15 PhD positions in the EU Horizon 2020 Marie Skłodowska-Curie Project:

Applications are invited for 15 PhD positions ("Early Stage Researchers") to be funded by the Marie-Skłodowska-Curie Innovative Training Network "AUTOBarge - European training and research network on Autonomous Barges for Smart Inland Shipping" within the Horizon 2020 Programme of the European Commission.

According to the European Commission, passenger transport is projected to increase 42% by 2050, and freight transport up to 60%. Needless to say, this puts an enormous burden on transport networks and our environment. Compared to other modes of transport – which often face congestion and capacity problems – inland waterway transport is characterised by reliability, energy efficiency and a capacity for increased use. More than 37,000 km of waterways connect hundreds of cities and industrial regions in Europe. In the EU, 13 countries share an interconnected waterway network, highlighting the potential for increasing the modal share of inland waterway transport. This will not happen unless we can make inland waterways economically competitive. However, with crew costs accounting for 60% of the total cost, autonomous inland vessels represent an exciting disruptive technology.

AUTOBarge is about seizing an opportunity. Europe's waterways are a vital resource that we have underused for most of the last century. Now, with the possibility for mass autonomous shipping, these canals and rivers offer a network that we can exploit without damaging the environment to the extent of new roads and aircraft runways. But to be able to do this we need new people with new skills. These innovators must be experts in remote control, monitoring, smart logistics, regulatory aspects, and many more areas associated with the complexity of inland shipping. The 15 early-stage researchers recruited to AUTObarge will begin this transport revolution.

The AUTOBarge Beneficiaries are 7 universities, KU Leuven (BE), Universiteit Antwerpen (BE), TU Delft (NL), NTNU (NO), Nord Universitet (NO), Chalmers Tekniska Högskola (SE), Universität Hamburg (DE), 2 high-technology companies, Periskal (BE) and Kongsberg Maritime (NO), and 1 non-university research institute, Institut Du Droit International Des Transports (FR). The consortium is completed by 10 Partner Organisations that include 4 companies, 3 non-university research institutes, 2 network/stakeholder organisations, and 1 governmental organisation. AUTOBarge unites some of the best and most relevant of European industry and the key academic players, guaranteeing not only an exciting interdisciplinary, intersectoral research-and-training programme, but also a head-start for bringing about the successful application of autonomy in inland-waterway transport.

Key dates:

- **15 May 2021: Launch of 15 ESR Positions**
- **01 Sept 2021: Deadline for on-line application**
- **06 October 2021: Circulation list "AUTOBarge preselected candidates"**
- **10 November 2021: AUTOBarge Recruitment Event**
- **19 November 2021: Circulation list "recruited AUTOBarge ESRs"**
- **01 April 2022: Targeted starting date for ESR contracts**

Key background info

EU FUNDING

This project has received funding from the European Union's EU Framework Programme for Research and Innovation Horizon 2020 under Grant Agreement No. 955.768.

Number of positions available
15 PhD Positions

Research Fields
Control Engineering - System Engineering - Mechanical Engineering - Safety Engineering – Electrical Engineering - Computer Science - Operations Research - Transportation Modeling - Maritime Economics - Innovation and Technology Management - Transportation Law

Keywords
Autonomous vessels - Inland Waterways – Model-Based Techniques – System Modeling – Sensor Fusion – Optimization – Model Predictive Control – Dependability – Human Computer Interaction – Maritime Economics – Logistics – Transport Law

Career Stage
Early Stage Researcher (ESR) or maximum 4 years of equivalent research experience.

Benefits and salary
The successful candidates will receive an attractive salary in accordance with the MSCA regulations for Early Stage Researchers. The exact (net) salary will be confirmed upon appointment and is dependent on local tax regulations and on the country correction factor (to allow for the difference in cost of living in different EU Member States). The salary includes a living allowance, a mobility allowance and a family allowance (if applicable). The guaranteed PhD funding is for 36 months (i.e. EC funding, additional funding is possible, depending on the local Supervisor, and in accordance with the regular PhD time in the country of origin). In countries where PhDs typically last longer than 36 months, beneficiaries foresee additional funding for the required time to finish the PhD if the ESR fulfils all technical requirements. In addition to their individual scientific projects, all fellows will benefit from further continuing education, which includes internships and secondments, a variety of training modules as well as transferable skills for the Jobs of Tomorrow as well as active participation in workshops and conferences.

On-line Recruitment Procedure (see Appendix 1 for full description)
All applications proceed through the on-line recruitment portal on the www.etn-autobarge.eu website. Candidates apply electronically for one to maximum three positions and indicate their preference. Candidates provide all requested information including a detailed CV (Europass format[1] obligatory), a motivation letter and transcripts of bachelor and master degree[2]. During the registration, applicants will need to prove that they are eligible (cf. ESR definition, mobility criteria, and English language proficiency). For some positions, candidates must be eligible with respect to national and international regulations for knowledge transfer and export control. The deadline for the on-line registration is **1 Sept 2021**. The AUTOBarge Recruitment Committee selects between 20 and maximum 30 candidates for the Recruitment Event which will take place in Bruges (Belgium) (**10 Nov 2021**). The selected candidates provide a 20-minute presentation and are interviewed by the Recruitment Committee. Candidates will be given a domain-relevant peer-reviewed paper (prior to the recruitment event) by their prioritised Supervisor and will be asked questions about this paper during the interview to check if the candidate has the right background/profile for the ESR position. Prior to the recruitment event, skype interviews between the Supervisors and the candidates are recommended, along with on-line personality tests. In order to facilitate their travel, selected candidates (from outside Belgium) receive a reimbursement of maximum 250 euro (paid by the prioritised Supervisor). In order to avoid delays in reimbursements, candidates are asked to keep all invoices and tickets (cf. train, plane, hotel...). If local circumstances in the country of residence of a candidate or supervisor do not allow for travels (e.g due to COVID-19 restrictions), a good quality digital connection will need to be organised. The final decision on who to recruit is communicated shortly after the Recruitment Event (estimated **19 Nov 2021**). The selected ESRs are to start their research as quickly as possible (target date: 1 April 2022).

Applicants need to fully respect three eligibility criteria (to demonstrated in the Europass CV):

1. **Early-stage researchers** (ESR) are those who are, at the time of recruitment by the host, in the first four years (full-time equivalent) of their research careers. This is measured from the date when they obtained the degree which formally entitles them to embark on a doctorate, either in the country in which the degree was obtained or in the country in which the research training is provided, irrespective of whether or not a doctorate was envisaged.
2. **Conditions of international mobility of researchers**: Researchers are required to undertake transnational mobility (i.e. move from one country to another) when taking up the appointment. At the time of selection by the host organisation, researchers must not have resided or carried out their main activity (work, studies, etc.) in the country of their host organisation for more than 12 months in the 3 years immediately prior to their recruitment. Short stays, such as holidays, are not considered.

[1] https://europass.cedefop.europa.eu/documents/curriculum-vitae

[2] Master students who will graduate in the next coming months are welcome to apply. In that case, please provide an overview of the transcripts that are already available.

3. **English language**: Network fellows (ESRs) must demonstrate that their ability to understand and express themselves in both written and spoken English is sufficiently high for them to derive the full benefit from the network training.

The 15 available PhD positions
(see **Figure 2** for interactions between ESRs/WPs)

ESR1: Online identification of vessel dynamics in confined inland waterways
Host: KU Leuven (BE)
Main supervisor: P. Slaets (peter.slaets@kuleuven.be)
Co-supervisors/mentors: J. Swevers (KU Leuven - BE), J. Oggel (NOVATUG, NL)
Duration: 36 months
Required profile: nautical engineer, mechanical engineer, electrical engineer , computer science or mathematics
Desirable skills/interests: signal processing, data acquisition, system modeling, estimation, simulation and optimization
Objectives: As a first step to create sufficient situational awareness for an autonomous inland vessel, accurate models of the vessel's own dynamics – i.e. how does or can it maneuver in its environment - should be available. In the past, quite some research has already been conducted in this area leading to the introduction of a diverse set of models: physics based (white box) models, grey/black box models, linear models, linear parameter varying models or even nonlinear models. However, up to now, standard practice has been that these models are derived from data that has been gathered from past experiments, typically sensor data from towing tanks at sea. These models are then considered as reference models and applied to the vessel-at-hand. Of course, there will always be a difference between such a predefined model and the actual vessel, thereby limiting the overall accuracy of the approach. ESR1 tries to achieve an important paradigm shift by deriving and updating the vessel's hydrodynamic model based on sensor data gathered during the actual inland waterway navigation of the vessel. The derived hydrodynamic model can then be continuously bench-marked against and updated according to the actual real-life behavior. While the proposed disruptive approach eliminates the need for expensive towing tank experiments, it requires solving significant challenges related to sensor information collection and sensor fusion.

ESR2: Unifying Simultaneous Localization and Mapping (SLAM) and Extended Object Tracking (EOT) for autonomous vessels in confined waterways
Host: NTNU (NO)
Main supervisor: E.F. Brekke (edmund.brekke@ntnu.no)
Co-supervisors/mentors: P. Slaets (KU Leuven - BE), O. Kjerstad (Kongsberg Maritime – NO)
Duration: 36 months
Required profile: control engineering, statistics, mathematics, signal processing, computer science, physics
Desirable skills/interests: sensor fusion, estimation, computer vision, optimization, simulation, algorithm development, candidates must be eligible for PhD at NTNU, which means a master degree (total of 5-years) in a relevant field with grade B or better in the 2 last years and grade C or better in the 3 first years
Objectives: As a second step in building up the situational awareness, the autonomous vessel should be continuously constructing and updating a model of its environment and be aware of its own location in that environment. For vessels operating in inland waterways, this is a very challenging task. Indeed, margins in harbors, rivers, and canals are much narrower and critical than in open sea. Therefore, this task will develop a general theory and set of algorithms for the seamless integration of multi-target tracking and Simultaneous Localization and Mapping (SLAM) as a key component in the overall sensor fusion and situational awareness systems for future autonomous inland vessels. ESR2 will start from recently developed methods for Extended Object Tracking (EOT), and integrate a map of the riverbanks by also treating them as an "extended object". The final algorithms will perform fusion of a variety of vessel-mounted sensors (radar, lidar, optical and infrared cameras) as well as shore-mounted sensors (radar and infrared cameras).

ESR3: From static to dynamic Inland Electronics Charts (IENC)
Host: KU Leuven (BE)
Main supervisor: P. Slaets (peter.slaets@kuleuven.be)
Co-supervisors/mentors: E.F. Brekke (NTNU - NO), G. Morlion (De Vlaamse Waterweg – BE)
Duration: 36 months
Required profile: nautical engineer, mechanical engineer, electrical engineer, computer science or mathematics
Desirable skills/interests: databases, computer graphics, simulation, communication protocols, software programming, semantic modeling
Objectives: As a third step in building up the situational awareness, Inland Electronic Navigational Charts (IENC) need to provide up-to-date and accurate information at all times. An IENC comprises any chart information required for safe navigation on inland waterways and in mixed traffic zones. It contains a lot more detail about bridges and locks, for instance, than a maritime ENC. Buoys, traffic signs and other signs that are specific to inland navigation are also charted. ESR3 has the ambition to develop a new type of ISENC database (so-called ISENC+) that fuses real-time navigational assistance information from point cloud sensors with the currently available navigational information (Automatic Identification System, IENC). This point cloud data will include additional real-time navigational information about, amongst others, bridges, stationary vessels, recreational vessels, unknown obstacles, shore side position, and vessel sizes. In a first stage, an initial ISENC+ database needs to be generated based on the currently available IENC information combined with the point cloud sensor data provided by e.g. the Flemish waterway administrator DVW (partner organization in AUTOBarge). In the second step, the previously generated ISENC+ database will be updated based on real-time point cloud data information to obtain a dynamic IENC.

ESR4: Protocols for communication between autonomous vessels themselves and autonomous vessels and traffic
Host: NTNU (NO)
Main supervisor: T.A. Johansen (tor.arne.johansen@ntnu.no)
Co-supervisors/mentors: R.R. Negenborn (TU Delft - NL), M. Skogvold (Kongsberg Maritime – NO)
Duration: 36 months
Required profile: control engineering, systems engineering
Desirable skills/interests: maritime navigation, ocean engineering, systems engineering, computer science, optimization, candidates must be eligible for PhD at NTNU, which means a master degree (total of 5-years) in a relevant field with grade B or better in the 2 last years and grade C or better in the 3 first years

Objectives: Autonomous vessels require continuously real-time information about other nearby ships, bridges, terminals, unmapped obstacles and other hazards in order to navigate safely and avoid collisions and grounding. Hence, future applications of autonomous vessels will rely heavily on different communication technologies to connect and interact with other vessels, infrastructure, the "cloud", etc. ESR4 will investigate which information is required to be exchanged, at which rate, and how to achieve tactical planning and operational control with the required dependability and security. The research will be based on dynamic analysis and simulations considering a wide range of scenarios as well as the requirements of centralized and decentralized Guidance, Navigation and Control (GNC) methods for collision avoidance and traffic control. Based on this in-depth analysis, new protocols for information exchange will be proposed and validated using realistic simulation and field experiments, e.g. in Trondheim fjord, harbor, river and canals.

ESR5: Enhanced Track Keeping Pilots based on model predictive control of autonomous inland vessels
Host: Periskal (BE)
Main supervisor: M. Persoons (m.persoons@periskal.com)
Co-supervisors/mentors: J. Swevers (KU Leuven - BE), E.F. Brekke (NTNU - NO)
Duration: 36 months
Required profile: knowledge of IT software programming, IT networks, extra is Embarcadero C++ / Delphi (Periskal's current development language)
Desirable skills/interests: Information Technology, automation, cyber security
Objectives: ESR5 will be dealing with the enhancement of existing Track Keeping Pilots in inland vessels with an onboard Inland Electronic Chart Display Information System (ECDIS) system in order to achieve a higher level of intelligence in autonomous sailing on rivers and canals. Track Keeping Pilots are essential for keeping the vessel on a certain track for a time. Currently Track Keeping Pilots have no interaction with the outside world like on-board ECDIS, Automatic Identification System (AIS), radar or other technical aids. In order to come to a higher level of autonomous sailing on inland waterways, interaction between several systems and sensors must be established. ESR5 will define the needs, the dataflow between Track Keeping Pilot system and the inland ECDIS via a model predictive control approach based on waypoints or track lines to make the system smarter and capable of avoiding collision with other ships/objects and avoiding grounding. In a first phase, interaction will be worked out and tested with simulators, later on the approach will be tested on real inland vessels.

ESR6: Scenario-based Model Predictive Control for collision avoidance and traffic control of autonomous ships in inland waterways
Host: Kongsberg Maritime (NO)
Main supervisor: B. Vik (bjornar.vik@km.kongsberg.com) (TBC)
Co-supervisors/mentors: T.A. Johansen (NTNU - NO), P. Slaets (KU Leuven – BE)
Duration: 36 months
Required profile: control engineering, marine system engineering
Desirable skills/interests: model predictive control, navigation, optimization, computer science
Objectives: The state-of-the-art Scenario-based Model Predictive Control (SB-MPC) for COLREGS-compliant autonomous ship collision avoidance will be extended in this task, such that it can be effective within the tight geographical constraints of narrow inland waterways. A first hypothesis is that selecting the collision avoidance maneuver directly by comparing the behavior in a finite number of predicted scenarios, as in SB-MPC, will be possible when using a more fine-grained selection of the scenarios and set of possible control behaviors. A second hypothesis is that a nonlinear MPC based on continuously parameterized trajectories and numerical optimization will provide benefits with additional degrees of freedom to optimize. Either way, the original concepts of SB-MPC will be used to define scenarios to represent uncertainty related to the future trajectory of other ships while following the planned path as closely as possible and at the same time avoid grounding and collision with infrastructure and other ships within the tightly confined inland waterways. The trajectory optimization will rely on situational awareness from sensors on the ship and communicated information from other ships, in addition to digital infrastructure such as digital maps of waterways and River Information Dystems (RIS). Both decentralized and centralized versions of the algorithms will be developed and validated using realistic simulation and field experiments in the harbor/canals/river/fjord in Trondheim.

ESR7: Real-time multi-objective voyage optimization algorithms based on on-line machine learning for efficient autonomous navigation
Host: Chalmers Tekniska Högskola (SE)
Main supervisor: W. Mao (wengang.mao@chalmers.se)
Co-supervisors/mentors: J.W. Ringsberg (CUT - SE), M. Persoons (Periskal – BE)
Duration: 36 months
Required profile: transport engineering, mechanical engineering, engineering physics
Desirable skills/interests: naval architecture, control and optimization methods, statistical methods, ship performance and maneuverability models, background and experience in programming language such as Python, C/C++, Fortran
Objectives: The aim of ESR7 is to build an online autonomous ship navigation platform to develop sophisticated multi-objective voyage optimization algorithms, that can in real time remotely optimize, update/adjust, monitor unmanned ship operations in inland waters, and communicate with various inland water infrastructures. The platform will integrate a ship's theoretical speed-power relationship and maneuverability models under various traffic and weather conditions. These models will be updated by developing online real-time machine learning algorithms taking into accounting a ship's real performance and surrounding navigation environments. Fast data processing algorithms will be developed to recognize surrounding weather and sailing schedule information, as well as the dynamic traffic and static obstacles/infrastructures. Based on the unmanned ship's real-time speed-power models and their maneuverability for navigation to avoid collision and grounding, a three-dimensional multi-objective sail planning algorithms will be developed to inject requirements on a specific voyage such as estimated time of arrival, port timeslots, obstacles, surrounding traffic, etc. to design and update the ship's sailing path and sailing speeds/powers continuously along the voyage. Finally, an online performance analysis system will be developed to monitor the unmanned ship's navigation and performance and to adjust the sailing plan in combination with the optimization system.

ESR8: Sailing energy optimization
Host: Chalmers Tekniska Högskola (SE)
Main supervisor: J.W. Ringsberg (jonas.ringsberg@chalmers.se)
Co-supervisors/mentors: W. Mao (CUT - SE), J. Van Bekkum (RH Marine – NL)
Duration: 36 months
Required profile: transport engineering, mechanical engineering, engineering physics
Desirable skills/interests: control and optimization methods, statistical methods, ship performance and maneuverability models, background and experience in programming language such as Matlab or Python.
Objectives: ESR8 develop a Voyage Planning Tool (VPT) which aims at optimizing (i.e. minimizing) primarily an autonomous vessel's energy consumption. The VPT includes ship performance and maneuverability models, voyage optimization algorithms) and weather information. All of them are continuously updated while the ship is sailing. The optimized route will be coordinated with traffic scenarios to enhance the sailing safety of the unmanned ship in addition to minimum fuel and expected total sailing time often required by ship operators. Two objectives are considered in the VPT: minimization of fuel consumption/air emissions and ship sailing safety in inland waterways. Two different types of VPT will be developed: one is used for onshore navigation center, and the other is used onboard of ships. The onboard system will create communication channel with a ship's Track Keeping Pilots system and Scenario-based Model Predictive Control to avoid collision and grounding for the planned minimum fuel consumption shipping route. Statistical methods and models will be used to assess the uncertainty of these VPTs in order to quantify the confidence in predictions.

ESR9: Fault diagnosis for safe control and coordination of inland waterway interconnected systems
Host: TU Delft (NL)
Main supervisor: V. Reppa (v.reppa@tudelft.nl)
Co-supervisors/mentors: R.R. Negenborn (TU Delft-NL), D. Pissoort (KU Leuven - BE), P. Van Terwisga (DAMEN - NL)
Duration: 36 months
Required profile: system engineering, control engineering
Desirable skills/interests: (distributed) fault diagnosis, model-based techniques, system theory, automatic control techniques
Objectives: ESR9 will develop a model-based methodology to diagnose faults that affect the operation of inland waterway interconnected systems. The efficiency of inland shipping, the workaround to decongesting road traffic, highly depends on the interconnectivity between various systems, both between vessels or between vessels and infrastructure (e.g. bridges, locks, cranes in inland terminals). However, this interconnectivity is safety-critical since any abnormal operation of one system will impact the operation of the full inland waterway ecosystem. Hence, there is a high need for tool to monitor the inland waterway network of systems to diagnose faults locally in their components and avoid that the effects of these faults are propagated through the physical and cyber-interconnections. This research will develop a multi-agent framework, where each agent will monitor one of the interconnected systems for (i) detecting the fault occurrence, (ii) isolating the faults in its monitored systems or propagated faults, and (iii) estimating the fault severity. Special emphasis will be given on sensor faults since the veracity of sensor information is crucial to ensure the reliability of automatic control, decision making and planning of the autonomous inland network.

ESR10: Safety assurance of remotely operated and fully autonomous inland vessels
Host: KU Leuven (BE)
Main supervisor: D. Pissoort (davy.pissoort@kuleuven.be)
Co-supervisors/mentors: V. Reppa (TU Delft - NL), E. el Amam (RH Marine – NL)
Duration: 36 months
Required profile: system engineering, safety engineering, control engineering
Desirable skills/interests: safety-critical / high integrity systems, system safety, reliability, dependability
Objectives: ESR10 aims to develop a generic safety-case structure to assure the run-time safety of remotely operated or fully autonomous inland vessels. For society to fully accept and trust the use and operation of unmanned inland vessels, one must be able to provide convincing confidence and argumentation about these vessels' trustworthiness. However, the challenges that come along with the safety assurance of unmanned vessels should not be underestimated. First, current standards assume that there is a human in the loop at every moment and that he/she can take over immediately in case of emergency. For remotely operated vessels, one operator will be monitoring multiple vessels at the same time, leading to divided attention, and for fully autonomous vessels, a human operator will even be absent. Third, the operation of unmanned vessels heavily depends on sensors, which unavoidably have their limitations. To overcome these challenges, ESR10 will integrate the principles of Functional Safety (i.e. avoid unreasonable risk due to hazards caused by randomly failing components or hazardous systematic design errors), Safety-of-the-Intended-Function (i.e. avoid unsafe behavior caused by sensors being used beyond their capabilities) and Safe Nominal Behavior (i.e. will the system produce safe behavior in all situations?) into a generic reasoning framework about the safety of unmanned vessels.

ESR11: Data content, sharing and exploitation: defining common ground and actor network for collaborative decision making in autonomous inland waterways
Host: Chalmers Tekniska Hogskola (SE)
Main supervisor: S. MacKinnon (scottm@chalmers.se) (M. Lundh monica.lundh@chalmers.se)
Co-supervisors/mentors: Q. Liu (UHAM - DE), M. Wahlstrom (VTT - FI)
Duration: 36 months
Required profile: The candidate is required to have knowledge within the areas of human computer interaction, interaction design and human factors
Desirable skills/interests: It is desirable for the candidate to have skills/interests in one or more of the following areas: cognitive systems engineering, human-centered design, activity theory, systems theory, orgnisational communication, computer supported collaborative work (CSCW).
Objectives: Autonomous systems are driven by Artificial Intelligence (AI) and are supported by Human-Automation Interactions (HAI). AI data structures are derived from a variety of sources, including sensors, third-party providers and regulatory/business frameworks and goals. The aim of ESR11 is to improve inland waterways traffic, infrastructure services and actor activity management. A detailed model will be developed with the

aim to propose an improved management system and an optimization of logistics through improved data coordination supported by autonomous systems within vessels and/or in remote, shore control centers. The technologies to generate optimization and prediction tools are in a maturing stage but their integration with human stakeholders (i.e. HAI) is not well understood and lacks standardization. The challenges are not only to introduce new technologies, but to also introduce and develop the collaborative culture in a sector that has a legacy of self-organization within the inland waterways transport chain (i.e. ports, ships, intermodal depots and supporting hinterland actors). By using a bottom-up process, any barriers and other obstacles that would hamper a successful implementation of collaborative decision-making in the context of autonomous inland shipping should be revealed.

ESR12: Freight transport model with autonomous inland shipping application and environmental externalities
Host: UHAM (GE)
Main supervisor: Q. Liu (Qing.Liu@uni-hamburg.de)
Co-supervisors/mentors: G. Solvoll (NORD, NO), T. Brauner (LIH – DE)
Duration: 36 months
Required profile: operations research, transportation & logistics
Desirable skills/interests: operations research, transportation modelling, maritime economics
Objectives: ESR12 will revisit the topic of the competition between the different transport modes for freight (road, rails, air, waterway, etc.) with an emphasis on inland waterway shipping, overall sustainability and technological solutions thereto. The inland waterway ecosystem in Europe will be analysed and compared to best practices applied in other regions, like U.S and China. Benefits, challenges and risks brought by technological advances, e.g. the increased use of autonomy, will be the focus of the research. ESR12 will comprise three parts. First, a multimodal transport model is constructed incorporating externalities, risks and agent interactions. Second, stated choice experiments will be conducted to measure transport demand with agent interactions. And third, the model will be applied to real business cases, in which scenarios with optimal/partial/no autonomous inland shipping implementation can be compared. The autonomous inland shipping operators' business and investment model will also be analysed. The economic, social and environmental implications of the mode split outcomes and public policy impacts will be analysed.

ESR13: Modelling the economic implications of the adoption of autonomous inland shipping
Host: NORD (NO)
Main supervisor: T.A. Mathisen (terje.a.mathisen@nord.no)
Co-supervisors/mentors: R.R. Hermann (NORD – NO), S. MacKinnon (CUT - SE), J. Dahlman (VTI – SE)
Duration: 36 months
Required profile: innovation/ technology management, transportation economics; business administration
Desirable skills/interests: supply chain management; logistics; agent-based modelling; complex systems analysis; maritime economics (for a full overview of the qualification requirements for a PhD at NORD, see this link)
Objectives: ESE13 will model the economic impact of the adoption of autonomous inland shipping, taking as point of departure an Agent-Based Modelling (ABM) methodology. The project will thus feed in policy implications to consider different scenarios which can create contingencies for the wide-spread use of autonomous inland shipping. To develop this theoretical model, the research will be based on a thorough empirical analysis following a case study approach, with the purpose to collect qualitative and quantitative data to feed in the theoretical model. In addition, ESR13 will involve: (1) theory operationalization through a cognitive map creation; (2) agent specification; (3) environmental specification; (4) rules establishment; (5) measurement/ data recording; and (6) run-time specification. The model will be validated and tested in collaboration with several of the industrial partners in AUTOBarge.

ESR14: Toolbox for autonomous inland shipping regulation
Host: IDIT (FR)
Main supervisor: L. Couturier (LCOUTURIER@idit.asso.fr)
Co-supervisors/mentors: W. Verheyen (UA - BE), V. Bailly-Hascoët (IDIT – FR)
Duration: 36 months
Required profile: master laws (LLM),
Desirable skills/interests: International law; European law; transport law; law and innovation; insurance Law; active knowledge of English and French language (C1)
Objectives: A large number of provisions in the existing regulation oppose against the application of unmanned inland navigation. The main problem underlying this is that a legal framework acknowledging unmanned shipping - going beyond (ad hoc) experimental legislation - is absent. ESR14 will analyse regulatory obstacles standing in the way of unmanned shipping and will evaluate the current policy arguments behind such obstacles. Based on this, ESR14 will provide a toolbox allowing actors involved in inland autonomous shipping to conduct a compliance check of their designs and way-of-working. Further, an in-depth analysis will investigate how such policy arguments were overcome in other industries, such as e.g. the airline industry. Based ESR14's research, AUTOBarge aims to make a proposal for a regulatory innovation allowing for a market-introduction of unmanned inland shipping.

ESR15: Designing a seamless integration of autonomous inland shipping in risk distribution models
Host: Universiteit Antwerpen (BE)
Main supervisor: W. Verheyen (Wouter.Verheyen@uantwerpen.be)
Co-supervisors/mentors: C. Sys (UA - BE), F. De Vries (IVR - NL)
Duration: 36 months
Required profile: master laws (LLM)
Desirable skills/interests: Contract law/ insurance law/ transport law/ commercial law/ law making/ law and innovation, active knowlegde (C1) of English language. Additionally: knowledge of French, German or Dutch language (B2)
Objectives: A dedicated contract law framework, taking into account the changed actors, information availability and risks resulting from the evolution to autonomous inland shipping is absent. This absence leads to legal uncertainty, which can endanger the insurability of risks and increase transaction costs. With this, the private law framework can constitute an important obstacle towards the commercial use of autonomous inland shipping. This is even more relevant taking into account the mandatory nature of transport law, thus limiting the room for contractual risk management. ESR15 will first of all analyse bottlenecks in the current contract law framework, standing in the way of legal certainty, predictability and a fair balance of interests for stakeholders involved in the operation

of autonomous inland shipping. Based on this analysis and building on best practises from other fields of law and a thorough sector consultation, ESR15 aims to make a proposal for contract drafting and an amended legal framework, ascertaining these interests.

ETN AUTOBARGE key project information

When people think about autonomous vehicles (AVs), they normally visualise driver-less cars on roads or drones flying through air. But what about on the water? Autonomous shipping offers many advantages over regular crewed ves- sels, but without the commonly perceived dangers associ- ated with autonomous cars or aircraft.

Despite the approximately 25,000 deaths per year on Eu- rope's roads caused by human error – about the same number of people as a fully laden Airbus A380 crashing every couple of weeks – the switchover to autonomous cars appears to be stalling. A small number of accidents during road tests, a few of them fatal, have at least partially applied the brakes. While most people are in agreement that roads populated only by AVs would be much safer, the idea of robot-driven cars mixing with human drivers of widely differing abilities is a worrying one that is not easy for many to accept. Scenarios where an AV faces the prospect of mowing down children or, alternatively, adults, often posed by those who oppose the introduction of AVs, make people extremely uneasy at the prospect of a computer driving a car. So, whether it is robots being confused by plastic bags blowing across the road or planes crashing due to hardware or software failures, it looks as if cars will have to take a back seat for the moment.

Safer inland shipping. An autonomous river boat or ca- nal barge would be safer. With much simpler scenarios to deal with than those faced by a car or lorry, and with many fewer unpredictable events, all happening at much slower speeds, autonomous inland shipping on Europe's 37,000 km of navigable waterways is an ideal infrastructure on which to introduce the large-scale deployments of AVs.

According to a study by Allianz, up to 96% of accidents involving shipping are currently caused by human error. So, if autonomous systems can reduce the reliance on humans who make these mistakes due to fatigue or bad judgment, autonomous shipping will increase safety levels on our canals and rivers. Even in the case of hav- ing a crew is on board, the data gathered from the ship's sensors combined with artificial intelligence (AI) will help the crew make better-informed decisions. Just as artificial intelligence promises in other applications, it is expected that autonomous barges will improve safety, increase efficiency, and relieve humans of having to carry out unsafe and repetitive tasks.

Environmental benefits. Moving people and goods via canals and rivers is not only safer, it is environmentally much more friendly. 1 litre of fuel can take 1 tonne of cargo up to 180 km along waterways, compared to a maximum of 15 km by road or 45 km by rail. Since about 85% of Europe's imports arrive by ship at one of its ma- jor ports, continuing their journey inland on waterways to their final destination makes a great deal of sense. The only feature that canal and river barges do not offer is speed.

Everything else is better with boats and barges – less noise, vibration, expense, and pollution, fewer health problems and accidents, plus the ability to carry very large payloads. Not surprisingly, the European Green Deal takes as a mat- ter of priority that a substantial part of the inland freight carried today by road should shift onto inland waterway.

Lower costs. Other important factors point to Europe benefitting from autonomous inland shipping. The captains and crews of the current fleets are aging; younger people are not attracted to this kind of work. Without the need for a crew, autonomous barges could operate for 24 hours a day and 365 days a year, so dramatically lowering costs. Eliminating a human crew reduces the crew-related expenses, which typically account for 30% of the budget. There are also efficiencies realized in vessel design and the use of fuel. One study projected savings of more than $7 million over 25 years per autonomous vessel from fuel savings and crew supplies and salaries3.

Challenges to overcome. With most of Europe's inland shipping operating in quite narrow waters, there is a lot more truly interdisciplinary research required to maximise the benefits of fully autonomous vessels operating without a crew. In the early stages it is likely that AI will reduce crews and help them make better decisions. Later, the vessels will become fully autonomous and able to operate completely independently of a crew, leaving Captain AI at the helm.

Overall aim of AUTOBarge. The *European training and research network on Autonomous Barges for Smart Inland Shipping* will:

- Build-up a highly skilled workforce for the autonomous inland waterway transport sector;
- Further develop the essential building blocks of the SUDA-model of an AV (Sense the environment, Under- stand the environment, Decide about the next action/ maneuver to take, Act according to that decision) that are needed for an autonomous vessel to take over the role of the human captain and crew;
- Address the many other socio-technical, logistic, economic, and regulatory conditions that need to be met for the successful and future-proof implementation of autonomous vessels in the inland-waterway transport sector.

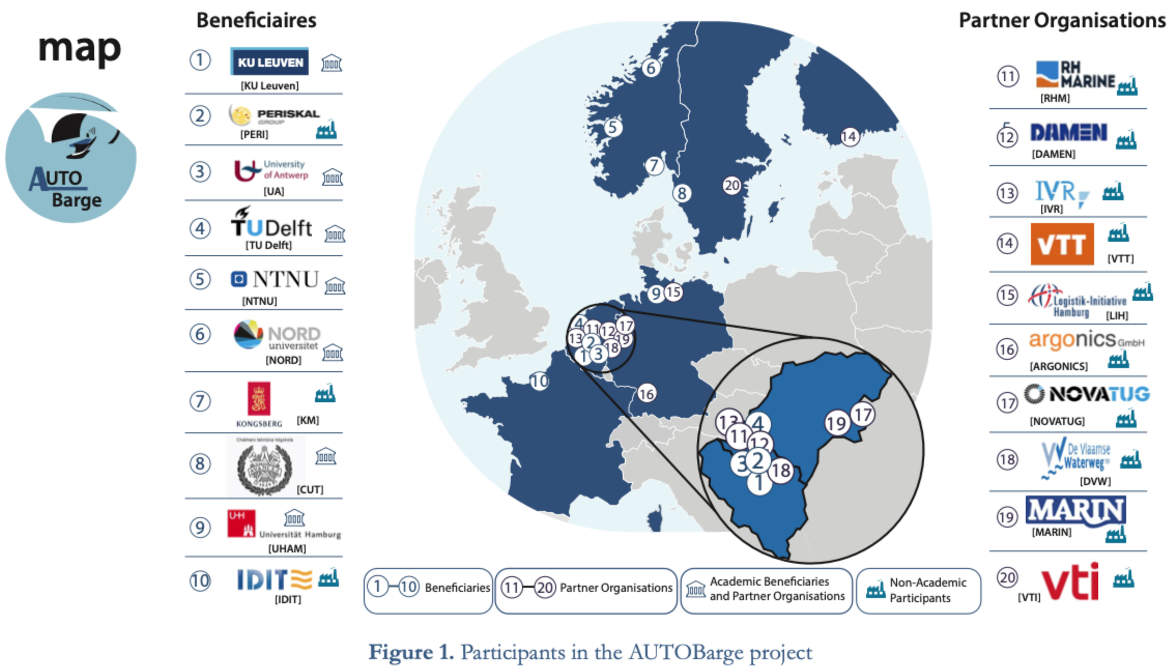

Figure 1: AUTOBarge Consortium

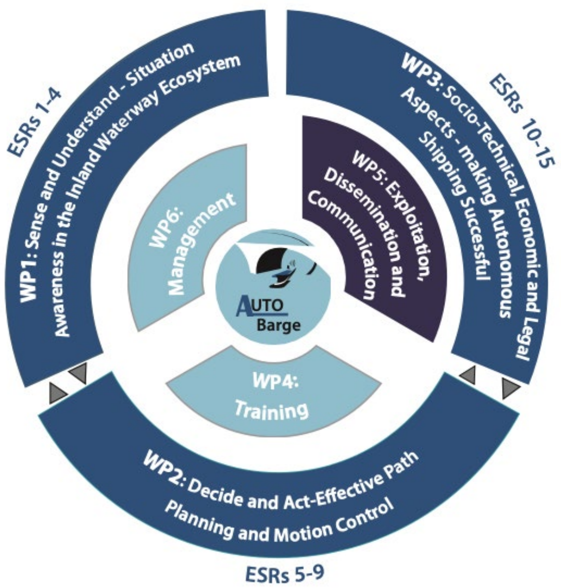

Figure 2: AUTOBarge WPs and ESRs

The AUTOBarge project is based on 6 Work Packages (WPs), three of which are S&T WPs (WP1–3), one for training (WP4), one for Exploitation, Dissemination and Communication (WP5) and one for Management (WP6), see Figure 2. Details of the activities in the 3 research WPs are described below.

WP1: Sense and Understand - Situational Awareness in the Inland Waterway Ecosystem

WP1 involves 4 ESRs and tackles the first two steps "Sense" and "Understand" of the SUDA model for autonomous vessels with the aim to get maximum situational awareness – *i.e., the perception of environmental elements and events with respect to time or space, the comprehension of their meaning, and the projection of their future status* – and take over that part of the role of the human captain and crew in a manually operated vessel. Together the 4 ESRs in WP1 cover a full spectrum: the state and maneuverability of the vessel itself, the location and motion of other vessels, other relevant static and moving objects in the vicinity, features like buoys or traffic signs, and the wireless communication of information between the different waterway actors.

ESR1 takes up the challenge of *developing accurate on-line/runtime models for an inland vessel's (hydro)dynamic behaviour and manoeuvrability.* Ship manoeuvrability has always played an essential role in navigation safety. However, up to now, research in this field has been mainly focused on the behaviour and manoeuvrability at sea. Inland vessels operate in a more complex navigation environment. For sure, the frequently used assumption of free-field conditions valid at open-sea, does not hold for inland waterways, which comprise small rivers, canals, harbours, etc. Moreover, environmental and vessel conditions change more rapidly for inland shipping. One could state that this happens on a quasi-continuous basis. Hence, the current practice of using (hydro)dynamic models which have been predetermined based on sensor data gathered from previous experiments on a "generic" vessel does not lead to the level of accuracy and trust needed for remotely operated vessels, let alone for fully autonomous vessels. Therefore, **ESR1** will establish a new way of working in which the (hydro)dynamic model of a vessel is continuously adapted and kept up-to-date based on sensor data that is gathered during operation. Apart from a strong collaboration with the other ESRs in WP1, **ESR1** will collaborate with **ESR9** (WP2) to validate the developed models on data gathered from available scale-model vessels and to take into account the influence of sensor noise and even sensor faults on the accuracy of the model. After further refinement of the models, these will be validated on a real tugboat, available through the industrial partner NOVATUG.

Whereas **ESR1** considers the so-called "ego-vessel" and tries to answer questions like "Where am I?", "Where am I going?", "How fast am I?", "What options do I have to manoeuvre?", **ESR2** considers the environment and tries to answer questions like "Where are the other vessels?", "Where are the riverbanks?", "Are there any other obstacles?", "Are they stationary or moving?", "If they are moving, where and how fast are they going?". Again, compared to shipping at sea, this task is more complicated for inland waterways as these are much narrower and more confined. Therefore, **ESR2** will focus on *an Extended Object Tracking approach for making an accurate model of a vessel's environment by unifying Simultaneous Localization and Mapping (SLAM), Multi-Target Tracking and sensor fusion algorithms.* Here, SLAM and Multi-Target Tracking are the current state-of-the-art algorithms for dealing with stationary and moving objects, respectively. However, for effective and dependable autonomous inland shipping, both have to be combined and augmented with data coming from both vessel-mounted sensors (radar, camera, lidar) and shore-mounted sensors (radar, infrared cameras). The work of **ESR2** will be a key element for the novel collision-avoidance algorithms developed by **ESR6** (WP2).

ESR3 will run in parallel with **ESR1** and **ESR2** and will work on *the transition from static to dynamic Inland Electronic Navigation Charts (IENC).* An IENC comprises in a digitized format all the relevant charted features necessary for safe navigation on inland waterways, such as bridges, locks, buoys, traffic signs, lights, etc. IENCs are displayed by an Electronic Chart Display and Information System (EDCIS) and integrated into an Inland System ENC (ISENC) database. In a manually operated vessel, the ISENC database greatly eases the vessel's navigating crew workload to pinpoint locations, attain directions, and navigate safely. But IENCs will also be a critical component for the success of remotely operated or fully autonomous vessels. However, to be effective and safe, an IENC to be used by an autonomous vessel must be orders of magnitude more accurate that those used by today's vessels and should provide completely up-to-date information at all times. This can only be achieved if the available navigational information available in the IENC is on a continuous basis and in a dynamic way augmented with real-time point cloud data gathered by a combination of radars, cameras and lidars, which is exactly what **ESR3** will be aiming for. To do so, **ESR3** will start from the latest developments in such dynamic electronic maps for autonomous driving but increase the performance of those algorithms to be able to handle the complexity needed for waterway charts. **ESR3** will interact intensely with **ESR6** (WP2), who will be working on enhanced Track Keeping Pilots integrated inside the ECDIS. Through a secondment at MARIN and a collaboration with DVW, the newly developed dynamic IENC will be directly tested for its practical usability.

Future applications of autonomous systems – including autonomous vessels – will rely heavily on different wireless communication technologies to connect and interact with other devices, infrastructure, the "cloud", etc. Although adding connectivity has its benefits, it also adds fundamental questions and challenges, among which the type of information to be exchanged, the rate at which this has to be happen, and not to forget the required dependability and security. To address this, **ESR4** will conduct an in-depth investigation of *wireless communication protocols for information exchange between autonomous vessels themselves and autonomous vessels and traffic control* with the aim to propose enhancements for higher traffic density, faster response, increased (cyber-)security and overall more robust communication.

WP2: Decide and Act – Effective Path Planning and Motion Control

WP2 targets the third and fourth steps "Decide" and "Act" of the SUDA model for autonomous vessels and will exploit the situational awareness obtained in WP1 for a safe, robust and energy-efficient path planning and motion control of the autonomous inland vessel. Dependable and efficient path planning and motion control is a critical problem for an inland vessel to sail autonomously in the dynamic inland waterway environment. In total, WP2 involves 5 ESRs, with 2 ESRs focusing on model predictive control, 1 ESR on control methods supported by real-time machine learning, 1 ESR on energy efficiency and, finally, 1 ESR on fault detection and isolation schemes.

ESRs 5, 6 and 7 will collaborate to achieve a breakthrough in the area of the planning and control of autonomous inland vessels while accounting for ship dynamics and risks due to grounding and collision. Both **ESRs 5 and 6** will use Model Predictive Control (MPC) as the basis for their research. **ESR5** will use the Model Predictive Control approach to *enhance current Track Keeping Pilots to the needs of autonomous inland vessels*. More precisely, **ESR5** aims at developing control and navigation algorithms to enable an individual ship to keep its track based on the integration of the Track Keeping Pilot with on-board navigation sensors and instruments like the Electronic Chart Display and Information System (EDCIS), the Automatic Identification System (AIS), radars, etc. In addition to this, **ESR6** focuses on the level of the inland waterway ecosystem and will work on *scenario-based Model Predictive Control (MPC) for collision avoidance and traffic control of autonomous ships in inland waterways.* **ESR6** will identify scenarios and their potential sailing hazards (such as static inland waterway infrastructures and dynamic surrounding moving ships) for autonomous navigation to avoid collision and grounding along an unmanned vessel's pre-planned route. Both decentralized (to be implemented on each of the individual ships) as centralized (to be implemented on the inland shipping infrastructure) algorithms will be considered. With research on *real-time multi-objective voyage-optimization algorithms based on on-line machine learning*, **ESR7** will actually act as a connecting bridge between the topics of **ESR5** and **ESR6**. The main novelty in the work of **ESR7** is that the vessel's performance and manoeuvrability (hydro)dynamic model (**ESR1**, WP1) as well as the real-time information about stationary and moving objects (**ESR2**, WP1) will be integrated into a real-time and multi-objective voyage-planning tool. Multi-objective, as it considers different requirements besides collision and grounding, such as estimated time of arrival, port timeslots, surrounding traffic, etc. The models, algorithms and platforms developed by **ESR7** will provide inputs to both **ESR5** and **ESR6**. For example, **ESR5** needs a predefined route (optimized and updated in real-time) as input to the Model Predictive Control algorithm, which can control a vessel's engines and rudders to accurately follow the route (sailing path and time schedule). **ESR7**'s real-time models for voyage optimization will help **ESR6** to predict the trajectories of surrounding ships, allowing online updating of route planning to avoid collision in a given scenario. In the opposite way, all the identified hazards by **ESR6** and the vessel's track keeping capability (**ESR5**) will act as inputs for the entire multi-objective voyage optimization.

ESR8 will go one step further and will *develop a voyage-planning tool that will optimise an autonomous vessel's overall energy consumption*, which is a key element if we want autonomous and electrified vessels to fulfil the promises they hold for reduced CO_2 emissions and, hence, avoid the big burden that current ships have on our climate. Of course, minimization of the energy consumption is bounded by other constraints, e.g., safety should always be guaranteed. Given the fact that environmental circumstances might change quickly in inland waterways, the voyage-planning tool should have the capability to update the planned route continuously while the vessel is sailing. Similar to **ESR7**, two different flavours of the voyage planning tool will be developed: one to implement onboard of the individual vessels and one to implement in onshore navigation centres.

Given the high reliance of autonomous inland vessels on sensor data and on wireless interconnectivity (vessel-to-vessel and vessel-to-infrastructure), the successful operation of inland shipping will become extremely sensitive to sensor faults and communication errors. Unfortunately, no complex system can be considered fault-free. The possibility for and effect of such faults and errors are a safety-critical aspect and must be taken into account during the path planning and motion-control phase. However, appropriate tools to do so are currently missing. Therefore, **ESR9** will develop a *multi-agent framework to identify and diagnose faults locally in their components to ensure safe control and coordination of interconnected autonomous inland vessels*. In the multi-agent framework, each "agent" will monitor one of the interconnected systems or subsystems. The agent's tasks are to detect if a fault occurs, isolate occurring faults such that they do not propagate further in the interconnected inland-waterway ecosystem, and estimate the severity of the hazard that the fault might induce. A close collaboration between **ESR9** and **ESR10** (WP3) focusing on the safety assurance of autonomous vessels will be established within the AUTOBarge programme. On the one hand, the development of the multi-agent framework by **ESR9** can leverage from the ideas within safety monitoring-and-handling frameworks that are currently being developed (mainly) for autonomous driving and autonomous robots. On the other hand, the argumentation of **ESR10** for the safety assurance of inland autonomous shipping needs evidence that the fault-handling role of the human crew has been adequately tackled and that fault-tolerant behaviour has been implemented.

WP3: Socio-Technical, Economic and Legal Aspects – Making Autonomous Inland Shipping Successful

Whereas WP1 and WP2 focused on the underlying technologies needed to develop and use autonomous vessels within inland waterways, there are many other fundamental hurdles to be overcome before autonomous inland shipping will be broadly adopted. Therefore, the AUTOBarge S&T WPs conclude with WP3, which considers the socio-technical, economic and legal aspects that are needed to make autonomous inland shipping a success in the near future. In total this WP involves 6 ESRs, covering safety assurance, collaborative decision making for maximized performance, logistics, economical benefits, and required changes to the regulatory framework.

When it comes to the adoption autonomous systems, the first question is nearly always about safety: how can we be sure that these unmanned or autonomous systems will be reliable and safe under all possible conditions and external inferences? One of the main premises for autonomous ships is that they must be safer than manned ships and that convincing arguments and evidence can be put forward that people can rightfully put their trust into these systems. **ESR10** will develop *generic safety assurance case patterns for remotely operated and fully autonomous inland vessels*. Here, a safety-assurance case is structured argumentation, supported by evidence, intended to justify that the system is designed such that its behaviour is acceptably safe when being put into service. Until now, safety assurance has been based on safety standards to which compliance is demonstrated during the system's design and test phases. However, existing standards are developed primarily for human-in-the-loop systems, where a human can step in and take over at any time. They do not extend to autonomous systems, where behaviour is based on predefined responses to a particular situation. Legacy safety standards focus on failing or malfunctioning components, while for autonomous systems functional insufficiencies (e.g., sensors on board an autonomous vessel that should prevent a collision with other vessels, but do not detect a kayak in 5% of the cases) and unsafe nominal behaviour (e.g., not keeping sufficient distance to other vessels given the current speed and weather conditions) must be taken into account as well.

The inland waterway ecosystem is a very complicated one with many actors. Moreover, it has a history of being a largely self-organized ecosystem where the different actors provide different kinds of services for other actors, but mainly optimize their operation based on self-interest. However, the effectiveness of an ecosystem depends on the extent to which the different actors can actually collaborate with the aim to maximize the overall performance of the full ecosystem. This has been demonstrated by, e.g., the aviation industry, where the concept of Collaborative Decision Making has provided a departure point for many innovations, including intermodal activities to evolve to new business models, practices and procedures. It has improved the operational efficiency of all airport operators by reducing delays, increasing the predictability of events during the progress of a flight and optimizing the utilization of resources. A key element for this is real-time information between airport operators, aircraft operators, ground handlers and air-traffic control. To achieve the same for the inland waterway ecosystem, **ESR11** will work on *data gathering, sharing, and exploitation as a common ground for collaborative decision making in autonomous inland shipping*. By using a bottom-up process, barriers and other obstacles that would hamper a successful implementation of collaborative decision-making in the context of autonomous inland shipping will be revealed. The use of artificial intelligence for the autonomous systems on vessels and on shore will be explicitly considered by ESR11 as data is a key input for those types of algorithms.

ESRs 12 and 13 both focus on the business-related aspects of autonomous inland shipping. On the one hand, **ESR12** will look at the logistic side and focus on the question "Which parts of the total logistic freight transport chain will benefit most from increased autonomy and how can or should this be combined with other types of transportation?" **ESR12** will do this by developing a *freight transport model for the application of autonomous inland shipping taking into account environmental externalities and agent interactions.* On the other hand, **ESR13** will look at the economic side and focus on the question "Under which conditions will autonomous inland shipping be broadly adopted by the current actors in the inland waterway ecosystem and give the most economic benefit?". In parallel with **ESR12**, **ESR13** will develop *an Agent-Based Model for the economic implications of the adoption of autonomous inland shipping*. In collaboration with the many industrial partner organisations in AUTOBarge, the models of both **ESR12 and ESR13** will be applied to real business cases and compare the benefits achieved by partial of full autonomy over no autonomy.

Last, but certainly not least, **ESRs 14 and 15** will take up the emerging challenge of the legal and liability aspects related to autonomous inland shipping. They will work on related but complementary projects. **ESR14** addresses the issue that in essence with the current overall regulatory framework autonomous vessels are actually not allowed on inland waterways, thereby significantly hindering the further development of this sector. **ESR14** will provide policy makers and industry stakeholders with a *toolbox for autonomous inland shipping regulation.* ESR14 will analyse exactly which obstacles currently stand in the way of unmanned shipping and will evaluate the current policy arguments behind those obstacles. Based on how these obstacles have been or are being overcome in other sectors (e.g., airline industry), a proposal will be made for regulatory innovation. **ESR15** will address the issue that the contractual risks born by the different actors in the inland-waterway ecosystem will change with increased autonomy and that contract law needs to be updated for that. To give a simple example: unmanned shipping will remove an important parameter in the whole chain, namely the crew on board. So, who will have to take over the risks that were previously assigned to that crew? Thanks to the participation of IVR, AUTOBarge has a unique opportunity to involve a large network of stakeholders into the research of **ESRs 14 and 15**.

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Appendix 1: Recruitment Procedure and Principles

Advertisement Process: The search for appropriate candidates will start as soon as the project is approved and is initiated through job ads published on ec.europa.eu/euraxess, *Die Zeit*/academics.de, LinkedIn and through personal contacts of the network partners. A preliminary AUTOBarge recruitment web page will be put on-line as soon as possible. A special effort will be made to promote the vacancies at Central and Eastern European universities (e.g. KU Leuven's Central Europe Leuven Strategic Alliance – CELSA)). To attract the right students, the required profiles are clearly listed for each ESR position (e.g. ESR1: mechanical or robotics engineering). Applications are made through an on-line, eligibility-proof form on the AUTOBarge recruitment webpage.

Selection Process: Applications are made through an on-line, eligibility-proof form on the AUTOBarge recruitment webpage. The candidates apply for a maximum of three specific ESR positions and list their order of preference. The Supervisors provide the names of their preferred candidates to the RC, which in its turn produces a short list of candidates: 2 per position. As such a maximum of 30 ESRs (from an expected initial pool of 120-200 candidates) are invited to the Recruitment Event, which coincides with the AUTOBarge Kick-Off meeting (10 Nov 2021, Bruges, BE). During the first day of the AUTOBarge Kick-Off meeting a dedicated training by the KU Leuven HR team will be given to all members of the RC to prepare them on the interviews of the candidates and to make them aware of factors like unconscious gender bias. On the second day, each candidate gives a presentation and is interviewed by the RC.

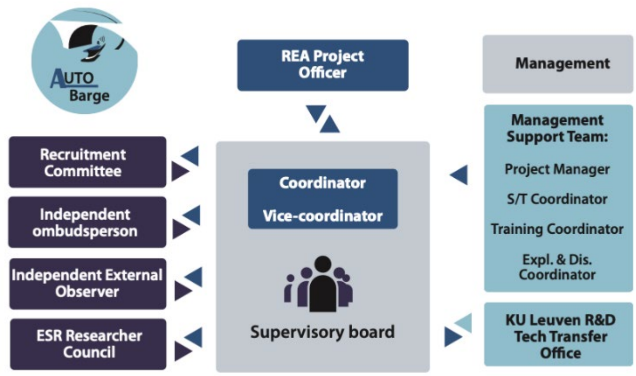

Figure 3: AUTOBarge Project Management Structure

Recruitment Committee = This committee involves the General Coordinator, the Vice-Coordinator and at least one representative per Beneficiary. Its goal is to oversee the recruitment of the 15 ESRs during the collective recruitment event.

Candidates will be given a domain-relevant peer-reviewed paper (prior to the recruitment event) by their prioritised Supervisor and will be asked questions about this paper during the interview to check if the candidate has the right background/profile for the ESR position. After a thorough evaluation, the candidates are ranked, and a collective decision is made. In this way a complementary team of ESRs can be assembled, as positively experienced from previous ETN recruitment events at KU Leuven (e.g. PETER, SAS, SULTAN).

In case not all 15 ESRs can be recruited during the collective Recruitment Event, the recruitment procedure is "decentralised", meaning that the involved supervisors continue the search for good candidates. The GC is kept informed at all times when new eligible candidates appear. The GC makes an official complaint in case the Code of Conduct for the Recruitment of Researchers is breached. The involved supervisor is then expected to find another candidate. Recruitment problems are also, if still needed, discussed during additional RC meetings in order to deliver specific action plans to target specific networks relevant for the vacant ESR positions. All details concerning the recruitment-procedure principles are communicated on the on-line application portal, so that potential ESRs know exactly what to expect and are stimulated to apply.
All the recruitment is in line with the European Charter for Researchers, providing the overarching framework for the roles, responsibilities of both the researchers and employers. The Code of Conduct for the Recruitment of Researchers functions as a set of principles and ensures that the selection procedures are transparent and fair. The recruitment strategy for AUTOBarge will fully comply with the Code of Conduct's definition of merit. For example, merit is not just measured on researchers' grades, but on a range of evaluation criteria, such as teamwork, interdisciplinary knowledge, soft-skills and awareness of the policy and economic impact of science. The Recruitment Committee has members of each gender and considers the promotion of equal opportunities and gender balance as part of the recruitment strategy. Special efforts are made to attract women and ESRs from new EU Member States. AUTOBarge aims at a participation of 50% female ESRs in the network. Researchers are employed on fixed-term contracts and are registered as staff candidates for PhD degrees. Therefore, they are entitled to pension contributions, paid holidays, and other benefits as governed by the universities and industrial companies.