HABILITATION THESIS SUMMARY

"EFFICIENT AND SUSTAINABLE PLANNING AND OPERATION IN NAVAL TRANSPORT"

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In accordance with the provisions of the current legislative framework (Order of the Minister of Education no. 3998/2024 for the approval of the Methodology for granting the habilitation certificate), the present habilitation thesis represents the synthesis of the capacities and main teaching and research performances of the candidate Cdor. Assoc. Prof. Dr. Eng. Dinu-Vasile ATODIRESEI. It encompasses the evolution of the candidate's academic, scientific and professional career, namely the main research directions in the field of Transport Engineering, based on the development of advanced methods for planning maritime navigation routes, transporting and operating dangerous goods, as well as quantifying the negative external environmental effects associated with naval transport.

The habilitation thesis "*Efficient and Sustainable Planning and Operation in Naval Transport*" is prepared in accordance with the Regulation on habilitation and granting the quality of doctoral supervisor within IOSUD-UNSTPB, fulfilling the structural requirements provided in art. 11 and art. 14 regarding the documented presentation of scientific and professional achievements obtained after obtaining the doctoral title, highlighting the originality and relevance of the contributions, as well as outlining the main directions for the development of the academic and research career. The work is written in Romanian and is accompanied by an extended summary in English, in accordance with art. 14 para. (2), and its structure -- centered on the chapters regarding scientific activity/scientific achievements and the evolution of the teaching and research career, respectively the development of research team coordination capacities -- corresponds to the habilitation thesis model requested by IOSUD

The scientific approach represents the major component of the thesis, which incorporated the three research directions into the concept of efficient and sustainable operation in naval transport. The references concerning the author's academic and professional activity were integrated both in the general field of Transport Engineering and in the specific field of Naval Engineering and Navigation. All of these formed the basis for developing the personal plan for evolution and development of the academic career and future research topics, substantiating the potential for developing the university career in the sphere of supervising doctoral work. Structurally, the work includes the classic elements of a habilitation thesis: Scientific activity/Scientific achievements (Chapter 1), respectively Evolution in teaching/research career and development of research team coordination abilities (Chapter 2);

The approach of using digital technologies and systemic modeling within different components of the maritime industry represented the scientific nucleus for the major research directions.

Chapter 1: Scientific activity/Scientific achievements:

Theoretical and strategic foundation

The first chapter addresses from the beginning the issue of efficient planning and operation of naval transport, under current legislative and technological constraints, and directly connects it with the conceptual framework of maritime sustainability. Maritime sustainability is articulated around three fundamental dimensions: economic (viability of maritime operations), environmental (reduction of emissions and conservation of biodiversity), and social (protection of seafarers and fair labor practices). Furthermore, the central objective was established to identify and integrate the elements that contribute to efficient and sustainable planning and operation in naval transport, ensuring navigation safety, economic performance and compliance with environmental protection objectives according to international legislation (IMO 2023, FuelEU Maritime, EU ETS). Efficient and sustainable planning refers to the multifactorial process through which the routes, speeds, resources and operating procedures of ships are defined, based on technical, meteorological, operational and normative information, ensuring compliance with SOLAS, STCW and SMS requirements.

The establishment of major research directions (DMC1--DMC3) was based on a set of criteria: own scientific achievements (publications in the field with their scientific relevance); research projects; development of new disciplines and course content and publication of teaching materials, books and

book chapters, after obtaining the doctoral degree; personal competencies acquired during the teaching and professional career, training courses with obtaining certificates in the field of modeling and simulation, guidance of students in the sphere of scientific research; international (IMO, EU, NATO, etc.) and national regulatory context in the field and its evolutionary dynamics; practical-applicative character generated by relevance on the labor market in the naval industry or national security (critical infrastructure);

Major research directions and developed research methodologies:

The research is structured on three major research directions (DMC), each with the objective of addressing specific challenges associated with efficient planning and operation for sustainable maritime transport:

DMC1: Planning maritime navigation routes.

This direction addresses route planning as a central element of bridge management (BTM/BRM), with the aim of ensuring safe navigation, energy efficiency and environmental protection, in full compliance with international regulations. Voyage planning is treated as a multi-stage process, based on an integrated set of information sources (nautical charts and publications, shipowner/charterer instructions, meteorological and hydrographic information, navigation warnings) and on the consistent application of risk analysis and cost-benefit principles.

Methodologically, DMC1 is built on three main categories of research methods (**MC**): **MC1-** route planning using intelligent navigation software products (ECDIS, BVS, SPOS, etc.) that integrate specific ship characteristics, nautical charts and publications, weather forecasts and oceanographic data in real time or statistical; **MC2-** cost-benefit analyses regarding the adaptation and implementation of renewable energy systems (wind and solar potential in the NW Black Sea) aboard ships and equipment serving coastal navigation; **MC3** supporting the explicit integration of port performance and congestion in the conceptual architecture of maritime route planning. These methods were documented and implemented within the PSCD projects (134/2020; 164/2017; 142/2016), *NAVY-INS-Tech* and *MARINETECH*.

Through the use of advanced planning software, navigation routes were comparatively analyzed, demonstrating the impact of route choice on fuel consumption, voyage duration and environmental risk. The implemented algorithms model the dynamic behavior of the ship under the influence of weather and oceanographic conditions, allowing real-time route reconfiguration based on future weather forecasts, thus ensuring increased economic efficiency of voyages. Furthermore, a multi-layered framework was proposed that combines deterministic queue analysis with cost and emissions modeling and robustness verification through stochastic simulation. The results obtained were validated through ISI/BDI indexed publications, which confirms the topicality of these directions correlated with the requirements of the labor market in the naval industry.

Major conclusions for DMC1: The integration of intelligent navigation systems with METOC databases allows significant reduction of fuel consumption (estimated 5-15% on typical routes), increased route safety through better anticipation of extreme hydrometeorological phenomena, and compliance with IMO GHG Strategy and SEEMP objectives. From the sustainability perspective, route planning, treated as a continuous and digitally assisted process, becomes an essential tool for achieving global decarbonization targets and meeting energy reporting requirements. Waiting times at anchorage can no longer be considered an inevitable side effect, but become a central element in voyage efficiency evaluation, as they determine direct fuel costs, port charges and penalties associated with emissions, including under European regulatory schemes.

Future research directions for DMC1: Extension of the performance level of route planning systems through integration of advanced artificial intelligence and machine learning techniques in dynamic risk estimation and automatic route selection according to multiple scenarios (navigation safety, intense maritime traffic, special weather conditions, environmental restrictions). Consideration is also given to the development of interoperable decision support modules (military-civil on navigation safety), which integrate METOC data, real-time AIS, ECDIS through integration of the IHO S100 standard and renewable energy modules on board, respectively evaluation of scenarios for using autonomous or semi-autonomous ships in areas with complex hydrometeorological conditions. The need to integrate real-time data -- AIS, hydrometeorological information and port performance data -- into digital decision support platforms will form the basis of recommendations regarding ETA dynamics,

optimal speed on route and, possibly, the port of call, depending on anticipated congestion, fuel costs and costs associated with emissions.

DMC2: Naval transport and operation of dangerous goods

DMC2 extends the digital approach to the field of transporting and operating dangerous goods, where safety, operational and environmental risks are significant, and compliance requirements (SOLAS, IMDG, IMSBC, IBC, IGC Codes, MARPOL Annex III) are very strict. The direction also aims to develop an integrated decision support framework for planning, monitoring and risk assessment in supply chains that include dangerous goods, both in port and at sea.

Research methods include: **MC1** - development of quantitative models for risk assessment associated with evaluation of operational disruptions in the case of dangerous goods (petroleum supply chains) and human errors (Fault Tree Analysis (FTA) method); **MC2** -- creation of scenarios integrating simulation and numerical modeling of human-ship interactions (including ship-tug interaction, port maneuvering, limit conditions); **MC3 -** development of methods that develop digital decision support systems (through integration of METOC information, navigation data and operational databases, for evaluating impact on missions and logistic flows.)

The conducted studies developed a risk-based simulation framework to optimize multimodal logistic flows of petroleum products, specifically focusing on diesel operations at Midia Port. Human error, particularly crew negligence, emerged as the main risk factor, aligning with global findings on maritime safety. Technical failures and adverse environmental conditions also contributed significantly to operational vulnerabilities. Through quantitative probabilistic modeling, the probability of a major incident was calculated at 2.39%, while the total normalized operational risk was determined to be relatively low (6.93×10^{-6}). By integrating FTA for human error analysis, the conclusion is strengthened that the human factor remains determinant in supply chains with dangerous goods and that it can be treated in a structured manner, compatible with requirements from IMDG, ISM and risk/management guidelines.

Understanding the human-ship-tug interaction in the developed scenarios represented the transition to numerical design of a tug/intervention platform adapted to these requirements and prepared for simulation. The innovation consists in developing new real-time intervention methods, based on the "intervention platform - integrated navigation simulator" duplex applied within the *PLATMARISC* project, which allows crews to apply optimal intervention solutions in the case of operating dangerous goods, generated through simulation.

Also, as distinctive results, we mention the creation of software products adapted to the specifics of military or civilian ships transporting dangerous goods from class 1 IMDG code, which compile in real time reports on navigation safety and METOC (Meteorology-Oceanography) hydrometeorological conditions that can integrate weapons/operation systems in the case of civilian ships and mission duration, specific for the northwest Black Sea contributing to improving the efficiency of naval missions and operations.

This application serves as an operational tool for supporting military and civilian maritime route planning of ships transporting and operating dangerous goods aboard them, using hydrometeorological forecasts particularized to operational requirements for civilian ships engaged in specific activities at critical infrastructure (oil/gas prospecting and drilling - class 2 IMDG Code, submarine cable and pipeline installation, dangerous goods operation at offshore terminals)

Major conclusions for DMC2: Integrated digital systems can significantly reduce uncertainty in operating dangerous goods, ensuring better anticipation of incidents and clearer structuring of response procedures. Business process simulation using AuraPortal BPM Modeler demonstrated that workflow improvements could reduce operational delays by 25%, significantly enhancing logistic efficiency and system resilience. Overall, the research underlines the critical importance of integrating real-time monitoring, predictive risk modeling and automated workflow optimization to secure the efficiency and safety of oil supply chains in increasingly complex and risk-prone operational environments. Risk

models based on FTA highlight critical vulnerabilities in petroleum and chemical supply chains, and allow definition of risk reduction measures adapted to each ship category and cargo type. Integration of these systems with crew training procedures and intervention protocols contributes to achieving high standards of safe operation.

Human-machine interaction exercised in the virtual environment is a necessary condition for increasing safety in real operation of dangerous goods. The fact that officers and students can test, in a controlled environment, the consequences of opening or closing a certain set of valves, starting or stopping pumps, ballast modifications or reactions to alarms regarding the quality of inert gas, allows identification and correction of erroneous mental schemes before they reach aboard ships.

Rigorous numerical design of an intervention platform/tug, correlated with environmental load modeling and development of a dynamic model usable in simulators, is essential to have effective intervention means in case of incident in coastal and port areas. An intervention unit with well-known characteristics of buoyancy, stability and maneuverability (in the case of the PLATMARISC project the general characteristics of the tug/platform were established with the economic agent Coremar S.A., taking into account operating conditions - tug berth length, equipment arranged on board, established missions, etc.) can be integrated into simulation scenarios together with loaded tankers, to test assistance and intervention tactics in case of collision, propulsion failure or pollution risk.

Future research directions for DMC2: Future topics intended to achieve performance will also be based on this direction on new technologies in accordance with IMO legislation, and as a legislative foundation reporting will be done to the International Safety Management Code (ISM Code). Research directions incorporating these topics can be grouped as follows: Extension and generalization of digital decision support systems developed in MC1; Development of a complex platform for simulation of maneuvering and operation of ships with dangerous goods, starting from MC2, Deepening of quantitative risk models and BPM simulation from MC3, through integration of incident data from external sources (maritime agency reports) for calibration and validation of developed models; Construction of a unitary model of integrated management of the human factor, safety and on-board conditions.

Future research may aim at defining integrated training modules, in which trainees move from simulating ship maneuvering with tugs, to simulating cargo installation operation and to simulating intervention in case of breakdown, using both LCHS 5000 and NTPRO 5000 but also *Platmarisc* models. Such an approach would respond to international requirements to address dangerous goods transport safety in a holistic manner, which integrates ship, installations, tugs and human factor in a single simulation and training ecosystem (Yorulmaz et al., 2025; Benedict et al., 2025; Piotrowski et al., 2025). Therefore, I consider that in a relatively short time, the research directions stated above can merge and have a new adapted name: *"Integrated management of human factors, maritime safety and on-board conditions of ships transporting and operating dangerous goods through advanced digital systems".*

DMC 3: Negative external environmental effects of naval transport.

DMC3 integrally addresses the negative external environmental effects associated with naval transport, focusing on pollution with hydrocarbons and chemical substances (MARPOL Annexes 1-2), as well as pollution with ballast water and underwater noise, relevant for marine biodiversity. The direction is structured in two main stages: predictive modeling of pollution and management of depollution interventions, respectively development of ecological technologies and acoustic evaluation methods for protecting marine ecosystems.

MC 1: Predictive modeling and management of depollution interventions. The MC1 method consists of integrated predictive modeling of pollution with petroleum products and chemical substances through use of GNOME v.47.2 software (simulation of pollutant movement under the influence of currents and wind) and ADIOS2 v.2.10.2 (evaluation of intervention methods: in situ combustion, chemical dispersion, mechanical recovery), completed with proprietary algorithms in Python that implement diffusion-advection-reaction equations to capture the complex behavior of pollutants under the influence of hydrometeorological parameters (salinity, temperature, turbidity, etc.).Validation of these models on real incidents, including post-incident simulation of spills from sunken oil tankers in the Kerch Strait (December 2024), demonstrates their operational applicability in support of structures responsible for disaster interventions (ARSVOM, Border Police, General Staff of Naval Forces).

MC2: Ecological technologies and acoustic evaluation. MC2 aims at achieving and applying new ecological technologies for treatment of contaminated waters (especially with hydrocarbons according to MARPOL Annex I and ballast waters according to BWMC Convention), through evaluation of existing systems and development of anti-pollution biomaterials (for example, based on *Rapana venosa* and chitosan extracted from local marine species), applicable according to BWMC (Ballast Water Management Convention) requirements.

Research methods also include evaluation of the underwater noise level generated by ships, which constitutes a significant source of disturbance for marine fauna. For acoustic pollution, passive acoustic measurements (PAM) correlated with AIS (Automatic Identification System) data are used, with standardized indicators for measurement processing. Acoustic signals are processed through STFT (Short-Time Fourier Transform) and DWT (Discrete Wavelet Transform) methods, and results can be correlated with audiograms of sensitive species (e.g., *Tursiops truncatus* dolphin) to determine areas and scenarios of high ecological risk. This approach allows evaluation of ships' acoustic footprint and development of strategies for protecting marine fauna sensitive to acoustic emissions.

Major conclusions for DMC3: Predictive modeling of pollution and development of standardized methods for evaluating chemical and acoustic pollution allow not only a faster and more efficient response in case of incident, but also better planning of routes and maritime operations in areas with increased ecological sensitivity (dolphin reproduction areas, marine protected areas). From the sustainability perspective, results show that developed ecological technologies and numerical tools can contribute to reducing the cumulative impact of naval transport on coastal and offshore ecosystems, in line with IMO, EU requirements, and regional initiatives regarding marine environmental noise.

Future research directions for DMC3: Development of integrated "ecological risk - route - ship type" models, which couple results of GNOME/ADIOS2 simulations with ecological sensitivity maps and maritime traffic scenarios, for efficient route planning in the context of environmental protection. Extension of research on biomaterials for decontamination, with a view to implementing them in scalable technologies aboard ships and in port infrastructure (ballast water treatment stations, waste management centers). Consideration is also given to consolidating a long-term database on underwater noise and correlating it with biological data (dolphin observations, marine fauna distribution indicators) and operational data, so that national and regional policies regarding noise limits and preferential routes for protecting biodiversity can be substantiated.

Chapter 2 -- Evolution in teaching/research career and development of research team coordination abilities

2.1 Teaching and professional activity

The author's academic path reflects a clear progression from initial multidisciplinary training (military engineer specialized in underwater weapons - bridge officer aboard military ships and ecologist) to the current position of associate professor at the "Mircea cel Bătrân" Naval Academy. This dual competency proved essential for the integrated approach to the topic of this thesis, combining technical expertise in the field of naval transport, dangerous goods operation with deep understanding of impact on marine ecosystems. My teaching and professional activity takes place within the "Mircea cel Bătrân" Naval Academy in Constanța and is closely correlated with the evolution of my scientific career and with the three major research directions presented in chapter 1.

The chronological path of positions held by the candidate reflects both the development of teaching and research competencies, as well as involvement in academic management and in consolidating the Academy's institutional role in the national system of training specialists in the maritime field. He obtained the title of Doctor Engineer in 2012, and from that moment teaching activity evolved progressively, from advanced university instructor to associate professor, going through all hierarchical levels. Extensive managerial experience contributed significantly to institutional modernization and development.

Under his leadership, new study programs were accredited, quality assurance systems were implemented in accordance with international standards (STCW, ISO 9001:2005, NATO, etc.), strategic partnerships were developed with the naval industry (especially shipping companies) and international academic institutions, new equipment, technologies, NATO work procedures were implemented in the educational process in accordance with the requirements of beneficiaries from the Ministry of Transport or Ministry of National Defense.

In didactic terms, he conducted teaching, seminar, laboratory, project activities in disciplines in the field of transport engineering and navigation, with emphasis on forming the necessary competencies for efficient and sustainable planning and operation of naval transport. The disciplines in which he was involved cover both the bachelor's level (study programs Navigation and maritime and river transport, Navigation, hydrography and naval equipment), the master's level (Nautical Sciences, Oceanography-Hydrography) as well as membership in guidance and academic integrity commissions within doctoral schools, being correlated with research topics and including courses such as *Transport and operation of dangerous goods, Safety of life at sea and marine environment protection, Marine hydrography and hydrographic surveying, Marine meteorology and oceanography, Marine environment protection*, etc.

Teaching activity also included preparation and updating of course syllabi, correlation of content with STCW competency standards and labor market requirements, as well as integration of own research results into course content.

In parallel with teaching activity, professional experience gained in the operational naval environment was directly valorized in the student training process. I sailed six years aboard ships: four years as chart officer and second on military ships participating in numerous international missions (*Cooperative partner* 1997, 1998; *Black Sea partnership* 1998, 1999; *Sea Breeze* 1998; *Joint missions with the American cruiser Yorktown* 1997), with direct responsibilities in route planning, dangerous goods transport and operation, followed by two years as IMO accredited instructor aboard the training ship "Mircea" or transport training ship "Albatros", coordinating students' practical training on international voyages.

This direct operational experience offered me not only solid theoretical knowledge, but also deep understanding of risks associated with operating dangerous goods, application of safety procedures and importance of decisions made in real time in ship operation. I obtained five IMO instructor certificates according to STCW standards, specializing in simulator operation for navigation (NTPRO 5000) and for dangerous goods (LCHS 5000, TechSim 5000 -- LNG Membrane Tanker, LNG Terminal, Chemical Tanker, Product Tanker). This professional background contributed to increasing the applicative relevance of my teaching and research activity, while facilitating dialogue with industry representatives and direct beneficiaries of academy graduates.

Regarding managerial activity, I successively held leadership positions: department director, vice-dean, dean, didactic vice-rector and, currently, president of the ANMB Senate. This evolution allowed me direct involvement in restructuring and modernizing study programs, implementing quality assurance systems according to ISO 9001:2005 standards and consolidating institutional relations with the socio-economic environment. I coordinated the accreditation and development of study programs -- bachelor programs "Navigation and maritime and river transport", master programs "Nautical sciences" "Oceanography and hydrography" (unique in Romania), as well as continuing education programs in accordance with STCW requirements. For programs intended for Ministry of National Defense students, I implemented NATO procedures and standards, ensuring compatibility of training with requirements of multinational military operations.

I supported and coordinated the acquisition and implementation of latest generation simulation equipment: simulators for dangerous goods operation, METOC laboratories equipped with weather stations and forecasting systems, bathymetry and oceanography equipment for applied research, which were implemented in a substantial portfolio of teaching materials, including manuals (6) for the aforementioned profile disciplines and 4 laboratory guides for using specialized software products in dangerous goods transport and operation, marine pollution modeling, as well as project management. The acquired experience thus contributed to developing an integrated vision of the institution's role in training human resources for the maritime field and to correlating teaching and research activity with national and international needs for security, efficiency and sustainability in naval transport.

2.2 Development of research team coordination abilities and international collaboration

Research team coordination abilities developed gradually, in correlation with involvement in research-development and innovation projects, as well as through student guidance activity in bachelor's theses, dissertations and scientific research. The candidate consolidated his research team coordination abilities in a continuous process, demonstrated within the 7 projects coordinated as director/responsible (1 international project, 1 national project within the Operational Competitiveness Program (POC), 5 projects at national level within the Sectoral Research-Development Plan of MoND (PSCD) that

addressed diverse research directions and topics. Statistically, these totaled over 140 teaching staff, researchers, research assistants, coming from universities in the country or abroad, as well as over 50 PhD students, master's students and students directly involved in research activities whose finality materialized through tangible results (over 30 works of coordinated students were published in national and international conferences, and 10 received awards at student scientific competitions).

In addition to previously coordinated projects, I had coordination or work package leadership responsibilities within the *MARINETECH* project dedicated to intelligent technologies for oceanography and navigation, NAVY-INS-TECH (NATO partnership) for advanced navigation systems in military operations, IMINT for Black Sea basin security, as well as a series of national projects related to PSCD. The aforementioned projects involved interdisciplinary and interinstitutional collaborations, which required managing mixed teams, formed of teaching staff, researchers, PhD students, students and specialists from the industry. Coordinating these teams required both scientific competencies and resource, time and communication management abilities, contributing to consolidating my profile as research team coordinator.

Also, throughout my career, I have coordinated over 250 students in preparing bachelor's theses and master's dissertations, guiding them in the process of rigorous and applied scientific research. The high number of students coordinated on the three major research directions -- planning maritime navigation routes, dangerous goods transport and operation, respectively negative external environmental effects of naval transport -- allowed validation and refinement of work methods, analysis structures and modeling tools that were subsequently integrated into own research.

My approach to research guidance was personalized, each student receiving a topic aligned with the three major research directions, but adapted to their specific interests and competencies from aboard ships, trying to integrate students into ongoing research projects, offer them access to real equipment and databases, connect them with professionals from industry for practical feedback. Representative examples of coordinated works include: on DMC1, topics such as "Optimization of maritime routes through integration of METOC data in ECDIS" (2019) and "Analysis of energy efficiency on alternative routes" (2021); on DMC2, works such as "Evaluation of operational risk in petroleum supply chains" (2020) and "Simulation of emergency scenarios in LNG transport" (2018); on DMC3, topics such as "Modeling of pollutant dispersion in the Black Sea" (2022) and "Technologies for reducing naval emissions" (2023). Through guiding students toward scientific research, I aimed to achieve a direct link between teaching and research activity. Thus, prepared works addressed topics aligned with major research directions, using quantitative and qualitative methods similar to those used in own publications and projects.

International collaboration: international activity, academic networks, invited lecturer, teaching stages and other international activities

The international collaboration component played an important role in developing the academic and research career. My expertise in the field of maritime transport was recognized not only at national level, but also internationally, opening opportunities for collaboration and contribution to developing global maritime education. I was invited as professor within the Erasmus+ program or within different activities from research projects, working as professor/specialist at universities such as: Naval Academy of Bulgaria, Liepaja Maritime College (Latvia), University of Ruse (Bulgaria), Odessa National Maritime Academy (Ukraine), Technical University of Varna (Bulgaria), Military University of Technology (Poland), Polish Naval Academy (Poland), University of Ljubljana (Slovenia), Greek Naval Academy (Greece), Piri Reis University (Turkey), Naval Academy of Turkey, University of Split (Croatia). Within these mobilities, I taught courses, participated in developing joint study programs, exchanged pedagogical and research experience with colleagues from these institutions, consolidating the European maritime academic network.

As dean and later didactic vice-rector, I was involved in the Naval Academy's joining BSAMI (Black Sea Association of Maritime Institutions) and IAMU (The International Association of Maritime Universities), while also working as research project evaluator within IAMU (competition: Research Proposals for IAMU's Research Projects in FY 2022), thus contributing to identifying and promoting the most innovative solutions for safety and sustainability of maritime transport at global level. Also, on the line of specialty training, I am a member of OceanExpert - A Directory of Marine and Freshwater Professionals OceanExpert. After completing the course "*The Challenge of Securing Maritime Areas for*

the European Union", I work as course director "*Meteorology and Oceanography: - METOC*", organized annually under the aegis of European Security and Defence College (ESDC) on the line of navigation safety on maritime routes within ANMB.

At institutional level, as part of management personnel, the author was part of the coordination committee in organizing the 21st ENASC Conference -- Conference of European Naval Academy Superintendents (May 2018) and the 18th International Military Academic Forum (June 2025), or the ESYO Conference (European Seminar for Young Officers), organized by the Naval Academy with significant international impact.

Also, the candidate worked as member in the scientific council of international conferences organized by the Naval Academy: Nav-Mar-Edu 2011-2015, Master-Nav 2011-2024, Cadet-Nav 2011-2024, Sea Conf 2015-2025, respectively as reviewer within the Sea Conf International Session 2015-2025, member of the scientific committee of "Fifth International Workshop on Advanced, Nano and Biomaterials and Their Applications Fifth French-Romanian Topical Meeting on Nano and Biomaterials.

As coordinator/member for a series of international projects, Dr. Eng. Atodiresei Dinu-Vasile was coordinator and board member for numerous events/seminars/training modules organized within these European projects (*Blue4seas, Ins-Navy-Tech, Cul-Mar-Skill, Healthy Sailing, Marinetech*, etc.)
International recognition of my contributions materialized through several distinctions: three distinctions awarded by the Minister of National Defense for contributions in the naval-military field and four "Admirals' Club" awards for scientific contributions in maritime transport. International collaboration also contributed to developing research and education infrastructure, through projects that aimed at equipping laboratories, modernizing simulators and updating curricular content in accordance with technological and normative evolutions in the maritime field. In this way, research team coordination and international collaboration mutually supported each other, generating a conducive framework for developing a research school with defined profile in the area of efficient and sustainable planning and operation in naval transport.

2.3. Plans for evolution and development of academic career including future research (methods and topics) approached with potential PhD students

Foundation of personal plan for evolution and development of academic career based on professional and academic profile

The personal plan for evolution and development of academic career is based on the professional and academic profile built at the intersection between teaching activity, scientific research and operational experience in the maritime field. This profile, based on combining competencies of bridge officer, mechanical engineer in underwater weapons and specialist in marine environment protection (the bridge officer-engineer-ecologist trinomial) offers the premises for developing a coherent direction of doctoral research coordination in the area of efficient and sustainable naval transport.
The strategic vision of the development plan takes into account the contribution to training a new generation of researchers and specialists capable of responding to challenges generated by new international regulations (IMO Strategy 2030/2050, FuelEU Maritime, EU ETS), accelerated digitalization of the maritime industry and decarbonization objectives of naval transport. In this context, I intend to valorize the already consolidated major research directions (DMC1, DMC2 and DMC3), through formulation of doctoral topics that deepen and extend the results obtained to date.
My personal strategic plan is thus based on the following directions:

- Development of interconnected intelligent digital systems, intended for real-time support for efficient route planning aboard civilian and military ships in the NW Black Sea area (assisted by AI and machine learning). The systems will be based on my previous research on creating hydrometeorological databases (METOC), integration of existing software products intended for: efficient route planning (SPOS, BVS, ECDIS, etc.), dangerous goods operation (TechSim 5000: LNG Membrane Tanker, LNG Terminal, Chemical tanker, Product tanker), marine pollution modeling (GNOME/ADIOS2, PISCES) but also energy efficiency depending on offshore energy potential (EEOI);
- Development of new disaster intervention platforms in the Romanian Black Sea coastal area (starting from experience gained in PLATMARISC and IMINT projects), based on modular maritime drone systems, capable of being equipped (as the case may be) with: sensor systems (data collection in deeply harmful environments -- chemical pollution, radioactivity), intervention (life saving at sea, depollution), monitoring (naval traffic monitoring, polluted area evolution, acoustic footprint

monitoring, etc.). Platforms will be interconnected with the navigation simulator in real time, for evaluation (prognosis) and assisted intervention of specialized structures (ARSVROM, Border Police, General Staff of Naval Forces, etc.);

- Extension of interdisciplinary doctoral research. As I mentioned at the beginning of my presentation, I owe a good part of my personal achievements to teamwork. I consider that, based on accumulated experience, I can contribute to developing interdisciplinary studies at the level of a doctoral school on the 3 major research directions supported by this habilitation thesis. These directions, supported by artificial intelligence, machine learning and regulatory compliance systems, meet the academic requirements of a future doctoral school, but also the applicative-practical requirements of research in the maritime field;
- Creation of a mixed team formed of PhD students and researchers within the Research Center of "Mircea cel Bătrân" Naval Academy, on the line of efficient route planning, research intended for dangerous goods operation and pollution management technologies aboard ships (according to Annexes 1-6 *Marpol 73/78*), respectively implementation of technologies related to renewable resources. Through the newly created research team, viable project proposals can be submitted to internal and international competitions on the stated topic.

Future academic research (methods and topics) approached with potential PhD students on major research directions (DMC)

1. Planning maritime navigation routes

Based on results obtained within Navy-Ins-Tech and Marinetech international projects, artificial intelligence is increasingly used in ship route planning to optimize routes, reduce fuel consumption and reduce emissions, thus contributing to consolidating the development of the concept of intelligent maritime routes. "Dynamic routing" systems will use IoT sensors, AIS and big data analyses for continuous monitoring and adaptation of ship route, with the aim of reducing consumption and operational risk, with the aim of obtaining applicable solutions in real operational scenarios.

Basing on my academic activity and institutional involvement through projects (PSCD no. 164/2017; PSCD no. 134/2020 and Platmarisc), the following methods and research directions can be addressed: planning navigation routes through implementation of intelligent navigation systems; adaptation and implementation of renewable energy systems aboard ships through processing and use of hydrometeorological parameters recorded in databases and algorithms regarding implications on energy efficiency

2. Naval transport and operation of dangerous goods

Addressing the sustainability dimension of dangerous goods transport and operation from the perspective of human factor risk management will be a priority. Also, workplace improvement is also included in the sustainability dimension, I intend to propose doctoral research topics that will incorporate modern research methods and equipment (TRANSAS simulators), as well as advanced knowledge acquired as instructor for dangerous goods simulator operation (TechSim 5000: LNG Membrane Tanker, LNG Terminal, Chemical tanker, Product tanker), which will support PhD students, oriented on 4 secondary directions: extension and generalization of digital decision support systems; development of a complex platform for simulation of maneuvering and operation of ships with dangerous goods; deepening of quantitative risk models and BPM simulation; construction of a unitary model of integrated management of human factor, safety and on-board conditions.

Future research will also focus on developing *digital twins* for dangerous goods terminals with real-time monitoring through IoT technologies and multi-parametric sensors, extension of risk models toward multi-hazard scenarios (weather + technological + cyber + conflict), and advanced simulation of human-machine interaction in operating LNG, chemicals and petroleum products on full-mission simulators.

3. Negative external environmental effects of naval transport

Having as starting point the methodological foundation laid in my doctoral thesis and subsequent experience accumulated within international projects (Ex. *Blue4Seas, Marinetech, RoNoMar*) and national *(Platmarisc, Imint*, 4 projects from MoND PSCD), I consider that the direction is based on 2 future fundamental pillars:

a. Integrated predictive modeling of marine pollution with hydrocarbons and chemical substances and depollution interventions, which will include creation of modeling and simulation

programs, deep learning algorithms and high-resolution sensor data for improving predictive accuracy and operational preparedness. Integration with real-time monitoring systems will allow faster responses to pollution incidents. These topics are not only at the frontier of current scientific research, but are increasingly relevant for shipping companies, port authorities, terminal operators and other entities participating in using maritime space according to the Maritime Space Planning approved by Emergency Ordinance no. 97/2023.

b. Ecological technologies for ballast water treatment and noise level evaluation intended for marine biodiversity protection. Doctoral students will be able to address at least two of the important problems at the level of marine biodiversity protection: ballast water treatment and those polluted with chemical substances aboard the ship (current problem, with major impact at biodiversity level) and one from a legislative perspective -- mandatory regime for controlling underwater noise emitted by maritime transport.

In conclusion, through the scientific content and through the way of capitalizing the research and innovation portfolio, the candidate has tried to respond at the same time to the specific conditions for granting the quality of doctoral supervisor in the Doctoral School of Transport, provided in art. 13 of the Regulation on doctoral university studies within the Doctoral School of Transport. The work capitalizes on a consistent portfolio of publications and projects in the field of Transport Engineering and fields related to the transport sector, thus supporting his academic preparation in the field of engineering sciences, both through the nature of the research directions approached and the fulfillment of the minimum standards of the CNATDCU Commission No. 13 (Commission of Aerospace Engineering, Vehicles and Transport) for habilitation.

Didactic and scientific activities carried out in relation to students and doctoral students in general are explicitly presented, as well as involvement within IOSUD (participation in doctoral committees within IOSUD (2 committees), co-authorship of articles with doctoral students within IOSUD (2 ISI articles, 6 BDI articles), organization of international scientific events), coordination and involvement in research and consultancy projects with the economic environment in transport (3 projects as partners with IOSUD), as well as participation in activities of the Faculty of Transport, IOSUD and UNSTPB for the benefit of students and doctoral students, in accordance with the requirements regarding mentoring experience, publishing in prestigious journals together with doctoral students and cooperation with the academic and economic environment. In this way, the habilitation thesis attempts to demonstrate the scientific and didactic maturity of the candidate, but also the concrete capacity to ensure the coordination of doctoral theses in the field of Transport Engineering, in accordance with the IOSUD-UNSTPB Regulation and the Doctoral School of Transport Regulation.

Therefore, ***the evolution and development of my academic career*** has as its central point my affiliation and activity within a doctoral school in the field of transport engineering, in accordance with the research directions assumed within the habilitation thesis on the component of efficient and sustainable maritime transport. Therefore, I will prioritize the development of methodologically innovative research, internationally relevant and institutionally integrated, for the benefit of future doctoral students, based on work in the dual supervisor-doctoral student team and on personal competencies, formed within previously conducted research activities.

My main objective will be to guide candidates capable of generating practical knowledge for the broad field of transport engineering, including here the national and international maritime industry respectively the Romanian Naval Forces, who will interact with other interested components from industry, from the governance domain and contribute to the transformation of maritime industry components into data-rich infrastructures, resilient to geopolitical stress and sustainable in the future.