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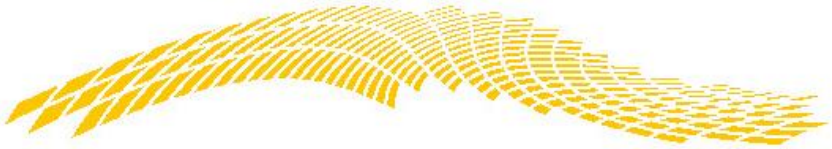
ECO-NautiNET



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Adriatic-Ionian Programme Interreg V-B (ADRION) 2014-2020

DT2.3.2 Innovation to Market - Invitation to relative researchers

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1. Project presentation

1.1 Project

PROGRAMME: Adriatic-Ionian Programme Interreg V-B (ADRION) 2014-2020

PROGRAMME PRIORITY SPECIFIC OBJECTIVE: Support the development of a regional innovation system for the Adriatic-Ionian area

PROJECT ACRONYM: ECO-NautiNET

PROJECT TITLE: Network's support for SMEs in the Nautical sector of the Adriatic-Ionian Region

PERIOD: February 2018- January 2020

The ECO-NautiNET project pursues the objective of improving the competitiveness and innovation of SMEs in the nautical sector through an innovative NETWORK Model based on a multilevel approach, which includes:

- involvement, motivation and training of SMEs to improve their networking approach
- the selection and training of key figures to support the creation, maintenance and growth of networks (facilitators, tutors and brokers)
- the creation of a web platform with particular attention to ECO-solutions in the nautical sector. The platform will give SMEs the opportunity to create or join the Ionian Adriatic eco-networks and to support product innovation through the involvement of research institutes and universities. The ECO-NautiNET network, jointly managed by the local Business Support Organization, will work together with the Research Institutes to assist the related SMEs and develop important tools to promote innovation and internationalization of SMEs
- a joint management system between business support organizations, SMEs and research institutes
- the creation of tools (for example, e-learning programs in the platform) to guarantee and facilitate the growth and transferability of results
- the use of a specific tool to support innovation and the transfer of new technologies "ready for the market" by researchers to SMEs

The project will capitalize the existing experimental experiences in the nautical network, also providing innovative aspects for the transferability and duration of the network, providing the BSO (business support organization), SMEs and research institutes, the tools to support the creation and duration of the networks, with particular attention to the nautical sector.

1.2 Partners

CA - Επιμελητήριο Αχαΐας Chamber of Achaia

CNA RAVENNA- CONFEDERAZIONE NAZIONALE DELL'ARTIGIANATO E DELLA PICCOLA E MEDIA IMPRESA ASSOCIAZIONE TERRITORIALE DI RAVENNA

RRC KOPER- Regionalni Razvojni Center Koper

UNIZAG FSB- Sveučilište u Zagrebu, Fakultet strojarstva I Brodogradnje

CCE PULA- Hrvatska gospodarska komora

DURA- Dubrovačka Razvojna Agencija

CCIT- Dhoma e Tregtisë dhe Industrisë Tiranë

2. Introduction

Eco-NautiNET project will, under activity 2.3, collect Best Available (and Ecological) Innovative concepts, services and products, that can be applied to the market, publishing them as open data. Initially, the work package leader UNIZAG FSB will collect and publish BATs, which was elaborated in Deliverable 2.3.1 Collection of Best Available Technologies. Further on the UNIZAG FSB will invite other research institutions and external researchers to collaborate in the publication of innovative services and product "ready to market". This will give SMEs the possibilities to understand last research, contact researchers on the platform and innovate in a collaborative way directly with researchers. This activity is aimed to give only useful information effectively related to each specific SME, giving them alert only in case of innovation in their specific sector and create a direct contact between SMEs and research institutes (R&I&D).

In this document, process of collection of Innovative proposals and invitation of other researchers to publish their own innovative services and products is elaborated.

The collection of initial innovative proposals from the staff of UNIZAG FSB is elaborated in chapter 3.

A list of contacted relevant researchers, which expressed their interest in the project or are key stakeholders that could join the Network at the later stage is given in chapter 4. Also, in the same chapter, innovative proposals of interested researchers and innovators is given in appropriate length.

In chapter 5, concluding remarks on this process are given.

Further details and materials are given in annexes.

2.1 Elaborations on the term of innovation

In order to understand what is considered as innovative concept, product or service, it is useful to provide definitions and limits agreed in ECO-NautiNET project, for the initial launch of the Network. Several questions, which were discussed first internally and then on the level of project partnership are:

- **Task is to deliver and publis „ready-to-market innovative products offered by Research Intitutes”** Due to the nature of work done by the research institutions, this turned out to be highly unlikely to encounter and demands a lot of time for particular innovative idea to be discovered. Reasons are explained in chapter 3.
- **Are the research institutes the only innovators?**

  Since it is elaborated that majority of research institutions do not offer high TRL innovative proposals, it is useful for the SMEs to open the possibility for offering innovative concepts to other innovators as well.
- **How to deal with not ready to market innovations?**

  Innovative concepts on lower TRL levels are also interesting to SMEs in the ADRION region, according to the results of Task 2.1.2 User’s needs collection. Therefore, innovative proposals with large spread of TRL’s should be allowed on the platform and in ECO-NautiNET Network.

Some further definitions of Innovations, considered in the start of this activity are:

Research and experimental development (R&D) comprise creative and systematic work undertaken in order to increase the stock of knowledge – including knowledge of humankind, culture and society – and to devise new applications of available knowledge. The term R&D covers three types of activity: basic research, applied research and experimental development. For an activity to be an R&D activity, it must satisfy five core criteria. The activity must be:

• Novel (to be aimed at new findings)

• Creative (to be based on original, not obvious, concepts and hypotheses)

• Uncertain (to be uncertain about the final outcome)

• Systematic (to be planned and budgeted)

• Transferable and/or reproducible (to lead to results that could be possibly reproduced). (OECD (2015), Frascati Manual 2015: Guidelines for Collecting and Reporting Data on Research and Experimental Development.)

Implementation of a new or significantly improved product (good or service), or process, or a new marketing method, or a new organizational method. The minimum requirement for an innovation is that the product, process, marketing method or organizational method must be new (or significantly improved in the case of product or process) to the firm. (ECD and Eurostat (2005), Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, §146, 148.)

All scientific, technological, organizational, financial, and commercial steps which actually lead, or are intended to lead, to the implementation of innovations. Some innovation activities are themselves innovative, others are not novel activities but are necessary for the implementation of innovations. Innovation activities also include R&D that is not directly related to the development of a specific innovation. (OECD and Eurostat (2005), Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, §149, 351.)

Overview of Technology Readiness Levels (TRL) is given in Figure 1, in order to clarify the rest of discussion in the following chapters.

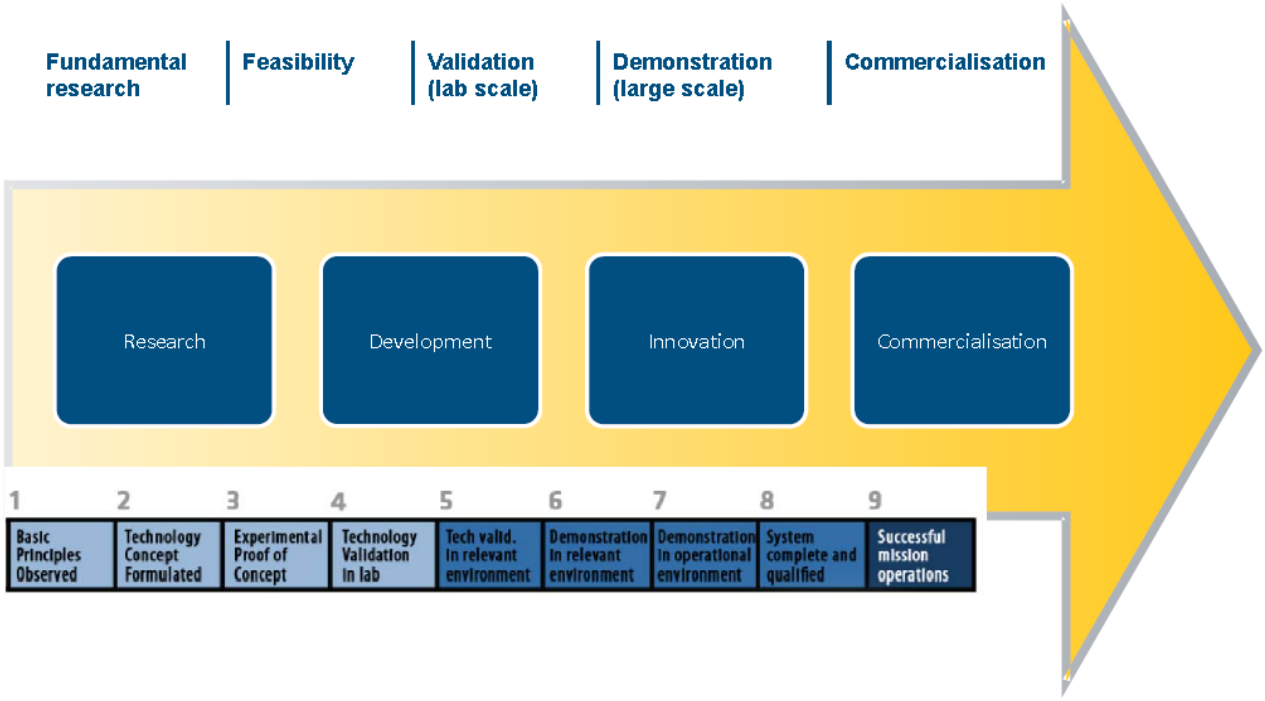


Figure 1 Technology readiness level evolution

TRL 1: Basic research. Principles postulated and observed but no experimental proof available. Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include fundamental investigations and paper studies.

TRL 2: Technology formulation. Concept and application have been formulated. Once basic principles are observed, practical applications can be formulated. Examples are limited to analytic studies and experimentation.

TRL 3: First laboratory tests completed; proof of concept. Active research and development is initiated. Laboratory studies aim to validate analytical predictions of separate components of the technology.

TRL 4: Small scale prototype built in a laboratory environment ("ugly" or quick and dirty prototype). Design, development and lab testing of technological components are performed. This is a relatively "low fidelity" prototype in comparison with the eventual system.

TRL 5: Large scale prototype tested in intended environment. The basic technological components are integrated together with realistic supporting elements to be tested in a simulated environment.

TRL 6: Prototype system tested in intended environment close to expected performance. Tested in a relevant environment. The system or process demonstration is carried out in an operational environment.

TRL 7: Demonstration system operating in operational environment at pre-commercial scale. Prototype is near, or at, planned operational system level. The final design is virtually complete. The goal of this stage is to remove engineering and manufacturing risk.

TRL 8: First of a kind commercial system. Manufacturing issues solved. Technology has been proven to work in its final form under the expected conditions. In most of the cases, this level represents the end of true system development

Points of interest for researchers in sharing their innovative concepts and joining the ECO-NautiNET network:

- Finding enterprises interested in commercial use or distribution of their market ready innovations
- Finding partners interested to cooperate in further development of their innovations that are not ready for market (4 < TRL < 9)
- Gain more information on currently available funding frameworks that are suitable for further development of your innovation
- Gain more information on IPR protection of innovations
- Gain more visibility among the potential partners from industry and entrepreneurship
- Creating new opportunities through international networking across the ADRION region and wider

3. Initial innovations published

The process of collecting innovative proposals for services and products started with dissemination and discussions among the staff at UNIZAG FSB. Expanding beyond the project staff, ECO-NautiNET was disseminated through collaboration with Interreg MED project PELAGOS, with organization of collaborative workshop on the 9th of November 2018 (Figure 2). Further on, project staff disseminated ECO-NautiNET project through mail correspondence and bilateral meetings with other researchers at the institution.

Figure 2 First presentation of ECO-NautiNET project to researchers and PELAGOS Croatian HUB

Difficulties encountered are in line with the concluding remarks of deliverable DT2.3.1 Collection of best available technologies;

"Significant difference exists between scientific research and innovative efforts and moulds the availability of market ready innovations, but also available technologies. This difference provided quite a challenge for the project team to collect useful technologies and innovative proposals by the researchers. More concretely, researchers aim to explore the unknown properties of new materials or technological solutions, through creating hypotheses and devising appropriate method to verify the validity of hypotheses. Their efforts are limited by the equipment and funding they have on disposal."

This means that, although significant research is being done, it is rarely pointed towards producing innovative proposals which can be ready to market some time soon. This is also noticeable from the results of activity T2.1.2 User's needs report (Figure 27. In DT2.1.2), where

researchers answered the question about the technology readiness level of their research and prospective innovation (Figure 3).

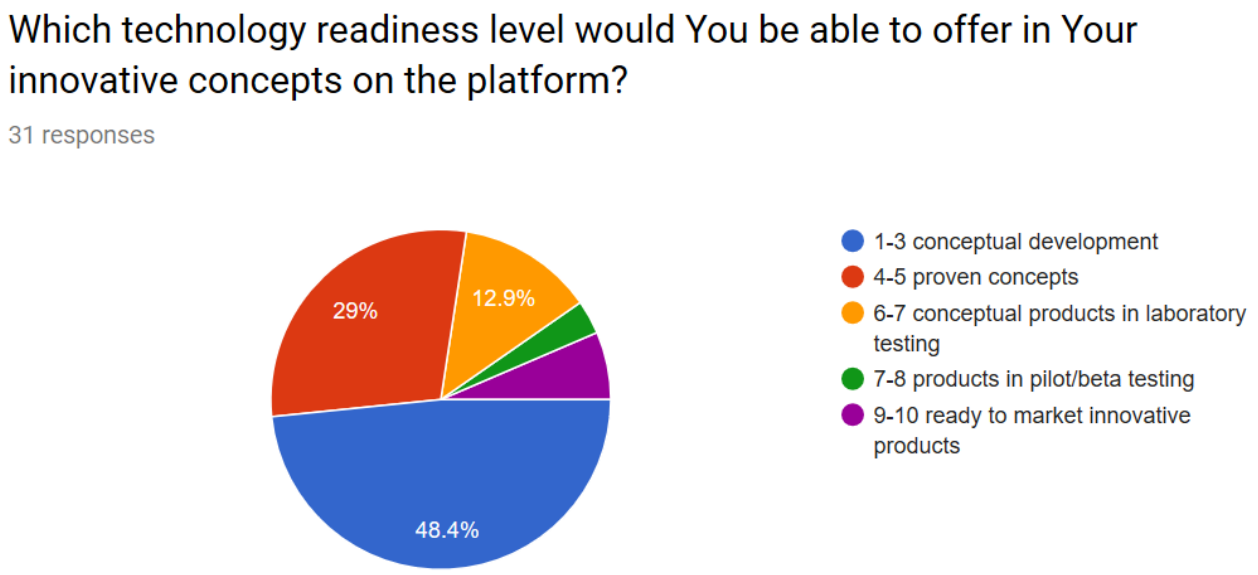


Figure 3 Researchers response regarding the TRL level of their innovative concepts

Technology readiness level of the innovative concepts from majority of researchers that were reached in the survey is low, on the level of conceptual development or proven concept at best. In this context, relatively low TRL was provided by the researchers who provided innovative concepts as starting ideas for ECO-NautiNET.

First set of three innovative concepts published on the platform are provided by UNIZAG FSB, in order to give examples for other research institutions to follow. This chapter provides short description of these innovative concepts.

3.1 Self-healing polymers

Improving efficiency and reducing maintenance costs is very appealing for any manufacturer. A newer class of structural polymers with self-healing effect might help in achieving those goals. Self-healing polymers is a group of diverse materials with rather different properties that appear as both polymeric materials and polymer-based composites.

When a load is applied to a material, especially dynamic or impact load, a crack can form within a structure where detection is difficult and repair can even be impossible. Microcracking can also be thermally induced. Cracking leads not only to mechanical and acoustical degradation but in the case of microelectronic polymeric components it can lead to electrical failure.

Polymers with self-healing properties may have a possibility to heal intrinsically and extrinsically. For the latter pre-embedded healing agents in the form of micropipes and microcapsules are needed. A catalyst is usually mixed into the base matrix. While extrinsic approaches are generally autonomous, intrinsic systems often require an external trigger for the self-repair process. This can be in a form of thermo-mechanical, electrical, photo-stimuli, etc.

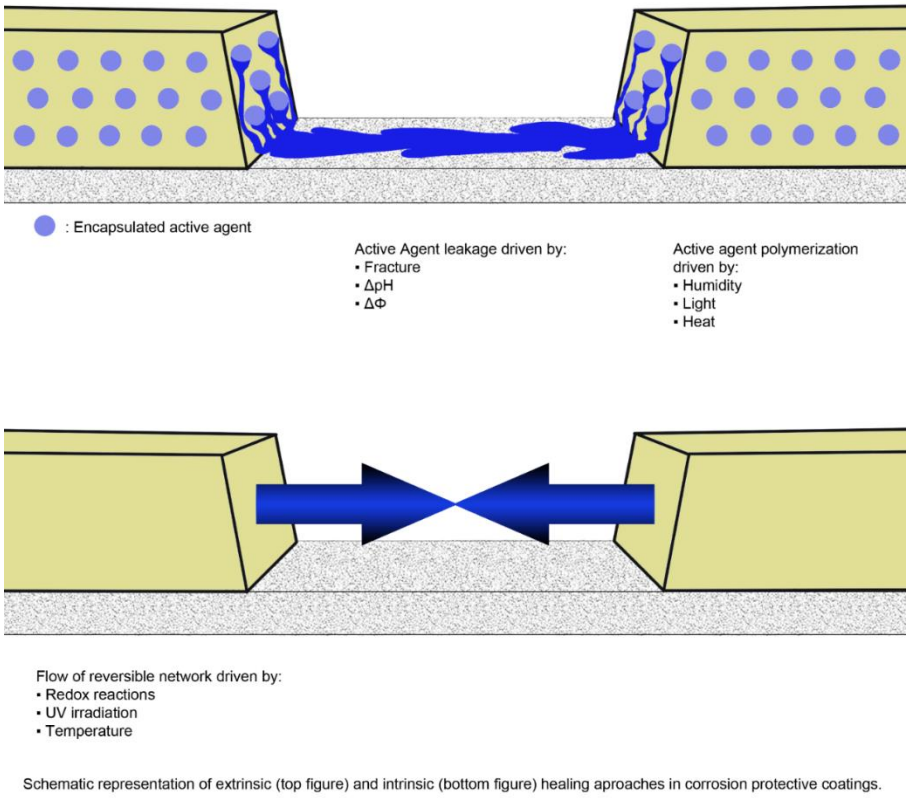
At the moment, in the **Laboratory for polymers and composites, Department of materials,** researchers deal with a co-polymer of ethylene and methacrylic acid with self-healing ability that can be thermally activated. This thermoplastic material is transparent and it has moderate

mechanical properties. Through research, improved mechanical properties have been achieved by adding the carbon fibres. Researchers performed ballistic tests on the neat polymer with different weapons and we tested mechanical properties after ballistic tests were performed. The stiffness of the material remains the same, but there is a drop in the strength of the material.

Laboratory's tests as well as literature sources [1] and [2] showed that the introduction of self-healing materials may be a solution for some applications, but still one has to be aware that some properties cannot completely recover. There are many possibilities for variation of this material by introducing different reinforcing materials.

[1] R. White, N. R. Sottos, P. H. Geubelle, J. S. Moore, M. R. Kessler,S. R. Sriram, E. N. Brown S. Viswanathan Autonomic healing ofpolymer composites, Nature 409, 2001.

[2] J. Asadi, N. G. Ebrahimi, M. Razzaghi-Kashani Self-healing property of epoxy/nanoclay nanocomposite using poly(ethylene-co-methacrylic acid) agent Composites Part A: Applied Science and Manufacturing, Vol. 68, 2015.



Schematic representation of extrinsic (top figure) and intrinsic (bottom figure) healing aproaches in corrosion protective coatings.

Figure 4 Self-healing polymers

Contact person: Associate Prof. Tatjana Haramina, PhD, tatjana.haramina@fsb.hr

3.2 Structural optimization of a bulk carrier according to IACS CSR-BC

According to IACS CSR for Bulk Carriers, a direct strength analysis based on a three hold FEM model of the cargo area is mandatory for all vessels above 150 m in length. Structural design according to CSR requirements is a challenging task that demands utilization of an integrated design system. To allow a designer to fully realize all benefits of a formal optimization procedure, an in-house structural design support system OCTOPUS-CSR was developed for concept and preliminary design phases. The developed design system was used for the structural design of the bulk carrier series to be built in shipyard "3.MAJ" in Croatia and the main achievements in the preliminary design phase are presented in this paper. Developed tools and

methodology enables the structural design team to optimize structural designs while satisfying the CSR requirements of structural safety.

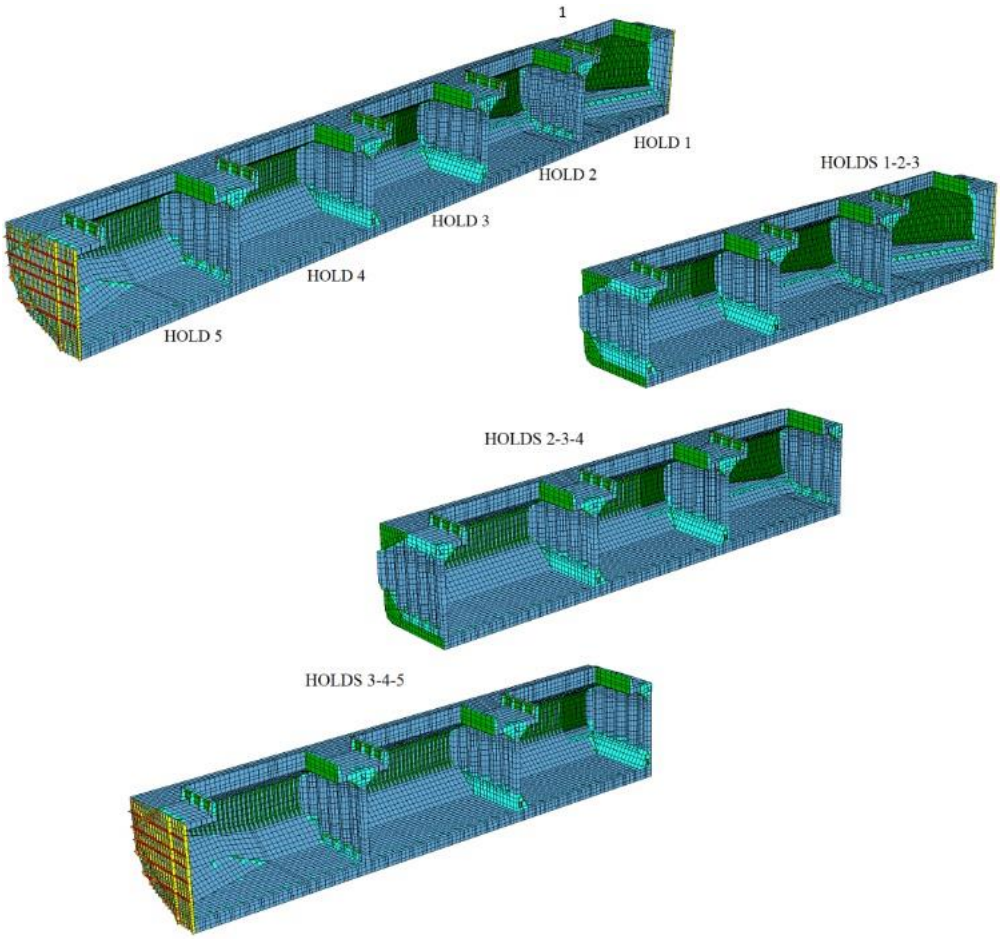


Figure 5 Optimization of structural design in shipbuilding

Contact person: Asst. Prof. Pero Prebeg, PhD, pero.prebeg@fsb.hr

3.3 Specialized CFD for Naval Hydrodynamics

Designing ships and offshore object often requires detailed hydrodynamic information in order to produce a more relevant, competitive and safer design. The challenge is the complexity of hydrodynamic problems that need to be solved in order to access these information. Finite Volume based Computational Fluid Dynamics is a class of methods that enables the flow problem to be tackled with minimum simplifications and assumptions. Free-surface flow with floating or submerged objects can readily be modelled with high accuracy using this approach. The Naval Hydro pack software based on foam-extend is a specialized software library for large-scale, two-phase flow with 6 degrees of freedom motion modelling capabilities. It is specially designed and developed to be able to handle a range of problems in the naval industry such as calm water resistance, self-propulsion, wave loads, green water phenomenon, sloshing, slamming and many other. The unique set of numerical methods contained in the software provides a robust,

efficient and accurate framework providing a valuable engineering tool for producing better designs.

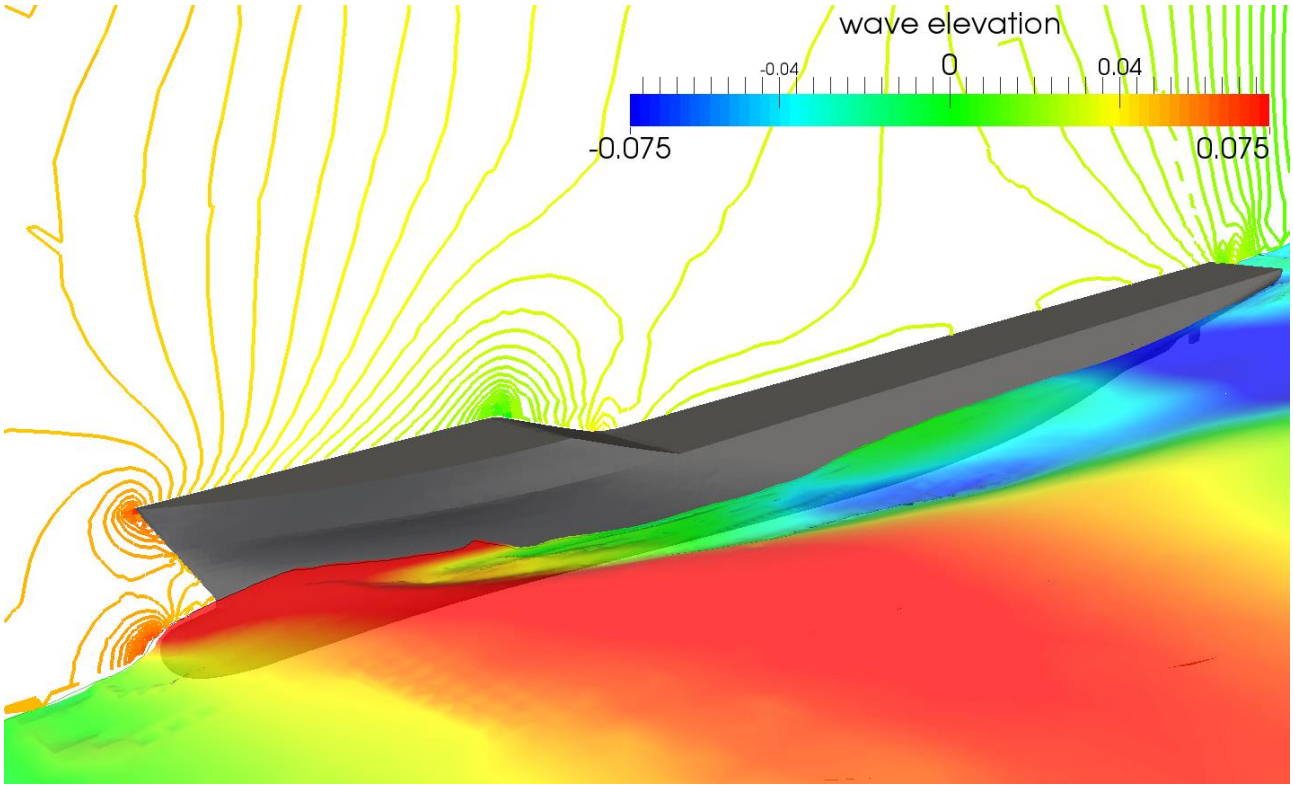


Figure 6 CFD simulations of naval hydrodinamics

Contact person: Vuko Vukčević, PhD, vuko.vukcevic@fsb.hr

4. Researchers list and additional innovations

After the presentation of the ECO-NautiNET project on the workshop co-organized with PELAGOS project, the staff continued to disseminate the project and invite researchers to participate through organization of bilateral meetings when possible or through discussions to extend the contacts. Also, other partners were in contact with local researchers in each participating country and disseminated the invitation survey (Annex 1). In Table 1, most relevant researchers are listed, with whom bilateral meetings were organized or they were included in e-mail correspondence in order to join the ECO-NautiNET Network. Majority of non-project staff at UNIZAG FSB, listed in the table, participated in collection of BATs, while some also proposed innovative concepts which will be published on the platform when the appropriate information is delivered and such proposals elaborated in extend suitable for each researcher.

Table 1 List of relative researchers invited directly or present at ECO-NautiNET events

Researcher	Institution
Prof. Blenard Xhaferaj, PhD	University of Vlora "Ismail Qemali"
Asst. Prof. Jakov Baleta, PhD	University of Zagreb, Faculty of Metallurgy
Prof. Alfredo Liverani, PhD	University of Bologna - Nautical and Marine Division
Vedrana Špada, mag. ing.	METRIS Materials Research Centre
Associate Prof. Andrić Jerolim, PhD	UNIZAG FSB
Prof. Nastia Degiuli, PhD	UNIZAG FSB
Kordej-De Villa Željka, PhD	Zagreb Institute of Economy
Slijepcevic, Suncana	Zagreb Institute of Economy
Jurić Filip, mag. ing.	UNIZAG FSB
Prof. Vera Rede, PhD	UNIZAG FSB
Marko Mlinar, dipl. ing.	Hydrographic Institute of the Republic of Croatia
Prof. Željko Alar, PhD	UNIZAG FSB
Prof. Zdravko Schauperl, PhD	UNIZAG FSB
Associate Prof. Irena Žmak, PhD	UNIZAG FSB
Asst. Prof. Ankica Kovač, PhD	UNIZAG FSB
Prof. Davor Zvizdić, PhD	UNIZAG FSB
Prof. Tatjana Haramina, PhD	UNIZAG FSB
Asst. Prof. Ivan Stojanović, PhD	UNIZAG FSB
Prof. Davor Ljubas, PhD	UNIZAG FSB
Asst. Prof. Hrvoje Juretić, PhD	UNIZAG FSB
Prof. Mario Štroga, PhD	UNIZAG FSB
Associate Prof. Helena Otmačić Ćurković, PhD	University of Zagreb, Faculty of Chemical Engineering and Technology
Prof. Sanja Martinez, PhD	University of Zagreb, Faculty of Chemical Engineering and Technology
Prof. Chrysostomos D. Stylios, PhD	Dept. of Informatics & Telecommunications, University of Ioannina
Prof. Frano Barbir, PhD	University of Split, Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture

Innovative proposals sent or discussed by relevant researchers or innovators who are already members of the Network and users of the platform are described in the following sub-chapters.

4.1 Emission reduction through numerical modelling and fuel substitution

Ships and industrial processes in general emit large amounts of diverse pollutants into the atmosphere, among which NO_x and SO_x take a significant portion. They can be reduced by various primary and secondary measures. In order to cope with the ever stringent environmental norms, equipment manufacturers need to develop energy efficient products that are at the same time benign to environment. This is becoming increasingly complicated and costly, and numerical tools offer way to reduce production costs together with the maintaining the same competitiveness level by testing different configurations in virtual environment. Areas of expertise also include combustion of alternative fuels, such as biodiesel, or more recently ammonia, which is a promising method to have zero CO_2 emissions from combustion.

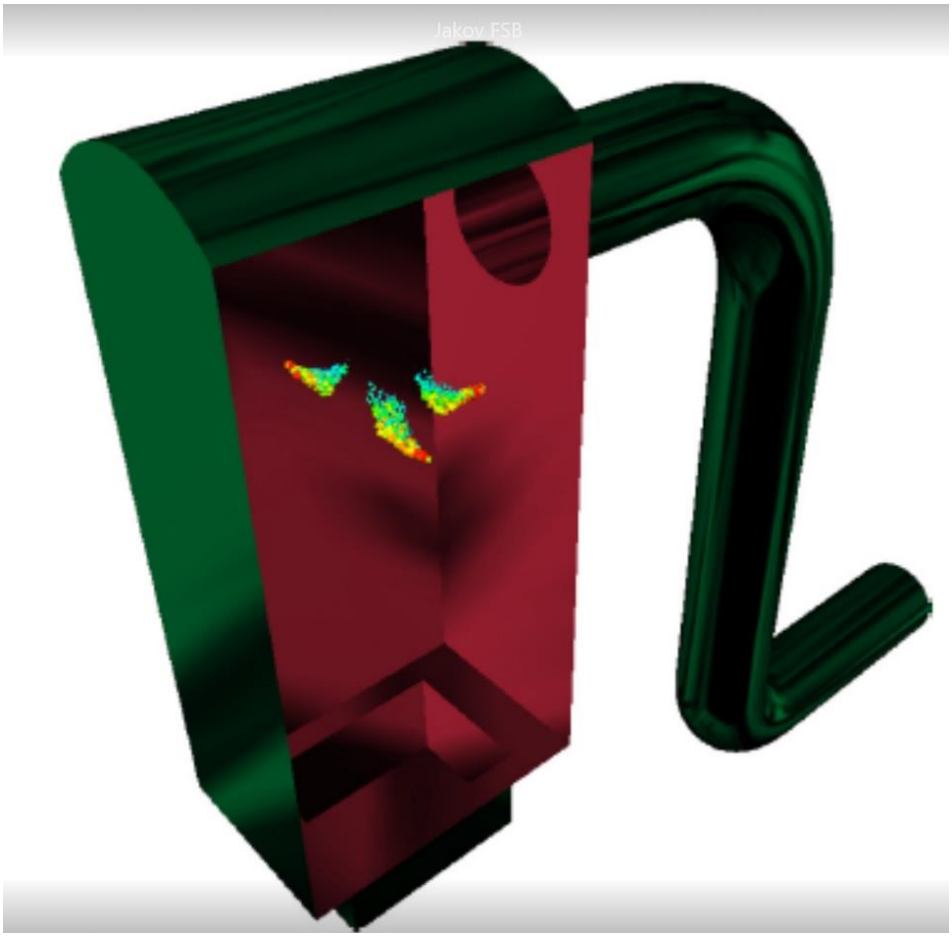


Figure 7 Emissions reduction through numerical modelling and fuel substitution illustration

Interests:

Design of combustion and gas aftertreatment systems

Partial or complete fuel substitution

Contact info: Asst. Prof. Jakov Baleta, PhD, e-mail: baleta@simet.hr

4.2 Hydrogen production using renewable energy and applications in transport

Power Engineering Laboratory is specialized in new technologies including hydrogen technologies and renewable energy sources (mostly solar energy). Researchers in this laboratory developed their own hydrogen production system via water electrolysis using solar energy, first Croatian hydrogen fuel cell powered bicycle, and first Croatian hydrogen refuelling station. They collaborate on many projects of hydrogen application in transport including both road and maritime transport. More can be found on link: https://hydrogen.hr/en

Figure 8 Hydrogen bike propulsion

Contact: Assist. Prof. Ankica Kovač, Ph.D., MEng. AE.; e-mail: ankica.kovac@fsb.hr

4.3 Innovative technical arrangement for coastal erosion mitigation

AQUATERRA elaborated for 10 years the results of more than 20 coastal protection experimental applications in Greece and abroad, initially implemented by the Stadium of Mechanics of the University of Patras (Emeritus Professor: C. L. Goudas) in coastal areas and islands of different wave climate/hydrodynamic & morphological conditions, before designing its innovative arrangement.

AQUATERRA's patented technical arrangement on coastal erosion mitigation was issued by the Greek Industrial Organization (OBI, issuance period 2014-2034). They are also developing its In-house hydrodynamic and morphodynamic modelling software capable of producing high-resolution results near shore and offshore, which has already been used in several coastal protection studies and applications in Greece and in USA (California).

For more info, contact ckapo@aquaterra.gr/ www.aquaterra.gr

Contact is available through the ECO-NautiNET platform.

4.4 Cathodic Protection & Galvanic Corrosion module

FEAC offers the PITHIA software to solve CP problems. Get realistic virtual models of structures with accurate knowledge of current and potential distribution by taking into consideration the nonlinear electrochemical behaviour of the metal (nonlinearity treatment with Newton-Raphson iterative algorithm variations).

Capabilities

• Accurate calculation of potential and current density distribution.

• Sacrificial and Impressed Cathodic Protection systems.

• Calculation of the total amount of current needed to achieve CP.

• Determination of optimum anode location.

Methods

• H-Matrixsolver for large scale problems offers - Faster computations using advanced solver technology. - Matrix compression and efficient in core or out of core storage.

• Multithreading - Parallelization for shared memory systems. Solve problems with all available processes.

• Non-linearity treatment with Newton-Raphson iterative algorithm variations

Contact is available through the ECO-NautiNET platform.

4.5 The new mobile experience for yachters and smart marinas

A new application for mobile devices (smartphones, tablets, integrated Yacht devices etc.) that aims to serve yachters, skippers and crew members, is now available. SaMMY app provides a simple environment for on-line berth booking, navigational and parking assistance services - during arrivals or departures - and instant communication with the preferred marinas. But it is not limited there. With SaMMY app users can enjoy a variety of high-level services:

- Real-time information about the weather and sea conditions
- Notifications of extreme weather events or maritime incidents
- Plus, full guidance to the nearby marina areas and points of interest SaMMY is the ultimate sailing companion that has been designed to assist and entertain the yachters in the simplest way.

SaMMY's advanced technologies transform a regular Marina into a 'Smart' one. A multi-purpose sensor grid consisted of waterproof wireless sensors is enrolled in order to feed a central system and provide booking, meteorological & environmental information. These services are facilitated through the installation of different types of sensors (ultrasound, meteorological, water quality, wave measurement etc.) which collect data and monitor the conditions within the Marina in real-time

For more info, contact: info@sammyacht.com

Contact is available through the ECO-NautiNET platform.

4.6 An Innovative people localization system for the safe evacuation of large passenger ships

LYNCEUS2MARKET project is based on the promising results developed in the LYNCEUS project where innovative technologies were tested in lab and in small scale pilots. LYNCEUS2MARKET brings together European global players in the field of cruise ship owners, operators, ship builders, maritime equipment manufacturers, a classification society, industry associations and important technology organizations with the aim to implement the first market replication of these technologies and products and to create significant impact by saving passenger lives during maritime accidents.

Maritime disasters in recent years stress the of the imperative need for timely and effective evacuation of large passenger ships during emergency. The Lynceus2Market project addresses this challenge through delivering a revolutionary operational system for safe evacuation based on innovative people localisation technologies.

The system consists of:

1) Localisable life jackets that can provide passenger location in real-time during emergency
2) Smart smoke detectors that also act as base stations of an on-board localisation system
3) Innovative localisable bracelets able to send activity data to the emergency management team
4) Low cost fire and flooding escalation monitoring sensor notes

5) novel mustering handheld devices for automatic identification and counting of passengers during evacuation
6) Smart localisable cabin key cards
7) Intelligent decision support software able to fuse all localisation, activity and disaster escalation data to provide an integrated real-time visualisation, passenger counting and evacuation decision support
8) Innovative shore or ship-launched Unmanned Aerial Vehicle for localising people in the sea in short time and assisting search and rescue operations when accident occurs in extreme weather, during the night or in a remote location
9) Low-cost rescue-boat mounted radars for people localisation in the vicinity of the boat.

Contact information: Mr. Tasos Kounoudes, tasos@signalgenerix.com

4.7 Prototype of quantitative coating quality meter for corrosion protection

Researchers at the Faculty of Chemical Engineering and Technology are currently involved in creation of a prototype of quantitative coating quality meter, which can be used as a method of anti-corrosive protection.

After the creation of a prototype, the intention is to offer the coating quality meter to the market and provide education to users, collaborate with SMEs in maritime sector in the innovative use of the meter for upgrading of their production processes and collaborate with SMEs which deal with protective coatings in the form of providing services.

Prof. Sanja Martinez, University of Zagreb, Faculty of Chemical Engineering and Technology; sanja.martinez@fkit.hr

4.8 Internet of Things application Portweather

Portweather is an IoT application, gathering and providing marine weather monitoring and forecasting to support marine traffic. The Portweather solution operates as an autonomous system to provide specific meteorological conditions and forecasts able to be integrated in LINCOLN (Lean Innovative Connected Vessels, developed through a H2020 project[1]) platform, which combines vessel behavior at sea and weather conditions at a specified geographical position.

The weather application forecasts the speed of the wind, hours ahead, based on previously recorded values and other measured parameters. Operation of the Portweather solution is illustrated in Figure 9.

[1] *This project is funded from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727982*

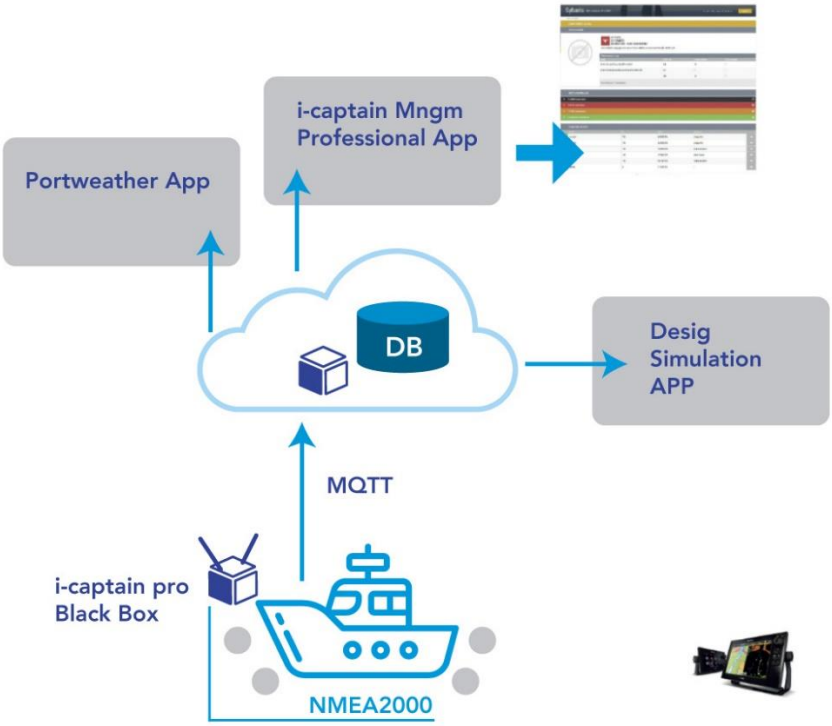


Figure 9 Portweather solution principle operation

It utilizes a small memory footprint Machine Learning (ML) algorithm, which runs in a low power, low CPU frequency, low memory microcontroller. It produces warnings reports and provides the forecasting values to the i-captain black box user. The data is collected online from an onboard weather station and used as input to an advanced Machine Learning Algorithm, which provides Wind Speed prediction for 1-2 hours ahead.

The method has been successfully tested in real data, example of which is shown in Figure 10.

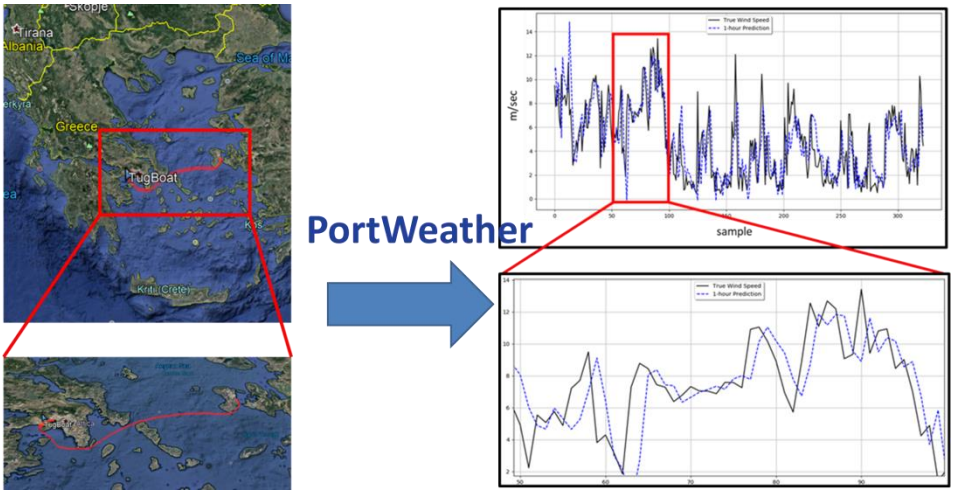


Figure 10 Portweather operation with real data

Computer & Technology Institute & Press (CTI) has the exclusive property of the Portweather module. The current TRL (technology readiness level) of the product is TRL6.

Contact details: Prof. Chrysostomos Stylios, [stylios@cti.gr], Computer & Technology Institute & Press

4.9 Design and Development of Decision Support Software & Innovative Methods of Port Process Management

The proposed technology makes use of state-of-the-art techniques for the resolution of real problems in port management, in combination with latest technology information systems, for the monitoring and coordination of processes in the terminal. These techniques are based on combination of meta-heuristic algorithm family and flexible computation in general. In addition, sequential decision methods such as reinforcement learning methods as well as simulation models based on monte-carlo methods are used. It is a decision support system for strategic decisions that can handle both qualitative and quantitative criteria for the final evaluation of alternative scenarios / solutions.

The interface and management system specifications to be proposed, on the basis of the "Single Window" principle allow all users of the port community to use on-line devices for monitoring, receiving information and participating in the various port operations defined. The direct objective is that the proposed applications will use modern user interface for easy and smooth acceptance of the system.

Figure 11 shows graphically the horizontal and vertical organization of the proposed approach for the specifications of the model port information system and machine2machine interfaces.

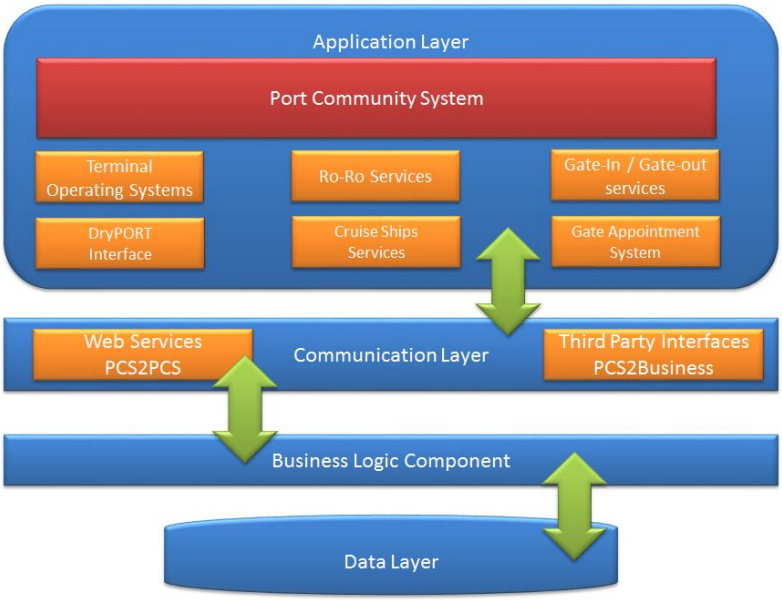


Figure 11 horizontal and vertical organization of the proposed approach to Port process management

An automation of the procedures concerning the placement of trucks and private cars (& motorcycles) is included, taking a range of parameters such as (scheduled departure, vehicle type and length, destination, load weight, etc.). These decisions are related to resource allocation, vehicle routing and spatial planning, and are usually modeled in the form of Mixed integer programming problems, which cannot be solved precisely in case of big scale problems. Consequently, metaheuristic algorithms (such as methods that will mimic ant colony optimization, particle swarm optimization, methods inspired by "harmony search") and their hybrids are used to solve such problems, in an attempt to create reactive search algorithms based on the aggregate information gathered by the individual agents.

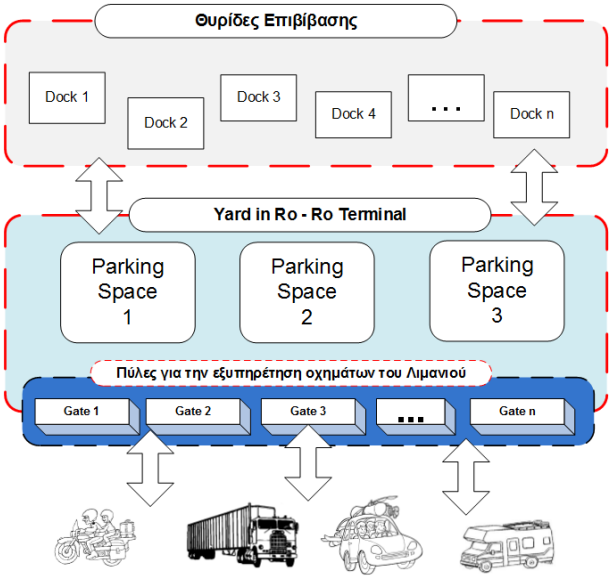


Figure 12 Logic of solution for procedures concerning the placement of trucks and private cars

Enhanced learning and reinforcement learning algorithms, approximate dynamic programming and anticipatory optimization will also be used to enable the system to adapt continuously for the best possible solving the aforementioned problems.

One of the key tools / subsystems is a decision support system at a strategic level. This system, which will allow the compilation of different criteria, either qualitative or quantitative, will allow for the assessment of different alternative decisions in a way that is "transparent" to the end user and to combine knowledge with different experts. The system will implement methods such as the Analytical Hierarchy Process (AHP) and the Analytic Network Process (ANP) without limitations to them only, as the research team has already developed an application that implements AHP. In addition, an effort will be made to combine additional elements from Fuzzy systems by adopting the particular advantages of each method but also by proposing to the user the most suitable one depending on the nature of the problem (selection of the best solution, classification of different solutions / decisions, assistance in finding / formulating a solution / alternative etc) it has to face each time.

Contact details: Prof. Chrysostomos Stylios, [stylios@cti.gr], Computer & Technology Institute & Press

5. Concluding remarks

Following the experience of the process of collection of innovative proposals from the research institutions, some relevant lessons learned can be extracted and used already in the remaining activities of the project, as well as for future projects.

Activities of publishing initial innovative proposals by the only research institution in the project started before the platform and it's functionalities went through the first debugging period and before official publication period, in which the project partnership invited all users (Facilitators, Tutors, SMEs and research institutions in general) to join the platform. The intention of this was to provide an early example of best available technologies and innovative proposals to other users, which benefits the SMEs, who are in this way able to see which processes, services, concepts and products the academic community can offer. But, at the same time, given that other activities are not finished, results of inviting researchers and publishing their contributions and publications of innovative proposals is ongoing, while the platform's operation and management systems are not complete. For this reason, activities regarding invitations to researchers continue and final results in number of research organizations, as well as number of published innovations on the platform will be tangible as approaches the end of activity 2.2 *Set up of functionalities of the networking platform and technical arrangements*.

Connected to the D.2.1.1 Agreement on Eco-NautiNET model of Network's joint management system, this agreement is used to verify the official adherence of research institutions to the network, in case that the institutions administration requires their legal representative to sign appropriate document. This process usually takes time, which prolongs the creation of institutions profile on the ECO-NautiNET platform.

Using the established platform and examples delivered in this document, further invitations to research institutions with the aim of attracting them to the ECO-NautiNET platform are continued.

6. Annexes

Annex 1 Text of the call for researchers

We are **ECO-NautiNET** - The cooperation network among enterprises, business support organizations and research institutes in nautical sector. Our mission is creation of new opportunities through international networking across the ADRION region. Our main focus is facilitation of adaptation of Best Available Technologies (BAT) in nautical sector using the web based networking tool supported by human agents. The network currently has over 70 SMEs, and we are rapidly growing.

We find your innovations that results from your applied research one of the key drivers for increase of (Adriatic - Ionian) nautical sector competitiveness in tomorrow's industry. Some of the benefits that participation in **ECO-NautiNET** network offers to researchers and research institutions are summarized below:

- Finding enterprises interested for commercial use or distribution of your market ready innovations
- Finding partners interested to cooperate in further development of your innovations that are not ready for market (4 < TRL < 9)
- Gain more information on currently available funding frameworks that are suitable for further development of your innovation
- Gain more information on IPR protection of innovations
- Gain more visibility among the potential partners from industry and entrepreneurship
- Creating new opportunities through international networking across the ADRION region and wider

ECO-NautiNET project is financially supported by ERDF in a scope of Interreg ADRION framework. The project main objective is the realization of a common and innovative ADRION's Network dedicated to SMEs, Research Institutions and Business Support Organizations with aim of improving SME's competitiveness and innovation in the Nautical sector and supporting their internationalization.

For the further information please visit the project pages (https://econautinet.adrioninterreg.eu/), contact one of our dedicated facilitators (link to specific page with contacts), or just start using the **ECO-NautiNET** (http://econautinet.fsb.hr/).

Annex 2 Signing sheet from the workshop held on UNIZAG FSB, November 9th 2018

Annex 3 ECO-NautiNET leaflet in Croatian, used to disseminate the project among the researchers