking into account the continuous technological transformation of the IWT sector.

The questions were structured in such a way as to find out in which direction the technological development of the IWT sector is going, as well as the need to update and refresh the competences of the IWT crew members.

The answers received to the questions have been consolidated and included in a report which will be available on the project website as well as on the EDINNA website for all those interested, *Report on legislation gap at EU and national level in the Rhine and Danube riparian countries and the needs and challenges for EU legislation implementation regarding permanent adaptation of professional competencies according to the implementation of innovative technologies and digitalization in IWT sector* - Deliverable D 2.1.1.

The questionnaire was distributed to over 100 stakeholders, representing inland waterway port authorities and subcontractors; logistic companies working with inland waterway port authorities or terminal operators, national inland waterway authorities; inland waterway shipping companies; public institutions with inland waterway regulatory power; craft operators; boatmasters on board IWT crafts; other crew members of IWT crafts; inland navigation crewing agencies; inland navigation VET schools, E&T institutions, via email with the following link: https://docs.google.com/forms/d/1NiizOg57mZ8BHEXcK3pd2PTNegOWjNNib6EpF_Citn0/edit?ts=65436352

Details about the answers to each question and pie charts analysing the opinions of the respondents can be found in the deliverable of the project D 2.1.1 in section 2.3. RESULTS QUESTIONNAIRE PART B, pages 36 to 46.

In total, 35 participants representing 11 countries: Belgium (1), Russia (2), Czech Republic (1), Netherlands (6), Republic of Moldova (1), Slovakia (4), Austria (1), Germany (4), Serbia (1), France (1) and Romania (13) completed the Questionnaire.

As per the above-mentioned report/ D 2.1.1, all respondents considered that:

- inland waterway transport represents a great potential for autonomous shipping and more automation brings the reality of synchromodal IWT vessel-type in Europe closer;
- all the relevant legislation should be revised, where necessary, in order to facilitate the uptake of autonomous shipping, with particular regard to the responsibilities of crew in emergencies or system failure, clarification of liability issues in cases of damage and, more generally, the safety aspects of autonomous vessels, in order to achieve a certain level of harmonisation and increase the uptake of the technology at EU level;
- all steps should be taken for the necessary training, upskilling and reskilling of crew working on inland navigation vessels;
- CESNI standards need further development to ensure the necessary skills for the crew members of inland navigation vessels;
- River Information Services (RIS) need to be further harmonised
- there is a need to modernise inland navigation education and training, focusing on the development of green and digital skills and overcoming language barriers, thereby creating attractive jobs for young people, including women, paying due attention to high and harmonised social and safety standards and qualification levels;
- there is the need for compulsory, continuous and regular training schemes for all crew members, including international exchange courses, in order to promote upskilling, reskilling, optimal labour mobility and safety throughout the sector, as well as the need for health and safety standards in line with the zero-accidents principle

At the same time, respondents complained about;

- the shortage of IWT personnel;
- insufficient attention from regional and national member states for the transposition of Directives;
- lack of IWT training companies, mainly in Austria;
- lack of regulations of the Directives (Romania) regarding the conditions under which certain categories of seafarers (graduates of higher educational institutions with a marine profile, former members of the armed forces, law enforcement agencies, civil defence services, fire services or other emergency services, graduates of vocational schools and secondary schools with a marine profile, a significant number of maritime deck personnel) can be

transferred to inland waterway crews.

As it is often the case, when it comes to new technologies, legislation lags behind innovation. Either the law remains silent on the new technology and, therefore, does not directly oppose it, or the law directly poses a hindrance to the implementation of the innovation by implicitly or explicitly prohibiting it.

The reason for this relatively slow process is the very different public regulatory institutional structure in inland shipping in EU countries; this consists of a multi-levelled regulatory landscape with different supranational, regional and national authorities. The rules and regulations adopted by these authorities diverge as to their binding or nonbinding nature, their geographical scope of application and their hierarchical importance throughout Europe.

This means that there is a need for harmonization and unification of rules and regulations in all EU inland navigation countries.

3.2 Outcomes of the sector consultation during PLATINA 3 project

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.

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 items:

- technical design of the track guidance assistant for inland navigation (TGAIN);
- Remotely operated or remotely supported vessels;
- developments towards more or fully autonomous inland vessel concepts.

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.

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.

More information about these consultations can be found in the Deliverable *D 3.3 - Report on competences needed to operate on board systems allowing for automation of inland navigation vessels*[22].

3.3 Outcomes of the sector consultation in Commission's expert group on horizontal social issues in transport

The draft content of the Commission Recommendations (EU) 2024/236 of 29 November 2023 on means to address the impact of automation and digitalisation on the transport workforce was discussed with the Commission's expert group on horizontal social issues in transport and, at a stakeholder conference in March 2023, with all relevant stakeholders from the transport sector, including public authorities, employers' organisations, trade unions, education and training providers, companies, and transport professionals. The sectoral social dialogue committees established in the various segments of the transport sector were also consulted.

Different stakeholders may perceive the objective of automation and digitalisation and their impact on the workforce different ways. Fostering a common understanding of the possible benefits and challenges of these developments and the issues at stake will reinforce cooperation and team spirit across stakeholder groups.

Transport-related European Partnerships under the Horizon Europe programme, such as Connected, cooperative and automated mobility (CCAM), Towards zero emission road transport and Zero emission waterborne transport (ZEWT), can facilitate the exchange on the social impact of the transition, as they bring together diverse and extensive public-private stakeholder networks.

European and national transport stakeholders – including employers, workers, education and training providers, sector associations, and the social partners, while respecting their autonomy, civil society organisations representing all groups of workers, in particular groups at higher risk of exclusion from the labour market, and policymakers and public authorities at national and regional level was invited to consider and promote these recommendations to address the impact of automation and digitalisation on the transport workforce, with a view to addressing the challenges and taking advantage of the opportunities related to raising awareness, upskilling and reskilling, improving

[22] https://www.danubecommission.org/uploads/doc/Platina3/03_Jobs_and_skills/D3.3_standards-for-competence-automation.pdf

working conditions, managing change, and funding.

4. METHODOLOGICAL FRAMEWORK – STEP BY STEP APPROACH IN THE CONTEXT OF THE TRANSITION TO AUTOMATION AND DIGITALIZATION

4.1. Raising awareness on impact of automation and digitalization

Employers in the transport sector should be aware of the impact of automation and digitalisation to prepare themselves – and their workforce – for a future that includes automation and digitalisation in a fair and just way. This involves following the latest automation and digitalisation developments regularly, including their impact on operations and human capital in transport. As the first element of awareness is transparency, individual companies could consider adopting a clear strategy detailing the impact of automation and digitalisation on their workforce. Where companies have limited resources or capacity to keep themselves up to date on relevant developments in transport, companies should seek appropriate support from their respective employers' organisations or sector associations at regional, national or Union level.

Employers' organisations should play an active role in providing relevant information on the social impact of automation and digitalisation to their affiliates.
They should pay special attention to raising awareness among SMEs in the transport sector, which often have limited resources or capacity to keep themselves up to date on relevant automation and digitalisation developments. In order to provide tailored support to their affiliates, employers' organisations could, for instance, carry out a needs' assessment amongst their members, or include the social impact of the expected changes in transport in the list of standard agenda items of their relevant meetings.

Workers in the transport sector should be aware of the expected impact of automation and digitalisation on their work to prepare themselves for their future careers and to remain employable. This may, for instance, involve seeking relevant information from workers' representatives or from their management, or participating in dedicated training events.

Workers' representatives should play an active role in raising the transport workforce's awareness of the impact of automation and digitalisation on their work.
Relevant information should be provided at the appropriate levels, for instance, workers' representatives in the undertaking should provide information to the workers of the undertaking; sectoral or national trade unions should provide information to their respective affiliates; and European-level workers' organisations should provide information to their national affiliates.
In order to provide tailored support to the workforce and engage all workers, including certain underrepresented groups, such as workers with disabilities and workers with a migrant background, in

a dialogue on the expected impact of automation and digitalisation on their work, workers' representatives could, for instance, compile information packages, create a website section, or organise dedicated training events. Targeted communication to specific groups of workers, for instance workers with potential difficulties to adapt to new technologies, could also be considered.

The social partners in the transport sector are invited to jointly contribute to raising awareness of employers and workers and their representatives in a partnership approach.
The dialogue between the two sides of industry, for instance in the framework of a collective bargaining process at company, national or sectoral level, may foster a common understanding of the issues at stake – including of definitions of relevant terms – and thereby contribute to raising awareness of the expected impact of automation and digitalisation on the workforce.
Where not already done, the social partners participating in the transport sectoral social dialogue committees at European level are invited to jointly address the social impact of automation and digitalisation.

Policymakers at national and regional level should use their existing dialogue with transport stakeholders to raise awareness of the social impact of automation and digitalisation. Existing stakeholder platforms should be used to provide relevant information on the social impact of the transition, which stakeholders can then pass on to their affiliates.
Policymakers could, for instance, include the social impact of the expected changes in transport and possible ways how to address them in the list of standard agenda items of their relevant meetings with transport stakeholders, and invite relevant experts. If appropriate, policymakers could organise specific information meetings for the social partners in the transport sector.

Sector associations (such as business associations and chambers of commerce) and civil society organisations representing all groups of workers, in particular groups at higher risk of exclusion from the labour market (such as workers with disabilities and workers with a migrant background), should play an active role in raising awareness of the social impact and opportunities of automation and digitalisation, including by investing in awareness campaigns and increasing transparency about the costs of non-anticipation and non-management of change.

4.2 Upskilling and reskilling of workforce from the IWT sector

Employers, workers, and public authorities at various levels should work together – including with the social partners – to assess and identify skills gaps and future skills needs linked to automation and digitalisation in the transport sector as a whole or in a specific company, mode of transport or occupation. In doing so, they should take advantage of and spread the word about existing tools at national and European level, such as:

- The skills intelligence tools of the European Centre for the Development of Vocational Training (Cedefop) providing evidence on current and future skills and labour market trends. These include Skills-OVATE (Skills Online Vacancy Analysis Tool for Europe) that offers detailed information on the jobs and skills employers demand using big data technology on online job advertisements;

- The Digital Skills Assessment Tool, a self-assessment tool allowing individuals to test their digital skills and access training opportunities appropriate for their needs;
- Cedefop guides on 'Understanding technological change and skill needs', aiming to inform analysts and policymakers about available skills anticipation methods used to navigate through the uncertainty of changing technologies and skills demands. For instance, the first practical guide provides useful information on employer and employee skills surveys.

Transport stakeholders – including the social partners – are invited to create strategic approaches and cooperation for concrete skills development solutions in the transport sector as a whole or in a specific mode of transport, with a particular emphasis on digital skills.
For instance, those modes of transport that have not yet engaged in such partnerships are invited to take inspiration from the ongoing Blueprints for sectoral cooperation on skills in maritime shipping (SKILLSEA) and rail supply and transport industries (STAFFER), as well as from the Automotive Skills Alliance, to prepare themselves for ongoing and future changes.
Moreover, transport stakeholders should contribute to the implementation of the Pact for Skills, for instance by establishing one or several large-scale partnerships on skills in the transport-related ecosystems identified in the European industrial strategy. Members of the Pact have access to knowledge on upskilling and reskilling needs, advice on relevant funding instruments to boost the skills of adults in their regions and countries, and partnership opportunities.
The use of micro-credentials as a targeted way to upskill and reskill workers, could also be explored, following the European approach to micro-credentials for lifelong learning and employability as laid out in the Council Recommendation of 16 June 2022.

Based on skills needs assessments, **transport stakeholders** – including the social partners – and **relevant education and training providers** are invited to design and organise adequate initial and continuing training programmes, including micro-credentials, and material.

Training programmes should be conceived in a lifelong learning perspective, contributing also to maintaining and enhancing the employability of the transport workforce, also in view of the expected changes of job profiles or tasks in the transport sector in an evolving labour market. For example, relevant work at European level includes a stocktaking exercise on current refresher classes in inland waterways in general and more specifically for automated vessel operation, and the comparison of vocational training systems to address the port work changes. Training programmes should also be conceived with due regard to ensuring inclusiveness and accessibility, including considering the increasing number of older workers or workers with disabilities.

Employers in the transport sector should promote upskilling and reskilling in their company, make relevant training measures (such as micro-credentials) accessible to their workforce, and motivate them to participate in training measures addressing their specific skills needs.

Access to training should be granted in accordance with legislation and collective agreements and to all groups of workers. Additional upskilling and reskilling practices, such as pairing younger and older workers within a transport company to facilitate a mutual transfer of expertise and skills, could also be considered.

Workers in the transport sector should be open to participate in skills assessments, and subsequently

in training measures addressing their specific skills needs. Depending on their professional career and in view of the expected changes of job profiles or tasks in the transport sector, they should consider themselves in a lifelong learning perspective to maintain and enhance their employability.

Policymakers and public authorities at national level should support the implementation of relevant Union initiatives to upskill and reskill the workforce in line with the actions under the European Skills Agenda, and promote relevant networks, such as the Pact for Skills and the Digital Skills and Jobs Coalition, as well as information about relevant Union funding opportunities.

4.3 Improving working conditions

The social partners in the transport sector are invited to contribute to improving working conditions in the context of the transition to automation and digitalisation.

Where not already done, they are invited to incorporate, in their collective agreements at company, national or sectoral level, dedicated provisions regarding automation and digitalisation. Taking inspiration from existing collective agreements in transport, the social partners at national and European level are invited to jointly identify good practice examples of such dedicated provisions for each mode of transport and share them with their respective affiliates.

In view of the important role of social dialogue in shaping economic transitions and fostering workplace innovation, and taking into account the variation of collective bargaining coverage across sectors and countries, **policymakers** at national and regional level should encourage and create the conditions for improving the functioning and effectiveness of collective bargaining and social dialogue.

4.4 Managing change

Employers in the transport sector should introduce and implement change management plans at company level to manage the transition to automation and digitalisation in a proactive and participatory manner and to incentivise and promote a positive attitude of the workforce to change. The change management plans should be developed in close collaboration with workers' representatives. The plans should include provisions on the evaluation, monitoring and revision of their change management methods and manners.

In this context, employers should follow the principles and good practices set out in the EU Quality Framework for anticipation of change and restructuring.

Employers' organisations should play an active role in promoting and supporting the need and merits of change management towards their affiliates. They should pay special attention to the needs of SMEs in the transport sector, which often have limited resources or capacity to set up their own change management plans.

In order to provide tailored support to their affiliates, employers' organisations should share good practices for introducing and implementing change management plans.

Workers' representatives should play an active role in developing change management plans at company level, both to respond to the workforce's specific needs and to ensure that all groups of workers are involved. This is particularly relevant to foster the digital inclusion of the transport sector's ageing workforce.

Policymakers and public authorities should accompany change management and support, disseminate and promote the wide application of the EU Quality Framework for anticipation of change and restructuring.

4.5 Funding

Transport stakeholders – including the social partners – are invited to use local, regional, national and Union programmes or funds to manage the social impact of automation and digitalisation, with due regard to ensuring inclusiveness and accessibility for all workers, in particular workers at higher risks of exclusion.

Examples for national programmes or funds are training funds, sectoral funds, individual learning accounts and vouchers. At Union level, there is a variety of funding instruments for upskilling and reskilling, which is accessible through financial intermediaries, through national authorities or through the Commission. An overview of the respective programmes or funds, application process, scope regarding skills, and total budget for 2021-2027, can be found on the website of the Commission. The Knowledge Hub of the European Pact for Skills includes an online database and search tool for Union-, national- and regional-level funding opportunities specific to upskilling and reskilling. Relevant Union funding opportunities for upskilling and reskilling to support the digital competences of individuals and organisations can be found on the Digital Skills and Jobs Platform. At national level, information on relevant programmes/funds should also be made public.

Employers' organisations and **workers' representatives** should help to raise awareness of their affiliates about these programmes or funds and how to use them. The same applies to sector associations at regional, national or European level. They should pay special attention to raising awareness among SMEs in the transport sector, which often have limited resources or capacity to find out about relevant national and Union programmes or funds. In addition, employers' organisations and workers' representatives should make their specific needs heard during the design phase of these programmes or funds.

Policymakers and public authorities at national level should promote and facilitate access to information of relevant funding instruments. When setting priorities for these programmes or funds, they should consult the social partners, including from the transport sector, on their specific needs.

5. CONCLUSIONS AND RECOMMENDATIONS

All modes of transport will be affected by automation and digitalisation, whether by automated vessels or vehicles or digitalised processes. A combination of a lack of awareness, lack of understanding of new requirements and fear of not coping with change contributes to scepticism and sometimes resistance to change in the transport sector.

The study on '**The social dimension of the transition to automation and digitalisation in transport, focusing on the labour force'**[23] assessed the awareness, preparedness and need for guidance of transport stakeholders. It found that, in general, in the sector, there is little awareness of the impact of automation and digitalisation on the transport workforce. Transport stakeholders are, on average, moderately prepared for this transition. Trade unions and national public bodies seem to anticipate or manage change more than employers. The surveyed stakeholders indicate that if guidance and additional measures are needed, they should mostly focus on knowledge sharing, as well as training and education of the workforce.

Against this backdrop, the transport sector would benefit from introducing and implementing ways to better manage this change. Change management includes methods and manners in which a company describes and implements change within both its internal and external processes to ensure a constructive and beneficial transition to automation and digitalisation.

In the short, medium and long term, sufficient financial resources are essential for the implementation of measures to ensure a smooth transition to automation and digitalisation for the transport workforce. It is crucial for workers to be able to adapt to changing skills needs. However, training is often perceived as costly by employers, and this can act as a barrier for them to provide training and lifelong learning opportunities. If no sufficient funding is dedicated to support the training and lifelong learning of workers, their skills might no longer be aligned with their job requirements, further increasing labour shortages.

European and national transport stakeholders – including employers, workers, education and training providers, sector associations, and the social partners, while respecting their autonomy –, civil society organisations representing all groups of workers, in particular groups at higher risk of exclusion from the labour market, and policymakers and public authorities at national and regional level are invited to consider and promote the following means to address the impact of automation and digitalisation on the transport workforce, with a view to addressing the challenges and taking advantage of the opportunities related to raising awareness, upskilling and reskilling, improving working conditions, managing change, and funding.

Furthermore, as autonomous ships are the next generation of vessels that are essentially an extension of remotely operated vessels, navigation and performance of such vessels will be controlled from an onshore operating centre, by means of detectors, sensors, cameras, satellite communication

[23] https://transport.ec.europa.eu/transport-themes/social-issues-equality-and-attractiveness-transport-sector/social-issues/automation-transport/study-social-dimension-transition-automation-and-digitalisation-transport-focusing-labour-force_en

systems etc. However, people will still need to monitor the vessel from the shore or to perform maintenance operations on a vessel. It is expected that crew members will not entirely disappear, but their profile and task will certainly change. This approach, on the one hand, will give the sector a chance to **attract specialists with new qualifications** and, on the other hand, will help to **cope with the shortage of crew members**.

The benefits of autonomous shipping are obviously a **reduction in crew-related operational costs and safety**. On an inland waterway vessel, the crew costs amount to one third of the total operational costs. On unmanned vessels, energy-consuming crew facilities, such as heating and sanitary facilities, may be dispensed with. Reducing the crew can thus significantly reduce the total operational costs of a vessel.

Autonomous shipping might also **reduce the human-related errors**, as the influence of the human factor will be minimized or excluded. Furthermore, an autonomous vessel can navigate full-time, as there is no crew that needs to rest. This will economize the travel time and allow cargo to arrive faster at the destination.

It can be pointed out that the approaches used in inland navigation and maritime shipping had much in common, however, differences between them should be taken into account while seeking for synergies in terms of technologies, cyber security and other aspects.

International cooperation is of major importance for developing the concept of autonomous vessels in inland navigation, in particular, international regulatory basis.

The added value of autonomous shipping at a pan-European level would be a harmonized approach and exchanges of best practices; fostering of innovations; making the sector more competitive and attractive; ensuring navigation safety and enhancing mobility.

Priorities and next steps for the development of autonomous shipping on inland waterways are: (a) research and development in automated technology; pilot projects and would be; (b) development of the legislative base; (c) dissemination of information; and (d) development of insurance policies.