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STRENGTHENING THE CAPACITY FOR EXCELLENCE OF SLOVENIAN AND CROATIAN INNOVATION ECOSYSTEMS TO SUPPORT THE DIGITAL AND GREEN TRANSITIONS OF MARITIME REGIONS

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REPORT ON ECOSYSTEMS' MAPPING

Deliverable D2.1

2024-07-12 by BSC Kranj, Regional development agency of Gorenjska region

DELIVERABLE INFORMATION

Work package	WP 2 - Cross-border joint R&I strategy
Task	T2.1 Mapping the ecosystems: actors, roles, activities, collaborative and competitive links
Due date	31/7/2023
Submission date	31/7/2023
Deliverable lead	BSC
Version	4.0
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Abstract	The report includes a comprehensive overview of Croatian and Slovenian Maritime and nautical ecosystems. For each of the ecosystems, the innovation ecosystem canvas was prepared. The content of each ecosystem canvas includes a description of the innovation ecosystem canvas as a tool, ecosystem mapping, a detailed description of each ecosystem, key findings, a SWOT analysis for each ecosystem, and a description of key challenges.
Keywords	

Document Revision History

Version	Date	Description of change	List of contributor(s)
V1.0	02/06/2023	1st version of the report ready for comments	Jelena Vidović (BSC Kranj), Peter Merc (Lemur Legal), Nikolina Pomenić (PRIGODA)
V2.0	21/06/2023	2nd version of the report ready for comments	Jelena Vidović (BSC Kranj), Peter Merc (Lemur Legal), Nikolina Pomenić (PRIGODA), Marko Šimic (UL)
V3.0	31/07/2023	3rd and final version	Jelena Vidović (BSC Kranj), Peter Merc (Lemur Legal), Nikolina Pomenić (PRIGODA), Gregor Erznožnik (BSC Kranj), Marko Šimic (UL), Hrvoje Marušić (UNIRI), Hugo Zupan (DIGITH)
V4.0	12/07/2024	4th version, corrections according to EC experts, Interim review meeting	Jelena Vidović (BSC Kranj), Nikolina Pomenić (PRIGODA), Petra Pintar, Marko Šimic (UL)

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The INNO2MARE project has received funding from the HORIZON.4.1 - Widening participation and spreading excellence under Grant Agreement No 101087348.

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EXECUTIVE SUMMARY

The INNO2MARE project aims to map the Western Slovenian and Adriatic Croatian maritime innovation ecosystems to support digital and green transitions in maritime and connected industries. This report provides a comprehensive analysis of the Slovenian and Croatian maritime and nautical industry ecosystem, including its innovation ecosystem canvas, SWOT analysis, and stakeholder list.

The main objectives of the mapping are to understand the current state of the industry, identify strengths and weaknesses, opportunities and threats, develop recommendations for improvement, and support informed decision-making. Specific objectives include understanding key stakeholders, ongoing processes, and relationships between stakeholders.

The ecosystem mapping provides a visual representation of the ecosystem to understand its structure and dynamics, identify areas of opportunity and risk, and develop strategies to enhance sustainability and competitiveness. It also helps understand the interconnectedness of the Slovenian and Croatian maritime ecosystems.

The mapping identifies the ecosystem's strengths and weaknesses, improvement opportunities, and potential partners and collaborators. Stakeholders are categorized into logistics, production, shipping, software development, service, infrastructure, startups, incubators, VCs, research and academia, and other maritime-related services. The mapping differentiates between innovative companies and those that are not innovation drivers.

In Slovenia, the ecosystem focuses on promoting innovation, addressing niche markets, and supporting entrepreneurial growth. The industry includes shipbuilding, transportation, logistics, and ports, with opportunities in large infrastructure projects and emerging technologies. Challenges include limited access to funding, lengthy administrative processes, and outdated infrastructure.

The Croatian maritime innovation ecosystem is dynamic, involving universities, research institutions, software companies, startups, shipyards, shipping companies, and more. The main driver of innovation in Croatia is the collaboration between public, private, and scientific research sectors. Despite challenges such as technological lag and lower productivity in state-owned shipyards, the industry is experiencing significant transformations to tackle climate and environmental challenges while maintaining global competitiveness.

The mapping process involved defining the research methodology, identifying key stakeholders, collecting data through various methods, and analyzing the data to extract meaningful insights. The results are presented in the form of an ecosystem map.

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ABBREVIATIONS

B2B segment	Business to business segment
B2C segment	Business to consumer segment
INNO2MARE	Strengthening the Capacity for Excellence of Slovenian and Croatian Innovation Ecosystems to Support the Digital and Green Transitions of Maritime Regions
NGO	Non-governmental organization
SPIRIT	Public Agency for the Development of Entrepreneurship in Slovenia
SWOT	Strengths, Weaknesses, Opportunities, and Threats analysis
VC	Venture Capital

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1 INTRODUCTION

Slovenia, located in the heart of Europe, may have only a coastline of 46,6 km, but regardless it has a thriving maritime and nautical industry. The country's strategic location at the crossroads of major transport routes and its well-developed infrastructure have made it an important maritime trade and transportation hub. Slovenia's maritime and nautical industry is relatively small, with the Port of Koper being a key stakeholder. Still, it is an essential part of the country's economy and has significant potential for growth.

Croatia, having the longest coastline in Eastern Adriatic can be regarded as a force in terms of maritime industry. The country's strategic location and its well-developed infrastructure have made it the most important maritime production, trade, transportation, and nautical tourism hub in the eastern Adriatic.

The Slovenian and Croatian maritime and nautical industry ecosystem comprises various stakeholders, including shipping companies, ports, shipbuilders, marine equipment manufacturers, logistics companies, maritime service providers, startups, software development companies, research centres, universities, clusters, and other important actors. These stakeholders are together creating a profitable and prosperous ecosystem that, as an industry vertical, contributes significantly to the country's economy. Slovenia has a long history and tradition of excellence, with many skilled workers and innovative companies. However, it faces significant challenges in competition, innovation, and sustainability. Croatia is known as a pool of high skilled engineers and seaman that are one of the main drivers behind the ecosystem's growth and innovation activities. The industry has a long history and tradition of excellence and presence in the international market. However, it also faces significant challenges in competition, innovation, and sustainability.

This comprehensive analysis will examine the Slovenian and Croatian maritime and nautical industry ecosystem, including its innovation ecosystem canvas, SWOT analysis, and a list of all stakeholders in the ecosystem, with a focus on innovation drivers. To identify such stakeholders among the private companies, the so-called "maritime & nautical innovation checklist" was designed and applied to all the identified stakeholders operating within the Slovenian maritime and nautical industry. In addition, to better understand the industry's structure, all the stakeholders were categorized into one of the predetermined categories, such as production, logistics, startups, and research institutions.

To better understand the innovation component of the ecosystem, a more comprehensive analysis of the startups' supporting environment analysis was conducted, focusing on funding mechanisms and other forms of government-supported programs.

This document was written based on the pre-approved "Methodology for an in-depth mapping of the Western Slovenian and Adriatic Croatian maritime innovation ecosystem" ("Methodology"). Mapping of the maritime ecosystems was conducted in several successive phases. The first phase focused on identifying all the stakeholders in both maritime ecosystems. Once stakeholders were identified and listed, data related to their business models and conduct was collected (second phase). Data analysis phase follows as the 3rd phase. The mapping process was completed by delivering the innovation ecosystem canvas.

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Several qualitative research methods were used to gather data and information for the purpose of in-depth mapping of the ecosystems. These involved the collection and analysis of various non-numerical data. Qualitative research methods included desk research, database search (both secondary research methods) and questionnaires and interviews as primary research methods.

The outcome of this document will be innovation ecosystem mapping, which will serve as a valuable tool for policymakers, entrepreneurs, and investors who want to understand the dynamics of the Slovenian maritime and nautical innovation ecosystem and develop strategies to support innovation and economic growth.

The output of the ecosystem's mapping is a visual representation of the ecosystem, which can be used to understand the structure and dynamics of the ecosystem, identify areas of opportunity and risk, and develop strategies to enhance the sustainability and competitiveness of the ecosystem. Once completed, ecosystem mapping of the Slovenian ecosystem will also be helpful to understand better how interconnected it is with the Croatian maritime and nautical ecosystem.

2 ABOUT INNOVATION ECOSYSTEM CANVAS AS A TOOL

An innovation ecosystem is a complex network of private companies, entrepreneurs, researchers, investors, policymakers, customer resources, public institutions, and other stakeholders that come together to support the creation, diffusion, and adoption of new ideas, products, and services. Thriving innovation ecosystems are characterized by collaboration, knowledge sharing, risk-taking, and access to funding and talent.

Innovation Ecosystem Canvas:

In the context of this document, the innovation ecosystem canvas is a tool that was used to analyse and understand various elements of the innovation ecosystem in Slovenia. It consists of nine building blocks:

1. **Customers:** Who are the customers or end-users of the innovation ecosystem, and what are their needs and preferences? Is this mostly the B2B segment or also the B2C segment? Are customers mostly local or foreign?

2. **Value Proposition:** What is the unique value proposition of the innovation ecosystem, and how does it differentiate itself from competitors? Is there any competitive advantage of the Slovenian ecosystem that might be further leveraged for the industry to be even more prosperous?

3. **Stakeholders:** Who are the key stakeholders in the innovation ecosystem, and what roles do

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they play? How crucial is Port of Koper for the functioning of the whole ecosystem? Apart from startups, which category proves to be most innovative?

4. **Resources:** What essential resources are available in the innovation ecosystem, including physical, financial, and human resources? Are there any resources (financial, organizational) established primarily for the maritime and nautical industry?

5. **Activities:** What are the key actions that take place within the innovation ecosystem, including research, development, and commercialization? How strong is support for innovation, sustainability, and long-term ecosystem resiliency?

6. **Networks:** What are the critical networks and partnerships that exist within the innovation ecosystem, and how do they contribute to its success? How interconnected is the ecosystem as a whole? How connected (and dependent) is the Slovenian ecosystem to the Croatian maritime and nautical ecosystem?

7. **Regulations and political stability:** What critical systemic regulatory frameworks affect the innovation ecosystem, including intellectual property laws and government policies? What is the dynamic of modernizing regulatory framework? How stable is government?

8. **Culture:** What is the cultural context of the innovation ecosystem, including attitudes towards risk-taking, entrepreneurship, and innovation?

9. **Infrastructure:** What are the critical physical and digital infrastructures that support the innovation ecosystem, including research facilities, incubators, and accelerators? Is there any known participation from large companies in different innovation consortiums?

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3 ECOSYSTEM MAPPING

Innovation ecosystem mapping is a specific type of ecosystem mapping that focuses on identifying and analysing the stakeholders, resources, and relationships within an innovation ecosystem. An innovation ecosystem is a network of individuals, organizations, and institutions that work together to generate and commercialize new ideas and technologies.

For this document, innovation ecosystem mapping involves identifying the key stakeholders in the ecosystem, including large companies with traditional business models (e.g., shipping, logistics), startups, investors, universities, research institutions, government agencies, and even non-governmental organizations (NGOs).

The relationships between these stakeholders are analysed to understand the flow of information, resources, and funding within the ecosystem. The mapping process also involves identifying the resources essential for innovation, such as tradition, talent, capital, infrastructure, and knowledge networks.

This innovation ecosystem mapping aims to understand the strengths and weaknesses of the Slovenian maritime and nautical innovation ecosystem and identify possible improvement opportunities. The mapping process can also identify potential partners and collaborators that can help strengthen the ecosystem, such as universities that can provide research expertise or corporations that can access markets. On the other side, innovation ecosystem mapping also aims to identify weaknesses and potential threats, which can be adequately addressed and managed later.

3.1 Categorization of stakeholders

According to the Methodology, all relevant and identified stakeholders within the ecosystem are, based on their core activity, categorized into one of the following categories, including the definition (scope) for each of the categories (Table 1).

Table 1: Categorization of the relevant ecosystem's stakeholders (category and description).

Category	Description
Logistics	Process of planning, coordinating, and executing the transportation, storage, and distribution of goods and services from their point of origin to their point of consumption. It involves the management of resources such as people, materials, and equipment to ensure that products are delivered to customers in a timely and cost-effective manner while maintaining quality standards. Logistics also includes activities such as inventory management, order processing, packaging, and transportation optimization.
Production	Process of manufacturing or assembling ships, boats, and another watercraft. This can include the construction of hulls, decks, engines, electrical and mechanical systems, and other components that make up a

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	vessel. Production in the maritime and nautical industries can be divided into different stages, including design and engineering, procurement of materials and equipment, fabrication and construction, outfitting and installation, and testing and commissioning.
Shipping	Process of transporting goods or products from one location to another by sea. The term shipping can also refer to the industry that is involved in the transportation of goods. Shipping involves various activities, such as packing, loading, transporting, unloading, and delivering goods to their final destination.
Software development	Services related to the software development for maritime and/or nautical industry.
Service	Auxiliary services to logistics, production or shipping services.
Infrastructure	Ports, port infrastructure, terminals, warehouses.
Startups	Startups developing solutions in the fields of maritime and/or nautical industry.
Incubators, VCs	Startup incubators and accelerators that support startups in their development, venture capital funds.
Research and academia	Universities, research institutes and other public or private institutions that are involved in a wide range of topics, from the design and engineering of ships to the economics of shipping, maritime law, and environmental concerns.
Other	Services related to maritime and/or nautical industry that do not fall under any of the above listed categories and which are not innovative (according to the *"innovation checklist"*).

In addition to the categories above, there are two additional categories (Table 2): private organizations and public organizations/entities. The said categories include:

Table 2: Two additional categories of stakeholders.

Private organisations	Associations, chamber of commerce, local or state federations, which are actively involved in the maritime or nautical industry.
Public entities	State agencies, regulators, and other public institutions, which are governing, supervising or in any other way actively participating in the maritime or nautical industry.

The stakeholders listed above two categories are not innovation drivers in their core nature.

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Notwithstanding, they have direct (regulation, state funding) or indirect (pressure groups, lobbying groups) impact on maritime or nautical industry development.

3.2 Maritime & nautical industry checklist

The number of identified stakeholders operating within the Slovenian and Croatian maritime and nautical industry exceeds those included in the ecosystem canvas (see "Ecosystem mapping" section). The gap mainly results from the difference between private companies, which are innovative in their business model, and companies which are not innovation drivers, because of their core business. Examples of the latter are legal entities operating as branch offices of foreign companies.

We expect many different stakeholders to be identified within each maritime ecosystem. However, not all of them will be relevant for mapping the innovation ecosystem canvas. Only those producers and service providers who are in any way drivers of innovation (directly or indirectly) shall be included.

For this project, we understand the innovation driver as follows:

- Factor or a set of characteristics that promote the development and adoption of new ideas, technologies, or processes that lead to significant positive change or improvement in the industry;
- innovation drivers can include a range of factors, such as changing market demands, new technologies, government regulations, and industry collaboration within the maritime and nautical industry;
- advancements in digital technologies, such as artificial intelligence, robotics, and big data, serve as innovation drivers, enabling more efficient and data-driven decision-making processes in the maritime and nautical industry;
- collaboration among stakeholders in the marine and nautical industry, such as shipbuilders, ports, logistics providers, startups, and software developers, can drive innovation by fostering the exchange of ideas and expertise across different sectors of the maritime and nautical industry.

To be consistent when deciding which company should be included in the innovation ecosystem canvas and which shall not be, we are introducing a "*maritime & nautical innovation checklist.*" For a company to be included in the canvas, the following criteria must be met (Table 3).

Table 3: Maritime & nautical innovation checklist.

1	**Maritime industry**	A wide range of economic activities related to the sea, including shipping, shipbuilding, offshore oil and gas exploration and production, ports and terminals, maritime logistics and transportation, fishing, and other marine-related services. The industry plays a crucial role in international trade, connecting countries and regions through the transportation of goods and passengers by sea.

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2	**Nautical industry**	A broad range of economic activities related to recreational and commercial boating, including boat manufacturing, sales, and repair, as well as marinas, yacht clubs, and other boating-related services. The industry includes various types of watercrafts, such as yachts, sailboats, motorboats, jet skis, and other water sports equipment. The nautical industry also includes various types of boating-related services, such as boat maintenance, storage, and transport.
3	**Innovation driver**	Company that promotes the development and adoption of new ideas, technologies, or processes that lead to significant positive change or improvement in the maritime and/or nautical industry. *A company that has no element of innovation in its core business operations, such as the sale of equipment or the brokerage of ships, is not considered an innovation driver.*
4	**Independent status**	Company has independent status, meaning that it has its own business operations, managed and executed by the company. *Company is not considered to have independent status if it is a subsidiary of a parent company (including holding company) registered in the countries other than Slovenia or Croatia.* *Branch offices also are not considered as having an independent status.*
5	**Presence in the business environment**	A Company must have a real presence in the Slovenian or Croatian economy, indicated by having an operating business, company's webpage and employees.

4 SLOVENIAN ECOSYSTEM

Slovenia's maritime and nautical industry is very diversified, despite its small size, which stems from a short coastline of fewer than 50 kilometres. Each key category in our methodology is represented.

Some general trends evident in the Slovenian economy are also clearly reflected in the nautical and maritime industries. One of these trends is promoting innovation, addressing niche markets with advanced technological solutions, and the rapid growth of the entrepreneurial ecosystem, which is the most critical driver of innovation in Slovenia. This trend can also be observed in the maritime and nautical industries. Innovation is driven by the increasing number of startups, various production companies, and software development companies.

On the other hand, the Slovenian ecosystem is made up of stakeholders coming from traditional industries. These are the logistics, shipbuilding, shipping, and other support services industries.

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The Slovenian maritime industry is characterized by another peculiarity, which stems from the relatively small size of the industry. Luka Koper is the only colossal company, and in terms of the number of employees and revenue, it ranks among the larger Slovenian companies. As such, it plays a vital role in the entire Slovenian ecosystem.

One of the weaknesses of the Slovenian maritime and nautical industry also stems from its small size. None of the past or existing government strategies have identified this industry as a key industry, which would mean that specific programs would be dedicated to its financing. Such is the case for the automotive industry, which is identified as a key industry in every governmental strategy. Thus, the potential of this industry is primarily dependent on the private sector, which can be an advantage, but also a disadvantage.

As will be further elaborated in this document, the Slovenian maritime and nautical industry has some strengths and opportunities, but on the other side also has some substantial weakness and threats (risks).

4.1 Stakeholders in the Slovenian ecosystem

The Slovenian maritime and nautical industry is very heterogeneous regarding the dispersion of identified stakeholders by category (Figure 1 and table 4). The largest share is represented by companies involved in manufacturing. We identified 39 such companies in Slovenia that also fulfil the innovation criterion.

The next largest category is logistics. 15 logistics companies in Slovenia are linked to the Port of Koper and thus to the maritime industry. 13 companies were identified.

In terms of size, the next category is startups. This is followed by a category of nine companies developing software related to the nautical or maritime industry.

All the remaining categories, namely business incubators, research institutions, and public institutions, are smaller.

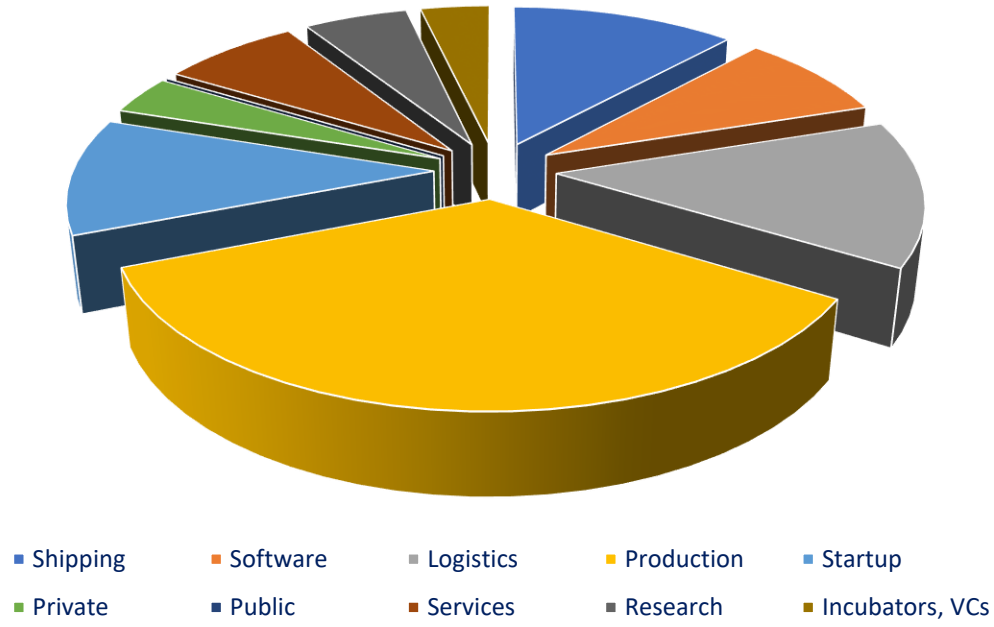

Figure 1: Slovenian maritime & nautical ecosystem (by categories).

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Table 4: Slovenian ecosystem mapping (ecosystem canvas).

Shipping	▪ Adria-Tow ▪ Adriatikagent ▪ Adrimed ▪ Bluemarine ▪ Capris ▪ Eurosea ▪ Gasmar	▪ Shippbuilding Izola ▪ Manta ▪ Mulec transport and logistics ▪ Ocean Koper ▪ Pulchra Mare ▪ Splošna plovba
Software developers	▪ Actual I.T. ▪ Datapan ▪ EMA ▪ Emigma ▪ Entraen	▪ IGEA ▪ IRM ▪ Solvesall ▪ Špica International
Logistics	▪ ALFA SP ▪ Europacific ▪ GEFCO Adria ▪ Intereuropa ▪ Interlogis ▪ Jadroagent International ▪ Luka Koper ▪ MAMA	▪ Navigo ▪ Navis ▪ Portšped ▪ Ribago ▪ Sloven Inter ▪ T.I. Sirk ▪ Vidavi Solution
Startup incubators and accelerators, VC funds	▪ ABC Accelerator ▪ Incubator Catapult	▪ Lab26 ▪ Ljubljana Technology Park
Production / manufacturing	▪ Adriaing ▪ Astel ▪ Blumar ▪ Bobič Yacht Interior ▪ CAP ▪ Carbonautica production ▪ Chemco ▪ Container ▪ ELAN Yachting ▪ Elektro Štumfi ▪ Fonda ▪ GS ▪ Hovercraft ▪ Intervela ▪ Iskra ▪ Kolektor Sisteh ▪ LXNAV ▪ Marinar ▪ Marinblu ▪ Morska pot (Boatsy)	▪ Multivario ▪ Mautic service ▪ NT electric ▪ Ocean Tec ▪ Orbipark ▪ Podkrižnik (E'dyn by Podrkižnik) ▪ Poliesterplast ▪ Pozejdon ▪ Quadrofoil ▪ Resnik glass ▪ Riedl CNC ▪ ROTO Slovenija ▪ Sandline ▪ Seascape ▪ Seaway Portorož ▪ Sigma Energija ▪ Sipaboards ▪ Supreme ▪ Veplas
Startups	▪ Be localc (SiMare)	▪ Remigo

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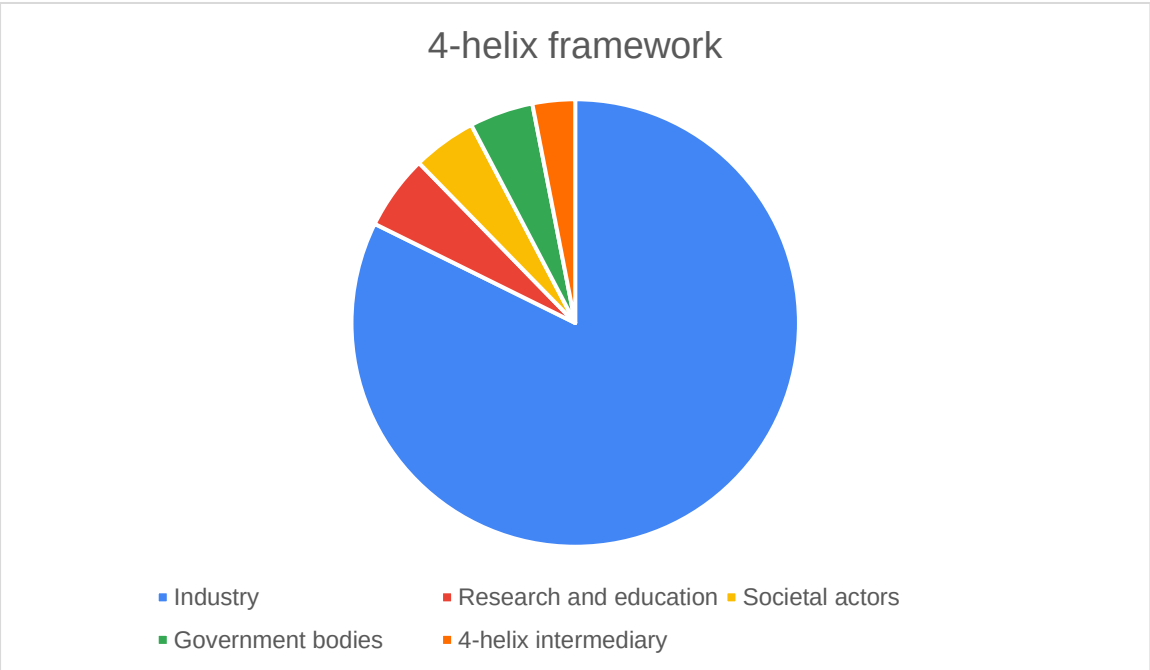
	▪ Cargo X ▪ Energ+ (Clera One) ▪ Gem Motors ▪ Interceptor ▪ KAAS (BRS Boat)	▪ Salvi ▪ SevVision ▪ Simarin ▪ Terral Nullius ▪ Waboost
Research & academia	▪ Algen ▪ Faculty for Maritime Studies and Traffic at the University of Ljubljana	▪ Innorew COE ▪ Juniba ▪ Nanocenter ▪ Sentinel Labs
Private organizations	▪ Društvo Aurata ▪ Društvo za pomorsko pravo (Maritime Law Association of Slovenia)	▪ Jadralska zveza Slovenije (Sailing association of Slovenia) ▪ Neptun
Auxiliary services	▪ B.B.Y. ▪ Bolta Leder Majster ▪ J&J Design ▪ Marea	▪ MB navtika ▪ Panger ▪ Remop ▪ VOM Creations
Infrastructure	▪ Marina Koper ▪ Marina Portorož	▪ Porting d.o.o. (Izola)
Public institutions (other than academia)	/	

Categorisation of Slovenian maritime and nautical industry stakeholders by the four-helix framework



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5 CROATIAN ECOSYSTEM

Croatia is a country known for its strong maritime heritage with an extensive shipbuilding tradition, significant maritime industry, and several major ports that contribute to the country's economy. Country's strategic location the Eastern Adriatic makes it an attractive destination for maritime and shipping companies looking to expand their operations. The industry includes shipbuilding, transportation, logistics, and ports. Croatia has several major ports which are of great importance for the country's economy as they handle various types of cargo and represent a major source of employment.

Croatia's maritime and nautical industry is very diversified which stems from a coastline of 1777 km which occupies most of the eastern Adriatic shoreline with over 1244 islands. Because of such natural asset, boatbuilding and marinas are an especially valuable segment of the ecosystem.

Global general trends towards green shipping and green shipbuilding, along with the increasing demand for more sustainable technologies in waterway transport, are on the rise. This is due to mounting pressure for shipping to reduce harmful emissions. These trends are also evident in the Croatian maritime industry, providing new market opportunities for the Croatian shipbuilding sector.

Also, there is a growing awareness of the importance of startups and entrepreneurship in Croatia which are important drivers of innovation and there is increasing support for these activities from government, academic, and business communities for the creation of a more innovation-friendly culture in maritime sector.

According to European innovation scoreboard 2022 Croatia is ranked as Emerging Innovator with performance of 66,50% of the EU average, and innovation performance has grown faster than the EU average thus the country's performance gap to the EU is becoming smaller.[1]
Performance increased strongest in Research systems, Finance and support, Innovators and Sales impacts. Performance did not change for Information technologies and declined for Human resources, Firm investments, and Environmental sustainability.[2] We can take this into consideration when explaining the innovation activities in maritime industry, since we didn't find the exact figures for the maritime sector itself.

The number of startups, various production companies, and software development companies is on the rise and drive innovation through digitalization of otherwise traditional maritime industry like logistics, shipbuilding, shipping, and other support services industries.

As will be further elaborated in this document, the Croatian maritime and nautical industry has some strengths and opportunities, but on the other side also has some substantial weakness and threats (risks).

Each category we have identified as key in our methodology has its representatives.

[1] https://ec.europa.eu/assets/rtd/eis/2022/ec_rtd_eis-country-profile-hr.pdf
[2] Ibid

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5.1 Stakeholders in the Croatian ecosystem

The Croatian maritime and nautical industry is very heterogeneous regarding the dispersion of identified stakeholders by category (Figure 2 and table 5). The largest share is represented by companies involved in production where we identified a total of 134 companies among which 34 companies that also fulfil the innovation criterion.

The next largest category is services with 47 companies, followed by shipping and software both with 17 identified companies.

In terms of size, the next categories are infrastructure and logistics with 15 and 16 companies. This is followed by startups with only 4 companies identified, and a category labelled "others", which includes 7 companies.

All the remaining categories, namely business incubators, research institutions, and public institutions, have fewer identified companies.

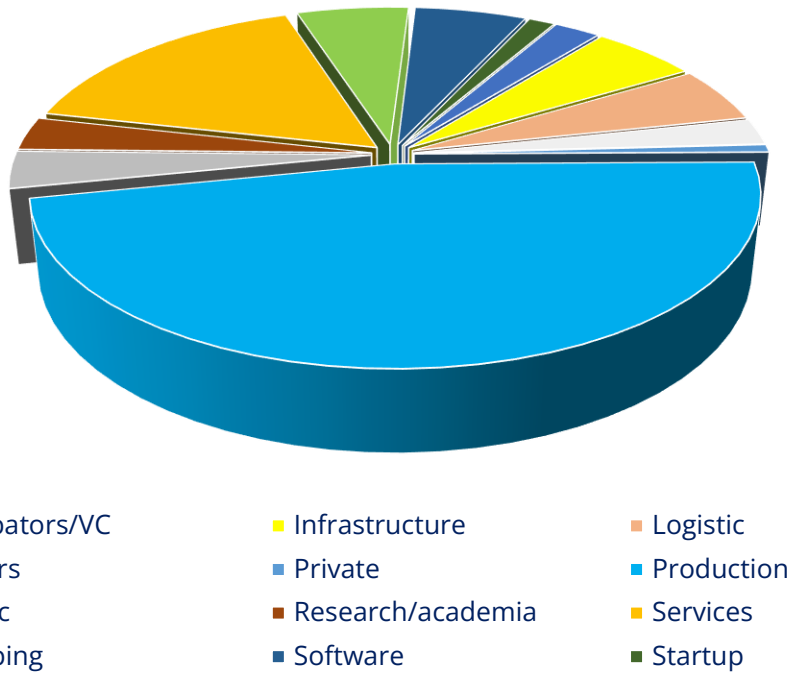

Figure 2: Croatian maritime & nautical ecosystem by categories.

In the Ecosystem canvas companies mapped are distributed into categories like in the chart below. However, to facilitate the use of canvas and to distinguish companies identified as innovative they are classified on top of each category and put in green font. Other companies in black font are those that represent the potential for implementing or innovation, i.e., they represent the demand side. (as later described).

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Table 5: Croatian ecosystem mapping (ecosystem canvas).

Shipping	▪ Jadrolinija ▪ Jadroplov ▪ Alpha Adriatic ▪ Atlanska plovidba ▪ Branko pilot ▪ Brodospas ▪ Croatia pilot ▪ Istra pilot	▪ Jadranski pomorski servis ▪ Kapetan luka krilo ▪ Korkyra shipping ▪ Ploce pilot ▪ Pomorski peljar ▪ Rapska plovidba ▪ Tankerska plovidba ▪ Zadar Pilot
Software developers	▪ Adricom ▪ Code Spark ▪ Brightdock ▪ Hexis ▪ Infobip ▪ Intellego ▪ Oculi mare	▪ Ototrak ▪ RIS ▪ Sarda ▪ Sense4Boat ▪ Sentinel ▪ Statim ▪ Vectrino
Logistics	▪ Adriatic logistic ▪ Bandic maritime ▪ Dina marin ▪ Global agent	▪ Jadrosped ▪ Jadroplov ▪ Obalna plovidba ▪ Plovput
Startup incubators and accelerators, VC funds	▪ ALUTech – Development Innovation Center ▪ EDIH Adria ▪ iNavis ▪ INOVacija ▪ PORIN- Rijeka Development Agency	▪ STEPRI- Science and technology park at University of Rijeka ▪ STECH Accelerator Split ▪ Technology Transfer Office of the University of Rijeka (SuR UTT) ▪ Technology Transfer Office of the University of Split (TTO)
Production / manufacturing	▪ AD Brodovi ▪ Adria Winch ▪ Aeda Inc ▪ Aitac ▪ Alveus -as2con ▪ Anorti ▪ Brodogradiliste Iskra ▪ Brodogradilite Viktor Lenac ▪ Brodogradnja Monachus ▪ Brodoplan	▪ Brodogradnja Marusic ▪ Brodoremont Punat ▪ Calafatus ▪ Carbo cat ▪ Coredus ▪ Crocon ▪ Damor ▪ Dunkic ▪ Eclipse engineering ▪ Elmar electronics ▪ Em yacht management

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	▪ Brodoremont Punat ▪ Brodosplit ▪ Brodotrogir cruise ▪ Cadcon ▪ Dalmont ▪ De Naval ▪ Emarine ▪ Flow ship design ▪ Inelteh ▪ Kod sedam ▪ Luerssen Design Center Kvarner ▪ Maritime center of excellence ▪ Marservis ▪ MEP ▪ Ms Tech ▪ Navis Consult ▪ Novatec ▪ Nuic Nautika ▪ PBM Croatia ▪ Salona Yachts ▪ Tehnomont Shipyard Pula ▪ Tema ▪ Vard Design Liburna ▪ Victory Marine ▪ Zorovic Maritime Services ▪ ABE Inzenjering ▪ ABE Ing Optimum ▪ Adria cad ▪ Adria oblik ▪ Adriana boats ▪ Adriatic metalmont ▪ Agena Marin ▪ Almar ▪ Anemus ▪ Armanija ▪ Avangard shipyards ▪ Beta marine ▪ Bilus Yacht design ▪ Bimes	▪ Enia ▪ Escomm ▪ Glavno rebro ▪ GM turbo ▪ IKI Marine ▪ Inelmar ▪ Inter Adria sc ▪ Inter diesel ▪ Inter mare ▪ Istra Yachting ▪ Jatro ▪ JLM Perkovic ▪ Kanula ▪ KMK Consulting ▪ Kvarner ▪ Losinjska plovidba brodogradiliste ▪ Mardesign ▪ Marine hidraulik ▪ Maritimus ▪ Marservis ▪ Mi nautika ▪ More marine ▪ Motortech consulting ▪ Narval ▪ Nauta Lamjana ▪ Nautica sigmarine ▪ Nauticka milja ▪ Navalis ▪ Navarch ▪ Navielektro ▪ Navproject ▪ Navtec marine ▪ Piculjan marine ▪ Plazma tehnika ▪ Prima navis ▪ Pro design ▪ Promar design ▪ Radez ▪ Ri naval ▪ Salona var

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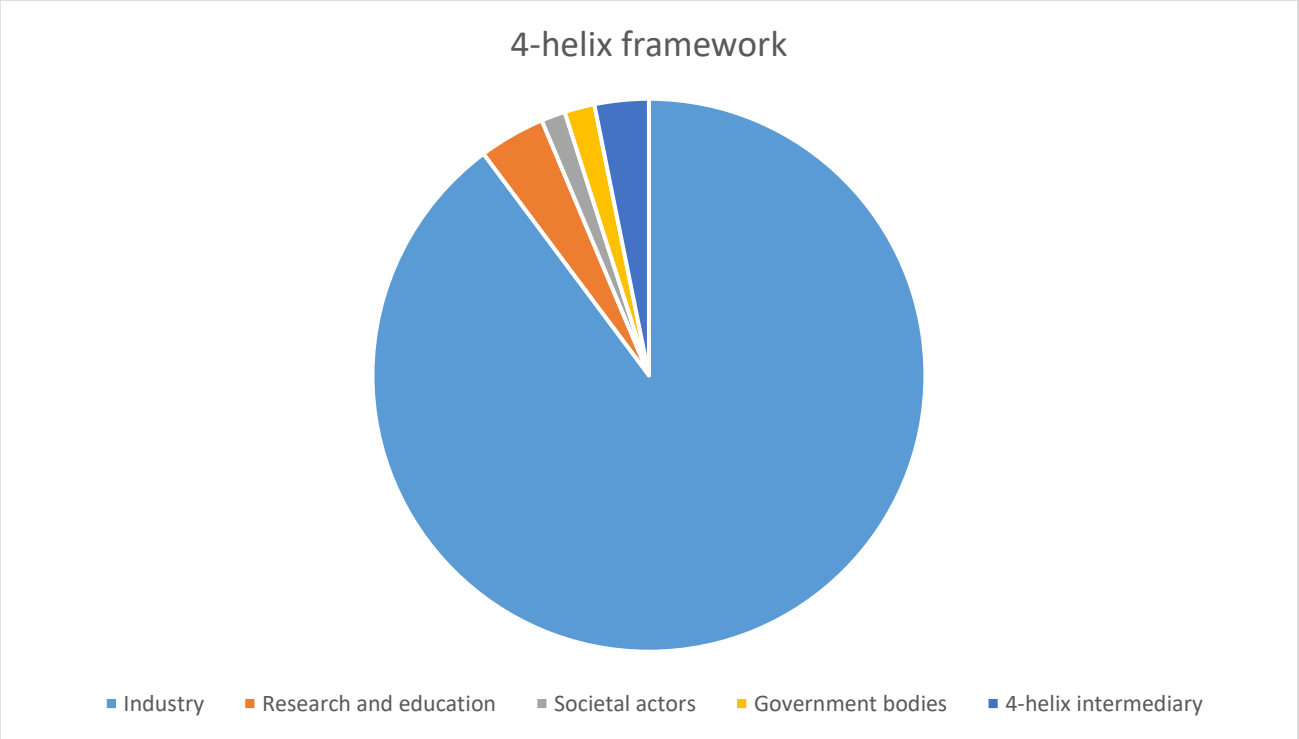
	▪ Bliznac ▪ Brodoarmatura ▪ Brodogradiliste 3. Maj ▪ Brodogradiliste Filipi ▪ Brodogradiliste i marina ▪ Brodogradiliste Punat	▪ Scam marine ▪ Simtec marine ▪ Saric projekt ▪ Uljanik brodogradnja 1865 ▪ Vertex ▪ Ximar
Startups	▪ Caelum 1029 ▪ Hestia Engineering	▪ Plurato ▪ Viakornel
Research & academia	▪ Faculty of Informatics and digital technologies at University of Rijeka ▪ Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture at University of Split ▪ Faculty of Engineering at University of Rijeka ▪ Faculty of Maritime studies at University of Rijeka	▪ Faculty of Maritime studies at University of Split ▪ Maritime Department at University of Dubrovnik ▪ Maritime Department at University of Zadar ▪ METRIS - Center for Materials Research of the Istrian County ▪ Technology Transfer Office of the University of Rijeka (SuR UTT) ▪ Technology Transfer Office of the University of Split (TTO) ▪ Maritime Center of Excellence
Private organizations	▪ MAR/NN -Maritime innovation Cluster	▪ Association of Applied Technical Sciences
Auxiliary services	▪ Bureau Veritas Croatia ▪ CroNoMar ▪ DNV Adriatica ▪ Rens ▪ Adria docks ▪ Adiainspekt ▪ Adriatic wawe ▪ Apave mare ▪ Asp Adriatic ▪ Azara Adria ▪ Biga grupa ▪ B.W.A. ▪ Capax ▪ CB Maritime ▪ Homa marine	▪ Hora electronic ▪ Indel marine ▪ Magnetron ▪ Marex elektrostroj ▪ Marinetek Adriatic ▪ Mata marine ▪ Metris ▪ Nauclerus ▪ Pabulum ▪ Sea Help Adria ▪ Socius ▪ Tekol teri ▪ Thome ship management ▪ Unimar Rijeka ▪ West wind

Funded by the European Union

Infrastructure	▪ ACI d.o.o. ▪ Jadranska vrata ▪ Laguna trade ▪ Luka Dubrovnik ▪ Luka Ploče ▪ Luka Pula ▪ Luka Rijeka ▪ Luka Split ▪ Luka Šibenik	▪ Luka Zadar ▪ Marina Hramina ▪ Marina Punat ▪ Marina Signum ▪ Marine Kastela ▪ Mitan marina ▪ Naftni terminali federacije
Public institutions (other than academia)	▪ HAMAG BICRO ▪ Hrvatski registar brodova ▪ CTK Rijeka ▪ Hrvatski hidrografski institute	▪ Hrvatska udruga za vodik ▪ Porin ▪ Rea kvarner

Categorisation of Croatian maritime and nautical industry stakeholders by the four-helix framework



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6 KEY FINDINGS ABOUT THE SLOVENIAN MARITIME INNOVATION ECOSYSTEM

6.1 General overview

There are three main categories of stakeholders in the Slovenian maritime and nautical industry and every category consists of specific types of stakeholders. In the first category, we find strong innovation drivers, such as startups, companies and institutions building a supportive ecosystem and environment for entrepreneurship, production companies and software companies. The second category includes stakeholders that are innovation drivers but only for the purpose of growth and securing their competition. These are mainly traditional industries (logistics, shipbuilding, and shipping), that are motivated to modernize but only because they need modernization to remain competitive. In the third category are the stakeholders who, while of importance to the maritime sector, are not driven by innovation.

As it is known worldwide, software companies are a very innovative part of any economy, which is also true for Slovenia. Slovenian software development companies participate in various EU-funded projects. One of them is "DIGIT NOO".

In recent years, there has been a huge development of startups in Slovenia. One of many reasons for the development is establishing a supportive environment and a wide network of business incubators and accelerators. In recent years, the first venture capital funds have appeared in Slovenia. There are several funds of different sizes investing in Slovenian startups. Some of Slovenian venture capital funds are Silicon Gardens, Suricate Ventures, and South-Central Ventures, however, there are many more planned to emerge in the next few years. Notwithstanding, we have seen that Slovenia does not yet have a venture capital fund that prioritizes investments in startups in the maritime or nautical industries.

The Slovenian Enterprise Fund has played a key role in the rapid growth of the Slovenian startup ecosystem through the establishment of funding programs. They have established a network of mentors who are experts in different fields. Another public agency that is important for the Slovenian entrepreneurial environment is the Public Agency for the Development of Entrepreneurship in Slovenia ("SPIRIT"), which promotes entrepreneurship, internationalization, foreign investment, and technology. The programs implemented by the Agency are open to all Slovenian companies that meet certain conditions.

Over the last decade, a network of private and public business incubators and accelerators has been established, operating at both local and national levels. They play an important role in the development of a supportive environment for startups in Slovenia. They are also mostly not specialized or limited to a single sector. For example, Lab26 is one of the most important business incubators for the maritime and nautical industry.

As in all areas, startups face certain difficulties. In Slovenia, legislation in this area is very slow to change, so Slovenia is not yet startup friendly. The same applies to tax legislation, which is often the reason for the "brain drain" abroad. To further improve the business environment, a special Ministry for Digital Transformation has been created, as one of its tasks is to foster innovation.

However, some other stakeholders involved in the production of products are also defined as innovative. While these stakeholders may differ considerably, what they have in common is that they adopt innovative approaches in their development. Most of them are export oriented. This group of companies is mostly privately owned and represents a significant share of innovation in the maritime and nautical

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sector.

We found that the share of research and training institutions working in the maritime and nautical sector is relatively low. For example, only one public university is active in this field and provides knowledge dissemination. However, we identified quite a few private research institutions related to maritime and nautical research.

We identified the Port of Koper as a very important stakeholder for the maritime and nautical sector and for the Slovenian economy in general, which is Slovenia's only international cargo port. Luka Koper, in its long history, has achieved various milestones, focusing on sustainable development, environmental protection, and the well-being of the local community. The port embraces digital transformation and tests new technologies through pilot projects. In addition, Luka Koper collaborates with universities, research institutions, and startups to drive innovation in the maritime sector. Therefore, Luka Koper significantly contributes to Slovenia's economic development.

6.1.1 Innovation drivers – general

In terms of their contribution to supporting innovation in the Slovenian maritime and nautical industry, stakeholders could be classified into three categories. Those who are (i) strong drivers and also creators of innovation, those who are (ii) only drivers of innovation because they need it to continue to grow and to secure their competitive advantages, and those who (iii) do not have innovation in their DNA, nor is it important for them to carry out their business activities today and in the future.

The first category can include all (i) startups, (ii) institutions building a supportive ecosystem for entrepreneurship, (iii) companies and institutions building a supportive environment for entrepreneurship, (iv) manufacturing and production companies developing their solutions using the latest technologies and innovative approaches, and (v) software companies developing their software, which they either market as stand-alone, proprietary products or develop on commission.

The second category includes stakeholders from traditional industries such as logistics, shipbuilding, and shipping. However, these companies are motivated to modernize and digitize their business, as this is the only way to ensure that they remain competitive in international markets in the future. To this end, they are engaging with stakeholders in the first category. If the stakeholders in the first category can be characterized as 'supply', the stakeholders in the second category can be described as 'demand'. As such, we also see these companies as drivers of innovation within the ecosystem.

We believe that in the long run all companies and traditional industries will become innovation drivers in this way, as with innovation in their business, their position in the market will certainly be protected in the long run.

In the third category, we include stakeholders that, although they are an integral part of the maritime and nautical industry, refrain from introducing any technological innovation in their business, nor, given the nature of their business, will they in the future. These are various subsidiaries of foreign multinationals that only handle sales in Slovenia, companies operating in the trade sector, and companies that own their own maritime infrastructure. These companies should have been included in the ecosystem mapping.

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6.1.2 Software companies

Software companies are, for the most part, the innovative part of any economy. This is also true for Slovenia. As noted, there are no technology companies in Slovenia that develop software specialized only for the maritime or nautical industries. In most cases, these are companies that develop software for different industries. They either market their products or develop software on commission for clients.

Based on the information we have received; we have found that Slovenian software development companies participate in various consortia funded by the EU. An example of one such consortium is "DIGIT NOO", where Luka Koper is the largest partner and software companies Actual IT, IGEA, EMIGMA, Špica International, and Solvesall are technology partners. The project aims at the digital transformation of processes at the Port of Koper.

6.1.3 Startup ecosystem

For several reasons, the Slovenian startup ecosystem has developed significantly in recent years. The main reason is establishing a comprehensive and effective support environment, which followed the emergence of venture capital, the Slovenian Enterprise Fund's programs supported by public funds, and a diversified network of business incubators and accelerators.

6.1.3.1 Venture capital

The first venture capital funds have emerged in Slovenia in recent years, alongside the establishment of an extensive and well-organized network of business angels. Silicon Gardens, Suricate Ventures, and South-Central Ventures are funds of different sizes that invest in Slovenian startups as part of their investment policy. Slovenia's Business Angels is an association of individuals willing to invest in technology companies in Slovenia.

In addition, new venture capital funds have also emerged in Croatia in recent years. These funds are financed mainly by the European Investment Fund ("EIF"), including Fil Rouge Capital and Feels Good Capital. The latter aims to invest one-third of its portfolio in Slovenian startups as part of its investment policy. At the same time, Fil Rouge Capital has also invested venture capital in several Slovenian startups that have partially transferred their headquarters to Croatia.

At least five new venture capital funds will emerge in Slovenia in 2023 and 2024. Silicon Gardens will launch its latest fund. The fund will be financed exclusively by private investors. Two funds will be financed from predominantly public funds, the SID Bank (Slovenian Development Bank) and the EIF, which will have as their investment policy to provide investments to Slovenian startups at an early stage. Another fund, mainly financed by the EIF, will be launched to transfer technology from universities to the economy. The Slovenian Enterprise Fund will primarily invest in a fifth fund and will also aim to provide sources of finance for early-stage Slovenian startups.

Thus, venture capital is already available in Slovenia, which is essential for developing a supportive startup environment. More venture capital is expected in the next two years, undoubtedly an excellent opportunity for the Slovenian startup ecosystem to flourish further. However, in all these cases, these venture capital funds do not have their investment policies tied to one vertical but invest across verticals. Thus, Slovenia does not have a venture capital fund that prioritizes investments in startups in the maritime or nautical industry verticals. We have yet to see any fund devoting at least part of its attention to this vertical.

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6.1.3.2 Slovenian Enterprise Fund

The Slovenian Enterprise Fund ("SEF") has played a vital role in the rapid growth of the Slovenian startup ecosystem. It has set up funding programs that provide startups at different stages with financial resources to develop and grow. Programs such as P-2 (grant of EUR 54,000), SK-75 (convertible loan of EUR 75,000), and S-200 (convertible loan of EUR 200,000) are designed to support startups at different stages of development. In addition, the SEF has set up a network of mentors, made up of professionals from different backgrounds, who provide expert assistance to startups that are part of the network of business incubators and accelerators.

In addition to the venture above capital fund, which the SEF will set up in 2023, with its assets managed by one or two private sector managers, the SEF has several other programs that provide financial support to Slovenian startups on a non-discriminatory basis. These include the equity program, whereby the SEF matches the private investor's investment amount, and the so-called voucher program, whereby the SEF provides grants to startups to cover costs related to intellectual property protection, transfer of ownership, acquisition of digital competencies, etc.

The SEF does not have funding programs and other forms of financial incentives specialized in one of the verticals. A review of the past recipients of P2, SK-75, and S-200 funding shows that the recipients of grants and convertible loans have been startups operating in various industries. Some of the recipients of these public funds have also been startups developing their solutions in the nautical and maritime sectors.

List of startups from the maritime or nautical industry which received public funding is shown in Table 6.

Table 6: List of startups from the maritime or nautical industry.

Startup	P-2	SK-75	S-200
SiMAre	x		
Interceptor		x	
Remigo	x	x	
Simarin	x	x	

Among the public agencies that are an essential building block of the Slovenian entrepreneurial environment, the SPIRIT is also worth mentioning. It is a public agency that promotes entrepreneurship, internationalization, foreign investment, and technology. SPIRIT offers funding, co-financing of participation in trade fairs abroad, and various training events to Slovenian technology companies aiming to internationalize their business through various public competitions and programs. SPIRIT does not have programs that target only one vertical. However, programs are open to all Slovenian companies that meet certain conditions.

6.1.3.3 Startup accelerators and incubators

In Slovenia, a network of private and public business incubators and accelerators has been established over the last decade, spread evenly across the country. Incubators operate predominantly locally. Local municipalities partly finance public incubators. There are also a small number of private incubators, which are not locally limited.

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Twenty incubators and accelerators are included in the so-called 'innovation environment list.' This program is managed by SPIRIT, under which the entities in the program receive public funds to finance various programs to promote innovative companies. With the limited public funds available to incubators and accelerators, the latter plays a vital role in developing a supportive environment for startups in Slovenia.

Except for some private business incubators, no incubator or accelerator specializes in one industry. The Katapult incubator (www.katapult.si) specializes in supporting technology companies developing hardware. In addition, the only specialized business incubator in Slovenia is Lab26 (www.lab26.eu), which promotes innovation in four fields related to the maritime and nautical industries. These are "maritime industry 4.0", "connected ports," "smart storage," and "Project VEN21".

Lab26 – technology innovation lab for the maritime industry

Lab26 is an entirely privately funded business incubator that brings together students, academics, researchers, and companies from industry to develop innovations for the maritime industry. Within the "maritime industry 4.0" area, they create digital solutions in sensors, automation, robotics, and data analytics to brighten the naval industry. Innovative solutions for safe port operations, predictive maintenance, monitoring processes, devices, and machinery are being developed in the "connected ports" area. IoT is being set in the "smart storage" vertical to monitor goods, smart warehouses, and supply chains. AI-driven predictive analytics for systems driven by AC (electric) motors are being developed under "Project VEN21".

With such specialized knowledge in digital innovation for the maritime industry and with development projects focused on this industry, Lab26 is one of the most critical drivers of the innovation environment for the marine sector in Slovenia.

6.1.3.4 Main threats and weaknesses of the Slovenian startup ecosystem

Given the legal framework, which is changing very slowly in Slovenia, especially in terms of systemic legislation (e.g., legislation governing commercial law), it is difficult to say that Slovenia is friendly to startups. The same applies to tax legislation, among the most unfavourable in Europe for startups. A prime example is the taxation of stock options, a reward system that is very popular in startups. However, under current Slovenian legislation, the effective tax of the option recipient can exceed 65%.

Given the above, the "brain drain" abroad is a significant risk for the Slovenian startup ecosystem and the very issue of promoting innovation in the economy. We know of several cases where Slovenian technology companies have left Slovenia and transferred their operations entirely abroad for tax reasons or because of strict legislation. Outfit 7 and Bitstamp are currently examples of the two most significant Slovenian exits.

Several entrepreneurial initiatives in Slovenia address limited challenges for technology companies and startups. But change is slow. However, in 2021, the Ministry of Digitalisation was established, whose mission is, among other things, to make concrete proposals on how to improve the entrepreneurial environment in Slovenia and how to accelerate innovation through systematic government action further.

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6.1.4 Innovative production companies

In addition to companies developing software for the maritime and nautical industries and startups and entities in the innovation environment (business accelerators and incubators), as described in the previous paragraphs, some companies involved in product manufacturing have also been identified as innovative.

The product portfolios of these companies are very diverse, also the size of the companies and their business model. They have in common that they use innovative approaches in their development through technologically innovative materials, designs, or other innovative techniques. They are primarily export-driven, selling their products to clients outside Slovenia.

To gain a better insight into the performance of innovative product companies, a comprehensive table has been prepared which lists these companies and provides vital information which is publicly available (company's webpage, annual reports, public announcements, etc.), namely:

- key innovative products;
- major business partners;
- major projects;
- product awards received;
- appearances at public events (e.g., trade fairs).

By the sheer size of this category (i.e., the number of stakeholders within the class), this group of privately owned companies is the most significant driver of maritime and nautical innovation in the Slovenian ecosystem. Out of 113 stakeholders identified within the Slovenian ecosystem (see "Ecosystem Canvas"), there are 39 companies categorized as production, which amount to 35 percentage of the ecosystem.

ADRIAING d.o.o.	From a company focused mainly on marine construction works and deep foundations, Adriaing has expanded through the years to other areas of the construction industry. The proportion of buildings has exceeded that of civil engineering construction in recent years. Adriaing is recognizable in Slovenia for providing a wide range of technical solutions for carrying out demanding earthworks and laying deep foundations with pile driving operations. Their distinctive feature is a floating platform (a lighter), which is unique in this regard and is indispensable for construction work along the coastal area.
Marine Constructions	Since its establishment, company has been providing services in marine construction and the construction of maritime infrastructure. The personal references of management staff go back to the period when the Port of Koper and other maritime centres along the Adriatic coast were at the height of their most intensive development. Company builds and renovates marinas, piers, breakwaters, dykes, and port terminals. Company has been collaborating closely with the Port of Koper for two decades. In harbours, the company builds new coastlines, independent berths and

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	revetments, and carries out sea-bed dredging projects by constructing reclamation grounds with the dredged mud. Marine construction works are performed from a floating structure especially equipped for excavation, dredging, and deep foundations. Bigger identified projects for Port of Koper: ▪ Port of Koper, garages ▪ Port of Koper, jet fuel storage tanks ▪ Port of Koper, warehousing area, berth 7c ▪ Port of Koper, berth 7c
ASTEL d.o.o.	The company ASTEL d.o.o. was established in 1991 and has been one of the leading European manufacturers of video surveillance equipment for over a decade. Experiences in the field of security and GSM alarm systems led to the development and production of electronic marine equipment that provides a high level of safety and dependability of operation. The ASTEL MARINE brand name was launched in 2004 and very soon it has become one of the leading brand names in marine industry. Astel Marine Products: ▪ Interior & exterior LED lights (with innovative design) ▪ Underwater LED lights (innovative and patented design) ▪ Superyacht underwater LED lights ▪ Underwater LED dock lights ▪ Wireless yacht control systems ***METSTRADE 2022, Amsterdam, The Netherlands*** The ASTEL MARINE products were presented for the 15th year in a row at the Slovenian national pavilion. This year in collaboration with Dock your Boat 3D simulator which together with their Wireless Yacht Control System easily impressed and entertained new visitors. ***METS 2018, Amsterdam, The Netherlands*** The ASTEL MARINE products will be presented at the Slovenian pavilion of the world's biggest and most visited B2B leisure marine equipment show with the Wireless Yacht Control System, GSM Alarm and Remote-Control Unit and the most innovative LED lighting including the new generation of EQUATOR Underwater LED Lights as the thinnest underwater LED lights on the market.
BLUMAR d.o.o.	BLUMAR d.o.o. is a company that has acquired extensive experience in the nautical field, more accurately the construction of boats. In the beginning, the company build boats for a well-known Italian firm which proved extremely helpful regarding production since they now build approximately 30 boats per year.

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	Company participated at the most important nautical fairs together with the Italian producer and attended many training services important for their work and therefore improved our knowledge and skills. **Services:** Company has expanded product range to the service activity which includes MODELLING, milling with CNC wood processing machinery, joinery work, winter storage of boats. Modelling models of different sizes (wind turbines for wind power plants, snow guns, slot machines and other models on request) Plastic work polyester products such as: masks for slot machines, wind turbines for wind power, and other custom-made products
BOBIČ YACHT INTERIOR d.o.o.	Company work combines a long joinery tradition with the newest technology. Company only uses environmentally friendly materials of the highest quality. The results of the company's work are quality constructed aesthetic products that make them one of the top manufacturers of exclusive interiors. Bobič Yacht Interior successfully cooperates with world famous designers, engineering companies, shipyards, hotel chains, and individual customers. Company is a reliable partner in the implementation of even the most demanding wishes. **Motor yachts and sailing yachts** Bobič Yacht Interior participates in projects with renowned shipyards, yacht designers, and engineering companies worldwide. Company's experienced team of engineers have fully delivered furniture for a number of Luxury Yachts, Motor Yachts and Super Yachts up to 140 metres in length. Company is regularly renewing CAD/CAM/CIM software while attending the educational seminars of their technology and material suppliers. Company has successfully delivered the project of two identical 77-feet aluminium motor yachts White Rose and Silver Rose. The project involved not only the making of furniture and teak decks but also plumbing, electrical installations, satellite equipment, upholstery, quarrying work, glazing and installation. The interior was designed by Guido De Groot.
CAP d.o.o.	Polymer group is an innovative lightweight polymer specialist, which sets standards in marine & caravanning industry. Marine: ▪ Steering wheels: carbon steering wheels made with monocoque technology further improved by their NO BONDING TECHNOLOGY. Also offering customized steering wheels. ▪ Gangways: extremely strong and rigid construction (achieved by high-end composite materials) ▪ Bathing platforms: lightweight (floatable), strong and durable platforms. All projects are customized

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	▪ Steering tillers: Modern ultra slim carbon fibre steering tiller. Also offering customized steering tillers. ▪ Interior headliner: 2D & 3D forming of headliners (interior panels) using LWRT (LightWeight Reinforced Thermoplastic). GANGWAYS – properties ▪ All folding models have smart locking system that allows locking of unfolded (opened) position ▪ Ergonomic design enables easy installation, handling and storing ▪ Antislip surface guarantees safe access to the boat ▪ All fittings needed for installation included (1 male and 1 female fitting in standard) ▪ Closed technology gives POLYMER gangway floatability ▪ All materials are UV protected ▪ All POLYMER gangways are protected against scratches while storing with special elastic side tape ▪ Special reinforcement and protection of bottom (pier side) ▪ Easy theft protection INTERIOR HEADLINERS – materials: ▪ 4 times weight reduction ▪ ZERO water absorption materials ▪ Automotive soft touch feeling and durable textiles/artificial leathers ▪ 3-5 times improved noise absorption
CARBONAUTICA proizvodnja d.o.o.	Specialises in the design and manufacture of high-quality Carbon Fibre and GFC (Glass Fiber Composite) components. Carbonautica has produced specialist carbon parts for applications as diverse as professional racing bicycles, rotors for radio-controlled helicopters and marine steering wheels. Company's main area of business is currently in the marine sector where they make carbon and GFC components for many of the world's leading yacht manufacturers as well as supplying Around the World yacht racing teams. Their current products include monocoque carbon fibre and GFC steering wheels, lightweight carbon gangways, and high-performance carbon or composite rudders. Carbonautica was the first to produce a true monocoque steering wheel for racing yachts with no bonds or seams and the quality of their work remains practically unrivalled. Products: ▪ Carbon and GFC steering wheels ▪ Custom steering wheels ▪ Flagpole

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	▪ Gangways ▪ Power boat wheels
CHEMCO, d.o.o.	Company is producing user and environmentally friendly products with the best technical characteristics. Innovative products including energy-efficient solutions are a part of the current portfolio. **Innovation** At CHEMCO innovation starts with understanding the needs and expectations of their customers. To be able to fulfil them, company has built its own laboratory and managed to develop a wide range of products characterized by quality and innovation. In-house laboratory is the heart of the company where young team of experts works on product development, quality control, and further innovation. From the very beginning, to this day company's mission remains the same: providing customers with high-performance products that take into account the quality of ingredients, customers' needs and environment. The laboratory at company's disposal allow to monitor all the future changes on the market and to quickly respond to the customers' evolving needs. Ambitious projects start with outstanding materials. CHEMCO provides high-performance products that take into account customers' needs, the quality of ingredients, and the environment. Thirty years of experience in the development and production of paints and varnishes are company's advantage and guarantee for reliable products made from the raw materials of the leading European manufacturers (Bayer, BASF, Huntsman, Petrol, and others). Company strives to source the best raw ingredients on the market and constantly improve quality and durability of their products. **CHEMCO NAUTIC** Coatings for all works performed on boats, yacht and other vehicles. Functional and aesthetic painting solution for modern shipbuilding. Line includes antifouling, primers, fillers, clear coats, enamels, thinners and more.
CONTAINER d.o.o.	Due to the various demands of customers, the containers can be used for different purposes: containers for transportation of bulk cargos, half-height containers, open top containers, containers for transport of radioactive waste, and containers for aggregates, insulated containers etc.

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	Company's main activities are: ▪ development, construction, testing and production of special containers, ▪ designing and production of steel constructions. Company pays a lot of attention to the green production and recycling of materials in the production process as well as in their final products. More than 95% of the materials used in their production can be recycled and reused. **Gold award for the developmental project Innotank** In 2016, Slovenian Chamber of Commerce awarded regional recognitions for the most innovative companies and innovators in the companies and public research institutes.
ELAN YACHTING, d.o.o.	Elan embodies a true passion for sailing, technological innovations and distinctive design. Every yacht coming from Elan's 16.000 sq meter boatyard in Slovenia is the result of their 70-years long passion for innovation-oriented quality boatbuilding. Humphreys Yacht Design have been principal designers for Elan Marine. The Elan/Humphreys team consistently strives to explore new developments and respond to feedback from owners, so that if an owner wants to race, he can win, and if he wants to cruise then he will be able to do so in a reassuring fashion, content in the knowledge that he can reel away the miles in comfort. This approach has won the brand a high level of customer loyalty which in turn translates into a motivated and passionate design team. Elan Yachting received many yachting awards for their innovations. ▪ Design award of the year 2022 ▪ Nominated for the British Yachting Awards 2022 ▪ European Yacht of the Year 2022 ▪ Shortlisted at the International Yacht & Aviation Awards 2022, category: sailing yachts
ELEKTRO ŠTUMPFL d.o.o.	Successfully implementing projects in the fields of electrical installations, vessel electrification, and the assembly of LV distributors. One of their services provided is the comprehensive execution of electrical installations on vessels. The nautical sector includes the manufacture and renovation of electrical installations for all types of vessels (sailing boats, motorboats, and yachts). One of the values are innovation, ambition, and self-initiative. ***METS fair 2022***

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	The company attended METS fair 2022 in Amsterdam, the Netherlands, to display products and services, learn more about the upcoming trends in the maritime industry, generate new business connections and strengthen existing connections with business partners and customers. Company also visited their Dutch business partner and supplier, Victron Energy. ***Updating electrical systems on older vessels*** Company installs and updates electrical systems on older vessels. Company updated the existing electrical system, which ran on lead batteries, to a system which is now being powered by lithium batteries. Company also installed a new operational control system for the batteries, which can be monitored with the help of a smart phone. The new electrical system will prolong battery life, enable a more efficient use of the electrical energy, and provide longer hours of worry-free sailing. ***Pegasus 50 nominated for European Yacht of 2021*** Company is proud that Pegasus 50 project has been nominated for the European Yacht of the Year Award in the Bluewater Cruiser category. Company made the entire electrical installation (wiring harnesses, electrical distributors) for this vessel and equipped it with a Fischer Panda generator with Victron Energy products (combined rectifier/inverter, batteries, MPPT regulator, etc.).
GS d.o.o.	**Gangways** GS Composite carbon gangways are a leap forward in nautical accessory design and are the first gangways manufactured by the VARTM system. Their extraordinary design, technological innovation and practical value launched GS Composite carbon gangways into the top tier of nautical equipment manufacturers. Offering different models: full carbon, prestige carbon, carbon look, dark blue line, custom colour gangway, teak look, … **Steering wheels** GS Composite steering wheels are produced from aluminium moulds with quality pre-preg fabrics. All wheels are made in EU and are certified with Germanische Lloyd certificate. Mechanical properties of carbon fibres are 10 times stronger in comparison to metals. They have the same stiffness, and they have lower weight. The most important of all is a lower rotational inertia results in improved feedback from steering system and consequently, in lower power consumption of autopilots.

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	Greenline – 2 solutions in one! 2 solutions in one! GS Composite exclusively for Greenline. Light carbon gangway turns into a padded bench in the cockpit and insures safe way to the yacht. The Greenline composite kit offers safety and comfort. ***Smart lock for foldable gangways*** Smart lock (safety side fixation) is an innovation for turning a foldable gangway into a solid model. It provides better filling and it is easier to handle the gangway when you lift it from the pier to the boat.
HOVERCRAFT d.o.o.	Hovercraft is an international innovative manufacturing and services company engaged primarily in the production of inflatable products. **Innovation** Company continuously seeks to provide solutions to potential challenges, as the world is changing rapidly. Thus, company is an international end-to-end tech innovation company. Company works with partners to create simple, effective solutions for real world problems. In addition, company offers R&D and OEM production for their partners. Projects: ▪ ELECTRICAT It is the fastest, the lightest, affordable inflatable solar electric catamaran in the world ▪ AirDrive is a study of inflatable amphibious vehicle made of double wall fabric. Their goal is to develop working product for all terrains such as sea, mud, ice, snow, rocks, sand, shallow waters and roads. Wheels have in wheel electric motor driven by wire. It will be operated remote, driven like a drone. ▪ SEAtrailer is an inflatable caravan or self-propelled vessel that offers a whole new standard among simple inflatable vessels. Never before has it been possible to ride as comfortably in the company of friends and family as is possible with an inflatable caravan for all types of boats. ▪ ALLCART is a smaller AirDrive ▪ EcoCraft is a platform for lakes, lazy rivers and calm waters, usually equipped with solar cell roof that you never ever think about charging it.
INTERVELA d.o.o. (OneSail Slovenia)	OneSails is a global network that adheres to independent sail lofts all over the world. OneSails Slovenia is the biggest sail loft in Eastern Europe. The loft makes sails for all classes of yachts, from Optimist One Design to mega yachts of over 30 metres. In One Design, the loft's biggest successes have been with sails for the Finn class with three World Championships and an Olympic bronze medal. Among

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	other projects, they have built sails for Gaia Legend and Maxi Jena, two very successful Slovenian Maxis. Their loft is also premium supplier to yacht builders such as Elan and Salona. ***OneSails has joined IMOCA Green Sail Rule*** OneSails has joined the panel of experienced sailmakers collaborating on IMOCA's new Green Sail rule. This chosen group of sailmakers will discuss the next steps needed to create real change to improve sustainability in the sail making industry. After more than 10 years of research, OneSails is currently the only sailmaker with ISO certification of high-performance sails, which deliver low CO2 emissions in the construction process with 100% recyclability at the end of the sail's useful life. **IFS™ Integrated Furling Structure** The next generation of furling sails. OneSails presented the IFS™ (Integrated Furling Structure), a new style of headsail and downwind sail construction which uses continuous fibre technology to create sails which can be furled without the use of a heavy and expensive anti-torsion cable.
ISKRA d.o.o.	Striving to be a trusted development partner in public infrastructure, the energy sector and global car and electrical industries in order to contribute to the creation of leading products and solutions. **Site Energy Monitoring Solution** This solution provides all necessary means for equipping a factory or business to have all relevant energy related data always centrally available for monitoring as well as for basic data analysis. Energy related data can now always be available at the tip of one's hands. **Signalling and Interlocking System at Rijekaport - Brajdica railway station** Project "Port of Rijeka multimodal platform development and interconnection to Adriatic Gate container terminal". Iskra designed, delivered, installed, and commissioned a modern signalling and interlocking system at Rijekaport – Brajdica railway station. ISKRA SHIPYARD is the leading ship repair yard on the eastern coast of the Adriatic Sea, specialized in repairs of all types of vessels up to 80 m in LOA, and in new build vessels up to 60 meters LOA. Shipyard offers Repair, Refit, Conversion and New Build Supervision services, as well as complete Technical Management. **Shipbuilding** The new-build program includes the production of aluminium catamarans for the

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	fish farm markets, a passenger M/B for 400 people and leisure boats of various size and type. **Commercial** ISKRA SHIPYARD service the fleet of Croatian national passenger ships (Jadrolinija, Atlas, G & V Line, Brodospas, Plovput), Port Authority and Harbour master's Office boats, and a large number of vessels intended for day tourism, fishing, leisure, and special purpose activities. All work is conducted professionally with the utmost attention to details and clients' requests. Latest project: BlueDrive – hybrid power split marine propulsion.
KOLEKTOR SISTEH d.o.o.	Kolektor Sisteh ensures a reliable, safe, and optimal water supply. With modern procedures and approaches, they plan, design and implement the complete technological systems for water treatment and purification and advanced solutions for controlling and optimizing the functioning of water supply systems. **Satellite detection and micro location of leaks in water distribution systems** An innovative satellite-based water leak detection technology. Undetected water leaks represent a major expense and a lasting challenge for water supply systems. Existing traditional technologies for water leak detection on water supply systems require a large financial and time investment of the water supply system operator. Asterra, the innovative satellite-based water leak detection technology is a new revolutionary way of detecting water leaks based on the analysis of radar satellite imagery. The technology developed by Utilis to seek water on other planets (Mars, Venus) is now being used to seek water leaks in water supply systems. **Solutions for remote water meter reading and for hydraulic optimization of water networks** In the field of water consumption measurement solutions, they offer high-tech automatic meter reading (AMR) systems and advanced metering infrastructure (AMI). The solutions can be implemented independently or as an upgrade to the telemetry systems. Designed specifically to meet the needs of water utilities, they are intended to improve management in measuring water consumption, reducing water loss and hydraulic optimization in water distribution networks. By means of the AMR/AMI solutions, the establishment of strategic metering points in the network and the correct selection of the metering and communication equipment and software, they provide a powerful tool for establishing flexible and stable water distribution networks, with an emphasis on automated monitoring of water consumption and diagnostics, localization and monitoring of water loss elimination, congestion of certain parts of the network and failures.

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	Waste water treatment Achieve savings by reusing wastewater. The company offers wastewater treatment technologies for municipal and industrial wastewater. Municipal wastewater is considered as readily biodegradable. In the absence of specific drainage requirements, conventional treatment plants with different technologies are used. Recently, they have been upgraded with the phosphorus removal process. The industrial wastewater is most often laden with chemical parameters (pH, COD – chemical oxygen demand, heavy metals); therefore, it needs to be properly treated to lower the critical values of parameters in water that are specific to each industry. Wastewater values need to be reduced to legally prescribed concentrations. **Innovation** Innovation, investment in cutting-edge technology, quality management system and, in particular, competent employees are the driving force behind their progress. In the company, they want to bring innovation to an even higher level; therefore, they allow all employees to act on the problems and opportunities that they encounter at every step. Their goal is to include all employees in all business fields, regardless of their education or position in the company. Innovation in numbers: ▪ Number of patents: 37 ▪ Number of innovative ideas: 33.526 ▪ Number of realized ideas: 24.474
LAXNAV d.o.o.	Producing top of the market aviation navigational equipment. Their goal is to bring the aviation precision to the marine world. Latest operation: development of flexible electric propulsion Smart devices and other intelligent devices: ▪ SmartEMU Smart engine monitoring unit ▪ SmartFLC Smart Fluid Level Converter

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	▪ SmartSHUNT Smart state of charge ▪ SmartGPS vessel tracking device
MARINAR d.o.o.	Dealing with the development and production of rubber boats. Products: ▪ Several types of boats with hard base ▪ Boats with inflatable bottom ▪ TRI boats with wooden floor and inflatable keel ▪ Raft boats ▪ Rescue equipment Products are fireproof, resistant to UV light, abrasion, hydrocarbons, extreme conditions, mechanical resistance and are easily repairable. Because of the excellent material and method of manufacture their boats are practically unsinkable.
MARINBLU d.o.o.	Marinblu's sales program includes the production, processing and sale of live, fresh, defrosted, frozen, smoked, dried and packaged sea and freshwater fish, shells, crustaceans, squids, octopuses, cuttlefish, algae and other delicatessen products.
METALIKA d.o.o.	Creating unique ship and yacht interiors with cutting-edge innovations. **Nautilus** A revolutionary sleeping pod for the marine industry.
MORSKA POT d.o.o. (Boatasy)	Specialized in developing and manufacturing innovative products for mooring and docking under trademark BOATASY. Products are used by many users across the globe, because of their unique solutions, which simplify and improve mooring or docking from on-board of their boats. The main advantages are that the user hands and boat deck remain clean after the operations, which are usually much shorter comparing to the traditional one. All products (GHOOK, HOOKLINKER and DOCKHOOK) are recognized for their quality, reliability, and unique technological innovation. **Ropecleaner** The Boatasy Ropecleaner is the new cleaner for overgrown ropes. It guarantees effective cleaning of various overgrown marine ropes – mooring and anchor ropes,

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	lazy lines, other underwater ropes, etc. Its compact size makes it easy to store and transport and can be used on the go without the need for electricity or a water source and in this way substitutes the traditional cleaning of the overgrown ropes. It is strong and fast, saves money and time. Nominated for DAME Design Award. **Hooklinker** Hooklinker is multifunctional boat hook unit for simple mooring and docking. Together with stainless steel spring snap hook, LED flashlight, and holder for Boatasy GHOOK, it guarantees a complete and quick mooring or docking experience. **Boatasy GHOOK** The GHOOK boat hook consists of a handle with an inserted rolling wheel and a safety latch. Additionally, a tow rope can be adjusted for even easier handling. Due to its simple use, it could be used by different crew members on different type of boats. **Dockhook** Boat hook for automatic attachment of loop lines. With integrated patented flexible spring locker guarantees simple onboard attachment and release of the loop lines (lasso) onto a cleat, pylon, bollard, or buoy, making it a quick and effortless process. Docking is now done automatically from onboard.
MULTIVARIO d.o.o.	Solutions for industry: ▪ Components for nautical and caravan industry ▪ Windshields for all vessels, various plastic components for boats and caravans, decorative plastic semi-finished products ▪ Illuminating signs and advertising panels ▪ Wooden pallets and packing solutions ▪ Pallets with blocks, slats ▪ Other boxing solutions Noise barriers: ▪ Transparent, aluminium, or wooden ▪ Combining options ▪ In compliance with many European standards

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NAUTIC SERVICE TRGOVINA d.o.o.	Maintenance and kitting of vessels and maintenance of industrial engines. Nautic service's activities are divided into three strands: 1. Vessel maintenance and completion 2. Maintenance and repair of Volvo Penta and Cummins industrial engines 3. spare parts and marine equipment trade
NT ELECTRIC d.o.o.	The idea of advanced plug-and-play electric propulsion was born with the aim to develop innovative electric propulsion technology, specifically designed for water-borne usage, coming with a disruptive motor cooling system, high-performance and easy plug-and-play installation. **Integrated plug-and-play electric propulsion system** Unique in being modularly built, designed to be quickly and easily assembled, customizable in motor power and battery capacity, equipped with smart software that automatically manages consumption levels, suggests travel modes, and much more. Each component (electric motor, battery bank, etc.) is fully modular and ready to plug&play. The end-user can choose the optimal solution (propulsion power, battery capacity, charging time, ...) for his own needs and each deployment is capable of being customized. Future scaling is also possible and very simple. Same as a new installation, scaling is also plug&play. This makes the retrofit very effective and reasonable. NT Systems can be used in various applications where there is need of reducing pollution, operating or manufacturing costs. Recreational and transfer boating is initial roll-out market, including tourist or cargo transportation for river or channel crossing, small ferry, taxi boats, harbour applications, work platform/barges, service crew, marina crew, rescue crew, coastal diving centres, coastal security and police boats, smaller towing applications, by-boats for ocean cruisers or personal use, island cruising, fishing boats, aquafarming, leisure personal boats and yachts, sailboats and much more. It is also very convenient for eco-sensitive environments such as lakes, rivers, national parks, city canals etc. **Throttle lever** The throttle lever is engineered in-house and specifically designed for electric propulsion. It is simple and ergonomic, with all marine functions. It supports control over multiple-motor installations and multiple stations, while Dock assistant feature will help with complex and precise manoeuvres.

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	Optimal power tracker OPT can optimise numerous parameters, make predictions on energy and power needs, optimise energy and fuel consumption, select smart mode (when to start range extender regarding prediction, SOC of battery, environmental factors such as temperature, noise level, etc.), customisation, different pre-sets for different users and other more basic tasks. The optimization of best-case scenario will not be based only on current driving parameters, but also on data from previous trips.
OCEAN TEC d.o.o.	Professional boat builders. Ocean tech concentrates on boat building with constant attention to innovation and improvements in composite technology. They want boats to be reliable, light, and finished to highest standards.
ORBIPARK d.o.o.	**Detachable Glue** A new system for gluing (connecting) parts, using thermoplastic glue. The novelty lies in the fact that parts, once already connected, can subsequently be separated in a controlled way. This advanced technology represents a major advance in glue technology. Benefits include faster installation (no drying time), the possibility of replacing parts, and simple disassembly for recycling. **"Recuperation of air layer under ship's hull"** This patent is about thin layer of air under the flat bottom of the hull. Air layer floats under the vessel and reduces friction, similar to "air lubrication" system that was developed in Japan, Holland and Norway. In front of the stern air is collected with suction grill and pushed toward the bow and is recirculated like in an "air conveyor". The reuse of air "recuperation" extremely reduces energy needed for creation of air layer. **"Hyperbolic Jet propulsion" – PROPULSION without propeller** They have built a hyperbolic cone like trumpet with functional inside spiral. The spiral is creating vortex spin of water. The entering opening is closed by sphere with opening in the middle and three side water cutting blades. They wanted to eliminate the water resistance of an electric motor that looks a bit bulky at classical azimuth thrusters. To create propulsion that will also be able to transfer centrifugal force that is created by spinning in to propulsion and to avoid problems caused by cavitation. In hyperbolic cone, they continuously compress water, so the steam cavitation bubble is created in axis of rotation, where nothing could be destroyed by cavitation.
PODKRIŽNIK d.o.o.	The company's production units strive for 100-percent "zero defect" supply and production. The success of the production is confirmed by the constant growth of operations, the growth of projects for existing customers, and the constant

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	attraction of new customers. Their value is business excellence, based on an open view of the future, aspiration for the technological progress set at a high organisational level, order and cleanliness, environmental protection, as well as self-initiative and self-control. ***Gold award for Innovative approaches in the field of process*** Process innovation solves technological issues ensuring the quality of polymer helical gears in planetary drive. High quality polymer gears directly increase the lifespan and ensure smooth running and low noise emissions. The solution combines interdisciplinary approaches to work, to eliminate the processes of machining teeth on pre-injected moulded bases with the process of injection moulding of the final gear shape. The solution had cost benefit in the production of e-mobility gearboxes and the reduction in the amount of polymer consumed, which is important in sustainable engineering. ***Silver award for Working boat with electric propulsion edyn*** The vessel for bathymetry is a complete solution for anyone who needs information on what is going on below the water surface. The vessel is suitable for rivers, lakes, or the sea. It can be used both to monitor changes in the bottom over time and to search for specific objects such as sunken ships or the variability of the bottom so that a safe passage can be determined for larger vessels with a higher draft. The entire set offers the user a high-tech solution, which we do not encounter very often on the market, or during our research such a dedicated application was not found at all. **Electric Dynamic Nautics (e'dyn by Podkrižnik)** They offer electrical propulsion systems for boats in different variations and powers. Their goal is to create smart electric mobility solutions for people who move around on water. E'dyn propulsion systems and motors can be used on various vessels on lakes, rivers, and seas. All products are produced and assembled in accordance with the latest innovations, technology improvements and customers' requirements.
POLIESTERPLAST d.o.o.	The company manufactures all polyester elements for boats.
QUADROFOIL d.o.o.	Revolutionary all-electric hydrofoiling watercraft **Quadrofoil Q2** Quadrofoil's high performance trimaran hull shape offers stability, top-notch

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	hydro and aerodynamics and spectacular handling when airborne. The lightweight modular hull is made from composite materials and is almost unsinkable due to its airtight top module.
RESNIK GLASS d.o.o.	RESNIK GLASS has gained an international reputation in the planning, manufacture, and design of glass production for nautics and glazing products of unparalleled excellence. The company manufactures glass products for installation in boats, yachts, sailboats etc.
RIEDL CNC d.o.o.	Providing high-quality complex metal products is based on accumulated knowledge, tradition and innovativeness of this company. Producing products for automotive, nautical and aviation industry.
ROTO Slovenija d.o.o.	ROTO manufactures more than 4,000 different products. Many of them are made using rotational molding. Indeed, ROTO is one of the market leaders in its industry. It has been responsible for many innovations in plastic-molding technology. The company's main production segments are final products for sport, nautic, agriculture, ecology, gardening. Using plastics composites and the latest production technologies, ROTO also makes kayaks, canoes, and high-performance boats.
SANDILINE d.o.o.	Technical watersport clothing.
SEASCAPE d.o.o.	The company works through two brands: the iconic "Beneteau First" and the innovative "SE – Seascape Edition" on a mission to achieve "the ultimate connection between humans and the sea".
SEAWAY PORTOROŽ d.o.o.	Production of sails.
SIGMA ENERGIJA d.o.o.	Sigma Energy has been developing, for several years, a novel type of wave energy converter (Sigma WEC). It is a point type wave power plant which transforms, by original mechanical PTO system, the vertical motion of the circular floating buoy due to waves into the electric energy. The performance of Sigma WEC has been analysed mathematically by an original software and proved by detailed model tests in several wave tanks. Very favourable performance has been found, with high efficiency even in the case of small models. **Sigma Wave Energy Converter (WEC)** Sigma Energy developed and implemented an original mechanical PTO system, with inertial unidirectional clutches which smooth the rotation of the generator and increase its efficiency.

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	Sigma Energy also developed an original circular float design with an open bottom and system of unidirectional valves. It captures pre-calculated mass of water, which makes the float properly weighted and (in case of extreme waves) it highly reduces the bottom slamming loads. Float is connected to the spar by specially constructed and patented spherical joint. The joint enables the float to pitch, which highly reduces the dynamic loads on (very exposed and tensed) vertical spar. It also makes the float motion considerably smoother, with reduced danger of bottom slamming. The spar is supported by a tension leg platform with three tendons of equal length, so it remains vertical throughout the motion. This, as proved by model tests, enables very favourable and effective heave motion of the float. There is an original, patented, procedure for deployment of the tension leg platform and the float at the chosen location. Most of the presented innovative solutions have been tested and verified by numerical analysis and several model tests.
SIPABOARDS d.o.o.	**World's first e-sup** Motorized electric paddle boards SipaBoards are designed to offer an all-round enhanced SUP experience. With a built in Paddle Assist module, one will paddle faster, ride further and get there and back again safer. "Conquer new shores, beat the tides, paddle up-wind or up-stream and explore more." Is the moto behind this innovative company.
VEPLAS d.d.	Veplas Group is one of the leading manufacturers of composite parts on east part of central Europe with almost 50 years of tradition of production from fibre reinforced plastic (FRP). We are producer of glass fibre (GRP), carbon fibre (CRP) and aramid fibre (ARP) composite parts with autoclave, RTM and hand lay-up manufacturing technology. Most used resin are: polyester, vinyl ester and epoxy. Production of ballistic visors (bullet-proof)

6.1.5 Research institutions and academia

Considering the identified stakeholders in the Slovenian ecosystem, particularly the number of recognized private companies operating in the maritime and nautical industry, we note that the number of research institutions is relatively small. The same is true for educational institutions dedicated to naval studies.

There is only one public faculty in Slovenia, the Faculty for Maritime Studies and Traffic, which operates within the University of Ljubljana, and has a curriculum dedicated to marine sciences. Private universities in Slovenia offer these programs outside one of their faculties.

We have identified a few private research institutions (Algen, Innorew COE, Juniva, Sentinel Labs) that mention in their program that they are focused on research related to the maritime industry and nautical.

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There are also some of the technical Faculties at University of Ljubljana and University of Maribor, which are, in terms of research and innovation activities, in close relation to the maritime sector or are focused on technical solutions that are directly or indirectly used in mentioned sector. One of the important technical faculties are Faculty of Mechanical Engineering, Faculty of Electrical Engineering, Faculty of Computer Science and Informatics, all members of University of Ljubljana.

6.1.6 Logistics, shipping, and shipbuilding companies

As mentioned in point v.ii.i. (Innovation drivers - general), stakeholders operating within traditional industries such as logistics, shipping, and shipbuilding have been found to be, for the most part, not direct drivers of innovation themselves, but an indispensable element of it on the demand side.

The logistics, shipping, and shipbuilding vertical (included in the manufacturing category) represents a significant part of the overall Slovenian ecosystem in terms of size. As such, it is also important in terms of ensuring the future flow of innovation in the Slovenian maritime and nautical industry.

6.2 Luka Koper (Port of Koper)

Luka Koper (Port of Koper) is the only Slovenian international cargo port and, therefore, of critical strategic importance for Slovenia. Due to its geographical and strategic location in the Adriatic Sea, the port plays a vital role in the logistics connections between Central and Eastern Europe with the Mediterranean and other overseas countries. The port represents the main entry for goods transported by sea to Central and Eastern Europe and has good road and rail links, allowing efficient movement of goods. It is also essential in Slovenia's economic development by representing an important export opportunity for Slovenian companies, contributing to job creation.

The Port of Koper has been in operation since its foundation in 1957 (then known as Pristanišče Koper), and a few years later, the port was granted the status of a free-trade zone. In 1974, the first regular container service for the Mediterranean was established. Since 1996, the Port of Koper has operated as we know it today (Luka Koper, d.d.). A year later, the first sea monitoring system was set up. In 2000, the ISO 14001 environmental certificate was acquired. The Port was awarded the EFQM European Award for Business Determination in 2005, and in the same year, its annual volume of handled cargo exceeded 13 million tons. A Regional representation was opened for the Far East in Malaysia. In 2009, the Northern Adriatic ports of Koper, Trieste, Venice, and Ravenna signed an agreement to form the North Adriatic Port Association (NAPA), which Rijeka later joined. Their long-standing success is also reflected in their position among the finalists of the ESPO 2009 (European Seaports Organisation) award, their AEO (Authorised Economic Operator) certificate in 2011 for port security and safety, and their shipping throughput surpassed 17 million tons. Luka Koper has long been aware of the importance of sustainable development, for which they were a finalist in the Containerisation International Awards in 2012 in the Sustainable Development category. Luka Koper was officially included in the EU's Mediterranean and Baltic-Adriatic transport corridors a year later. In 2014, Luka Koper was awarded the Brand Leader Award for the best port operator and logistics service provider in South-Eastern Europe and the first prize of the European Sea Ports Organisation (ESPO), which awards prizes for the most environmentally friendly and socially responsible ports in Europe. In 2015, the European Commission awarded special recognition in environmental management, and in the same year, the annual ship throughput reached 20 million tons.

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A record of 24 million tons was achieved in 2018. In 2021, they also received the award for the safest Slovenian company from the Institute for Corporate Safety Studies (ICS).[3] Throughout the years, they have calibrated their operations to achieve the overall quality of their business. They have obtained several certificates in the areas of quality, environmental management, occupational health and safety, energy management, organic production, and others.[4]

The Port promotes the broader social environment through sponsorships and donations. The Living with the Port Fund announces sponsorship and donation funding yearly. The company's decision to grant support is to strengthen its brand and corporate image, exercise social responsibility for the local environment, and pursue commercial interests. The company prioritizes ecology, the arts, humanitarian activities, education, sport, and tourism. They know the impact of port activities on the people who live directly next to the port. Therefore, they try to contribute to promoting cultural, sporting, environmental, humanitarian, and other activities. Together with other companies, they have financially supported the University of Primorska. This enabled the successful launch of the third Slovenian university.

The Port of Koper has high quality and safety standards and is actively committed to sustainable development, environmental protection, and the local community's well-being. The Port of Koper is part of the city of Koper and its fragile natural environment. It is surrounded on two sides by built-up areas, in the hinterland by a natural setting of exceptional value (Škocjanski zatok) and on the outside by a sensitive marine ecosystem. They are therefore committed to improving the lives of the surrounding inhabitants while preserving nature as pristine as possible. The development strategy of the Port of Koper is based on environmental management. It is also proud to be the only port in the northern Adriatic with several quality systems for environmental protection, occupational health, and safety, food safety management, etc. They balance environmental, social, and economic requirements in developing the port. They will continue to develop the green port concept in the future.

They recognize the importance of skilled and, above all, motivated staff, who make a crucial contribution to the success of their business and the achievement of their development plans. They foresee that the increase in throughput will also increase the need to recruit new staff. They will also link up with educational institutions to offer internships and scholarships for young people. The Port of Koper provides regular training and education for staff. In 2022, 86% of employees received training.[5] This is also an indication of the very stimulating working environment created by Luka Koper and the desire of employees to be as competitive as possible in their work. Even at the beginning of 2020, when the world was struck by an epidemic, which was particularly felt in the economy, they quickly reorganized their work to ensure it ran as smoothly as possible while ensuring that their employees were sufficiently protected. As a strategic infrastructure, the Port of Koper generally operated throughout the epidemic, providing services to its customers.[6] The critical strategic orientations of the Port of Koper relate to sustainable management, employment, and the natural and social environment. They are committed to ethical business conduct, a corporate integrity culture, and human rights protection. This concept also includes a wide range of stakeholders with whom Luka Koper is in constant contact and committed to

[3] On https://www.luka-kp.si/en/company/history/

[4] https://www.luka-kp.si/en/company/quality/

[5] https://www.luka-kp.si/wp-content/uploads/2023/04/LK-LP-2022-SLO-v_FIN2.pdf

[6] https://www.zivetispristaniscem.si/wp-content/uploads/2021/07/Luski-vozli-2021_za-web-FINAL.pdf

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transparency of communication.

The Port of Koper is committed to ESG standards and has taken several measures to meet them and ensure sustainable development in the port industry. It has several initiatives to reduce its carbon footprint and promote sustainable practices. As a green port, it has ambitious targets, some of which go beyond the requirements of national legislation. They strive to introduce good business practices and thus become internationally recognized for their competitive advantages. They want to become a low-carbon port. They carry out a wide range of activities in the field of environmental protection, including monitoring and managing environmental impacts as part of their regular activities. Perceived impacts are monitored, measured, and appropriately mitigated at the source. In 2009 the Port of Koper launched a website, "Living with the Port," which enables the local community and anyone interested in the sustainable development of the port to communicate directly about the Port's sustainability activities. The website also provides real-time information on measuring noise levels and airborne particulate matter emissions at several points close to the port. Some information about monitoring the sea's state is already available.[7] They are also striving to become as energy independent as possible and, in this light, are switching to cleaner and more renewable energy sources.[8] In conclusion, the Port of Koper has a strong environmental awareness and is constantly striving to reduce the impact of port activities on the surrounding area and for greater energy efficiency. They have been awarded an Energy Efficiency Certificate for their efforts to date. They also plan to electrify the port's lifts by 2030 and increase the share of electric service vehicles. In line with the European Directive on establishing infrastructure for using alternative fuels in transport, the construction of shore-side docking stations to supply electricity to ships at berth has already started. This will also help to reduce noise in the port.

Investing in sustainable development is now essential to attract and maintain strategic partnerships with leading companies in the maritime sector. All this is possible thanks to the ability of the Port of Koper to adapt to changes in the marine sector continuously. The port promotes innovative approaches to the maritime industry and the development of sustainable and efficient port management. In this context, it cooperates with various universities and other research institutions in Slovenia. They are involved in multiple projects dealing with intelligent ports, logistics, and transport and support startups and entrepreneurs in the maritime sector. They are also working on a continuous digital transformation towards an intelligent port. In the field of digitization and digital transformation, they are constantly following the trends of development. They will gradually continue to introduce automated workflows. New technologies are continually being tested in the form of pilot projects with both domestic and foreign scientific institutions.[9]

It is worth mentioning that the Port of Koper also has its own research and development department, which develops new technologies and processes for more efficient and sustainable port operations, thus contributing to developing the maritime innovation ecosystem in Slovenia. They also participated in various development, research, and pilot projects (e.g., Horizon 2020-supported projects). The Port attracts numerous foreign investors and is involved in several investment projects. In recent years, it has

[7] https://www.zivetispristaniscem.si

[8] https://www.luka-kp.si/wp-content/uploads/2021/03/Strategija-druzbene-odgovornosti-in-trajnostnega-razvoja_FINAL-popravek-1.3.21-1.pdf

[9] https://www.luka-kp.si/wp-content/uploads/2021/03/Povzetek-SPN-2020-2025.pdf

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invested heavily in modernizing its infrastructure and developing new services and technologies to improve the port's efficiency and productivity. Suppliers also provide essential support to the business of the Port. Quality suppliers are also the ones that contribute to more efficient business processes. The company also regularly evaluates its supplier relationships. Among other things, the selection of suppliers is based on their perception of sustainable development and environmental protection.[10] They also strive for good customer relations and regularly monitor customer satisfaction.

The Port of Koper is important not only for the economic development of Slovenia but also for the wider region. It plays a vital role in strengthening the competitiveness of the European maritime sector. The Port of Koper, with its sustainable, innovative, and intelligent solutions, has become an ambassador of the campaign to promote the Slovenian economy under the slogan "I FEEL SLOVENIA. Green. Creative. Smart.", confirming that the development into a green port is heading in the right direction. With this, Luka Koper has become one of the 19 companies whose activities will help to raise the profile of the competitive advantages of the Slovenian economy.[11] In that context, they continuously carry out various marketing activities to promote the competitive advantages of Koper and Slovenia in general and raise the profile of Slovenia as a cruise destination in the Mediterranean region.

6.2.1 Port of Koper going digital

While gathering information from various stakeholders in the ecosystem, we have repeatedly confirmed that Luka Koper is a critical stakeholder in the Slovenian ecosystem, especially from the perspective of the maritime industry, which also includes the support industry.

Luka Koper is not only a customer or business partner to other companies in Slovenia but is also involved in various entrepreneurial consortia that have received European and other public funding under multiple programs to develop innovative technological solutions that Luka Koper will use to modernise and digitise its operations.

Luka Koper has formulated a five-year Strategic business plan that they started carrying out in 2020. The plan tackles multiple goals that will contribute to the expansion of the capability of the port. This strategy includes a digital transformation that is set to digitise key processes. Digitalization and new technologies will play a part in achieving connectivity in the logistics chain, increasing the level of cost efficiency and increasing the throughput of the port.

They plan to have a modern and digitally developed port system which they will achieve through digital transformation projects. This system will provide the foundation for long-term and stable growth.

[10]8 https://www.luka-kp.si/wp-content/uploads/2023/04/LK-LP-2022-SLO-v_FIN2.pdf

[11] https://www.luka-kp.si/en/news/luka-koper-is-the-ambassador-of-the-green-creative-smart-initiative/

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In the realm of technology, they have obtained funds that allowed them to carry out testing of 5G technology in the industrial vertical of logistics. This helped them set the foundation for further technological development of work processes.

One of the key factors in the development of their port will be the construction of the second track of the railway line on the Divača-Koper section. They will continue investing in the capacity of the port so as to be ready, when the work on the second track of the railway line will be finished.

A prominent external risk that they face in relation to this is that the timeline for the construction for the previously mentioned railway line is uncertain. And so they are working on improving the existing railway that currently doesn't have the proper capacity to support the expected growth of traffic.

EUROPEAN PROJECTS

- The project Luka.DT - from the Recovery and Resilience plan was approved for co-financing. Consequently they will receive new IT solutions from the consortium partners as well as funds for their own activities.

- Within the EU COMODALCE project they procured and installed an OCR (optical character recognition) system in January 2022, which will digitally record certain aspects of rail transport containers, such as wagon numbers and specific markings.

INFORMATION TECHNOLOGY

While the digital transformation of the Port of Koper was being implemented even before the year 2019 it was in that year that they presented guidelines for activities and projects that they plan to realise by the end of the year 2025. They will continue to try to utilise information technology as a means to optimise their business processes.

In the year 2020 they made many changes to key information systems with the goal of digitalization and optimization of processes. Just one example of this is a new billing system that they introduced at a certain profit centre.

The information systems of Luka Koper will continue developing in the areas of optimization for customers and integration of systems in the logistics chain. They will also continue to proactively focus on cybersecurity and information security, to ensure safe operating of the company.

Employees will be offered tools and devices which will allow them to work more effectively. To combat the risk of not completing the digital transformation as set in their strategic goals, they decided to improve the digital competencies of their employees in 2022 with training.

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7 KEY FINDINGS ABOUT THE CROATIAN MARITIME INNOVATION ECOSYSTEM

7.1 General overview

Croatian maritime innovation ecosystem is a dynamic environment that consists of many different stakeholders that include universities and research institutions, software companies, startups, shipyards, shipping companies, ports, clusters, boatbuilders, marinas etc.

Croatian maritime sector is going through profound transformations, driven by the need to tackle climate and environmental challenges while maintaining a competitive position in global market. If we consider that apart from new technologies, the main driver of innovative performance is the networking of the public, private and scientific research sectors with the aim of cooperation and strengthening the competitiveness and innovation of the shipbuilding sector and related industries in Adriatic Croatia we can conclude that the collaborative links between Croatian stakeholders exist but are not developed enough. One major stakeholder who acts as an innovation initiator and generator does not exist, but the ecosystem is heterogeneous and comprised of many intersected links between them. The major stakeholders are either competitors especially regarding high skilled workforce, to some extent collaborators, or not as interested in local collaboration since they operate in global market.

The major stakeholders are classified in different categories and explained in more detail in the following chapters.

7.2 Production

As it is shown in the ecosystem canvas most of the companies operating in the Adriatic Croatia maritime ecosystem belong in the category of production. The tradition, knowledge and experience in design and production of wide span of vessels (passengers, tankers, military, fisherman, cargo, mega-yachts, yachts, luxury yachts, boats etc.) meets the highest quality standards and is internationally recognisable. The GDP share of shipbuilding in the last ten years is around 2% of national GDP and around 10%-15% by exports[12]. The Croatian shipbuilding industry in the four largest shipyards employs approximately 7,200 employees, or over 5.0% of the workforce in the industrial sector.[13]

Within the category there are three major actors: design offices in maritime engineering that play a crucial role in ship design, shipyards and marine equipment producers and suppliers.

[12]https://mingor.gov.hr/o-ministarstvu-1065/djelokrug/uprava-za-industriju-poduzetnistvo-i-obrt-6090/brodogradnja/velika-brodogradnja/7001
[13] Ibid

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Design offices

Design offices play an important role as the conceptual design is crucial for a vessel's operational efficiency. They employ engineers and naval architects educated in Croatian universities and can cover the entire field of ship design from project concept, from basic up to detail. Production design and engineering offices (that can be entirely or partly integrated in a shipyard) develop a ship design which matches the operational criteria set by either the yard or the owner. These companies usually collaborate with shipyards and are mostly located in counties where shipyards are situated. Primorsko-goranska County, namely its capital Rijeka is a naval engineering hub of Croatia where about 40 companies are specialized in marine engineering and naval architecture. Some of the most influential ones are entirely or partly owned by large multinational companies, or act as their branches or subsidiaries namely from Germany, Norway, Finland, Netherlands, and Italy and thus operating in international market. In that way it can be stated that major players in maritime industry like Luerssen, Mayer Group, Royal IHC, Kongsberg Group, Vard, NAOS Group etc. are very much present in Croatia bringing their expertise and know-how and thus connecting Croatian ecosystem with more developed and sophisticated maritime ecosystems. They are among the most technologically advanced companies in the Croatian maritime innovation ecosystem that use state-of-the art design software and design the most innovative and technologically advanced vessels.

However, innovation is mostly based in their headquarters and Croatian companies in their ownership merely collaborate in parts of the design process, although there are companies that are involved in joint subsidy-headquarters innovation projects. Therefore, they can deliver the most technologically demanding design for their clients and thus employ and invest in expert and highly skilled workforce that is globally competitive and subjected to brain drain. These companies are closely collaborating with universities regarding student apprenticeship and employment and there is a fierce competition between them for finding and keeping best talents.

Design offices preferably in cooperation with universities, research institutes, classification societies but also R&D and design divisions of shipyards can play an initiating role in certain innovations and there are Croatian companies that match those criteria (Aitac, being one of the most important). Designers can also cooperate with marine equipment manufacturers to take part in joint development projects.

The dominant roles of the companies involved are firstly, competition in terms of workforce demand and retention, and secondly in terms of obtaining significant contracts with major state companies namely in shipping and logistic sector, i.e., state owned passenger transport company Jadrolinija for designing electric passenger ship fleet or ACI for designing smart marinas. Since all these companies are export oriented and operate in an international market collaborative links that exist in Croatian ecosystem are mainly related the joint design activities of big projects or an (unfortunately) rare cases of joint innovative projects together with software companies, an example being the "EKO brod" project that involves companies MEP, Sarda, Conmare and Zorović which encourages the transition to environmentally friendly passenger vessels using electricity, LNG or hybrid drive. Furthermore, several marine design companies are involved in developing design for several hybrid/ full electric ships, like the full electric small catamarans designed for National Park Krka in Croatia.

Shipyards

The shipbuilding industry is a strategically very important industry for the economy of Croatia. Due to the size and complexity of the ship construction, a significant part of the Croatian industry, especially small and medium-sized enterprises are dependent on this sector as subcontractors of large shipyards. These subcontractor companies are mostly completely dependent on large shipyards which are their major, and often the only client.

This branch of industry represents a significant source of employment in Adriatic Croatia counties in

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which major shipyards are situated (Istarska County, Primorsko-goranska County, Splitsko-dalmatinska County, Sibensko-kninska County). Due to the strong export orientation of Croatian shipyards, which sell almost all its production on international markets and thus generate export Croatian government supports shipbuilding industry (state owned shipyards) with various subsidies and guarantees.

Considering the scope of work, capacities, and size of the vessels they build, shipyards, as basic production units within the shipbuilding industry, they can be divided into three groups: large, medium, and small shipyards.

Large shipyards are:

- Uljanik Shipyard 1865
- 3. Maj Shipyard
- Viktor Lenac Shipyard
- Dalmont
- Brodotrogir
- Brodosplit d.d.

Shipyards Uljanik (Istarska County), 3. Maj (Primorsko-goranska County) and Brodosplit (Splitsko-dalmatinska County) are oriented on new buildings and offshore construction. Shipyard Brodotrogir (Splitsko-dalmatinska County) is involved in new buildings and ship overhauling activities, Dalmont (Primorsko-goranska county) in newbuilding, electric ships, and repair, and Shipyard Viktor Lenac (Primorsko-goranska County) is involved in ship overhauling, conversions, and reconstructions and is collaborating with 3 maj shipyard on various projects.

The specific situation of the restructuring process of most of the Croatian state-owned shipyards puts great challenges before the Croatian shipbuilding industry. In the beginning of 2019. procedure to determine the prerequisites for bankruptcy proceedings against Uljanik, umbrella company of the Uljanik shipbuilding group, which comprises 12 subsidiaries, including shipyards 3 Maj in Rijeka and Uljanik in Pula was announced and since then the complicated court procedure is still going on putting Uljanik shipyard on the verge of bankruptcy. 3. Maj shipyard has managed to survive and obtain new contracts with the support of government intervention.

Major weaknesses of state-owned shipyards are technological lagging, lower productivity, inadequate structure of skilled workers and low financial potential which are also major obstacles for innovation and therefore they are not included within the ecosystem canvas as innovative companies. Ongoing privatization process, with the general task to restructure the Croatian shipyards, could enable them to operate on international shipbuilding market more efficiently.

Brodosplit shipyard is a member of DIV Group and is focusing on building zero CO2 ships, and Brodotrogir through company Brodotrogir Cruise is specialized in building and repair of all kinds of middle size ships and yachts.

Medium shipyards:

- Tehnomont Shipyard Pula
- Iskra Shipyard Šibenik
- Lošinjska plovidba Shipyard

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- Punat Shipyard
- Nauta Lamjana (Kali)
- Betina Shipyard (Brodogradilište i marina d.o.o.)
- Rand Shipyard d.o.o.

Due to constant increase of demand to produce high quality "tailor-made" ships with innovative design and features, unique performance, and extraordinary service characteristics several medium shipyards are responding well to these new trends. These shipyards build a significant number of fishing, cargo, passenger vessels and mega-yachts as well as offshore structures which are used in general construction but also in the energy sector.

It is important to emphasize the importance of company AluTech in Šibenik-Knin County through which a successful cooperation between Norwegian maritime sector and Croatian shipyards begun in 2009 when first contract to build catamarans for Norwegian market was signed. Since then, 200 ships had been built in Croatian shipyards to the demanding global mariculture market. Most of them are aluminium monohulls and catamarans, and in recent years more and more boats are hybrid powered. Majority of these boats ended up on the Norwegian market, where they are used to work in fish farms, as fishing boats, as service boats for fish farms and as multipurpose vessels. Currently, Iskra shipyard from Šibenik, Tehnomont from Pula, Oštro and Nuić nautika shipyards from Kaštela and Brodotrogir are building boats for Norwegian clients, mostly Moen Marin.

Directly, CroNoMar is not involved directly with R&D institutions, but indirectly initiates:

- Cooperation between R&D institutions and industry in order to bring forefront know-how into new products and services
- Cooperation between companies within clusters/branches to gain competitiveness to a cluster through increased focusing of individual companies and joint marketing efforts
- Cooperation between regulatory agencies, R&D institutions, and existing industry to maximize outcome of public strategies for development of national resources (Fisheries, Aquaculture, Offshore, Coastal Zone, etc)

Iskra Shipyard, also located in Šibensko-kninska County is a part of Slovenian Iskra company since 2019. and as such represents the strongest link between Croatian and Slovenian maritime ecosystem.

The shipyard is among the first in Croatia to start producing hybrid, diesel-electric powered aluminum vessels. Working mostly with Norwegian clients, and with given experience with Norwegian projects they see themselves as leading builder to participate in Croatian maritime transition to CO2 neutral (passenger, fishing, aquaculture, small cruise vessels...).

Tehnomont Shipyard located in Istarska County also took the innovative path and is building aluminum boats with water jet propulsion.

Large and medium size shipyards, excluding state-owned, are mostly all parts of larger foreign groups and like before mentioned design offices are linked with their parent companies in Slovenia, Italy, Denmark etc. Their main competitors are global players, especially Asian shipyards, and since they produce ships for international clients, they are not direct competitors in the Croatian maritime ecosystem (except for state-owned Jadrolinija and Croatian military projects).

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Small shipyards

Small shipyards, often possessing exceptional craftsmanship and know-how include around 100 companies specialized in yacht, luxury yacht, modern and traditional boatbuilding and repair and maintenance are very important for cruising, racing and tourist activities in Croatia.

The product portfolio of these small shipyards mostly consists of a different kind of "tailor-made" new buildings of various sizes, overhaul, repair but also manufacturing ship equipment meeting the highest quality standards.

Small-sized shipyards, mostly located along the entire coastline are oriented on design and construction of yachts, boats and ship equipment both for seagoing ships and inland ships, yacht and boat repair and maintenance and on developing new innovative solutions in shipbuilding.

Furthermore, they are also a great number of important for companies that are engaged in boatbuilding and small yacht building, either traditional or modern ones, companies that produce yachting and boat equipment, offer maintenance and repair of yachts, sell boat equipment, and supplies etc. There exist SME-s that innovate in that area that are identified in the ecosystem canvas. Their role is an active one, as the innovation creators and some of them apply EU funding for their innovative projects.

The main drivers for business and networking in Adriatic Croatia are networking events, such as business fairs and showcases where companies, mostly SME-s present their products and innovations. Key nautical events in Adriatic Croatia are Croatia Boat Show, Biograd Boat Show, Rijeka Boat Show and Croatian Small Shipbuilding Days that are organized every year.

In an ecosystem like Croatian where stakeholders are in most cases loosely and sporadically linked these events are very important as they represent the chance to engage in collaborations and showcase the latest that Croatian boatbuilding has to offer.

Marine equipment producers and suppliers

The marine equipment industry is very important for shipbuilding and in Croatia it is mainly represented through SMEs. Although marine equipment suppliers are also present and important, they mostly import and sell marine equipment.

On the other hand, marine equipment producers can be, and some of them are innovative companies that invest in innovation and produce components that can make a difference for the total performance of the ship and/or operational costs. Marine equipment actors tend to perform most innovations in-house and the tendency to develop their innovations internally is a driven by the fact that innovations are of crucial importance to their existence, since they are faced with global competition, and they may fear knowledge leakages (risks of violation of property rights).

Such companies set up partnerships with universities mainly to develop specific techniques or technologies that target specific problem. Most of these companies are financing their innovations through EU funding, meaning that they do not have sufficient means to invest in R&D and that EU funding is crucial for developing innovative products.

7.2.1 Innovation drivers – general

In terms of their contribution to supporting innovation in the Croatian maritime and nautical industry, stakeholders could be classified into three categories. Those who are **(i) strong drivers and also creators of innovation**, those who are (ii) only drivers of innovation because they need it to continue to

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grow and to secure their competitive advantages, and those who (iii) do not have innovation in their DNA, nor is it important for them to carry out their business activities today and in the future.

The first category can include all **(i) startups**, **(ii) institutions building a supportive ecosystem for entrepreneurship**, **(iii) companies and institutions building a supportive environment for entrepreneurship**, **(iv) manufacturing and production companies developing their solutions using the latest technologies and innovative approaches**, and **(v) software companies developing their own software**, which they either market as stand-alone, proprietary products or develop on commission.

The second category includes stakeholders from **traditional industries such as logistics, shipbuilding, and shipping**. However, these companies are motivated to modernize and digitize their business, as this is the only way to ensure that they remain competitive in international markets in the future. To this end, they are engaging with stakeholders in the first category. If the stakeholders in the first category can be characterized as 'supply', the stakeholders in the second category can be characterized as 'demand'. As such, we also see these companies as drivers of innovation within the ecosystem.

We believe that in the long run all companies and traditional industries will become innovation drivers in this way, as without innovation in their business, their position in the market will certainly be compromised in the long run.

In the third category, we include stakeholders that, although they are an integral part of the maritime and nautical industry, do not introduce any technological innovation in their business, nor, given the nature of their business, will they in the future. These are various subsidiaries of foreign multinationals that only handle sales in Croatia, companies operating in the trade sector, and companies that own their own maritime infrastructure. These companies are included in the overall mapping but were not included in the innovation ecosystem mapping.

7.2.2 Software companies

Software companies are, for the most part, the innovative part of any economy which is also true for Croatia. However, although Croatia is a country with large and diverse maritime industry there are not many technology companies that develop software specialized only for the maritime or nautical industries.

However, there has been a significant increase of very successful companies that are involved in boat monitoring using the IoT technology and cloud technology or companies dealing with autonomous mooring surveillance systems for marinas, so there is a direct link between software companies and nautical sector, primarily infrastructure (marinas and yachts).

Anyway, in most cases, the companies that develop software for different industries are also involved with developing innovative product and services in maritime industry through cooperation with maritime companies and/or universities.

The examples of such companies are Sarda which is taking part in the "EKO brod" project or company RIS that is developing unique software product called "NAVERIX" with local stakeholders.

Furthermore, a great example of cooperation between academia and software companies as enablers of innovation and knowledge transfer is the company Adricom that has cooperated with the Faculty of Maritime Studies Rijeka on several projects:

- Development of VR360 tour of the ship, as part of the project EU PANDORA

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- Development of a complete virtual reality simulator, as part of the EU MEDUSA project
- Creation of digital presence and simulation of business models for EU Interreg Italy -Croatia, as part of the project E-CHAIN

The company in all their cooperations provides innovations to their partners and is currently most focused on the production of innovative VR engine room simulator.

In Adriatic Croatia, there are many IT and telecommunications companies that have a foothold in technology, but also in artificial intelligence, and some of them are also global players, such as Infobip, the first Croatian unicorn company that provides mobile communications services in the cloud.

7.2.3 Startup ecosystem

Startup ecosystem is crucial for the growth and development of innovative startup companies, small and medium-sized entrepreneurs in the maritime ecosystem. Although in Adriatic Croatia there is several startup accelerators and incubators, we haven't found too many startups that are exclusively dealing with maritime industry. Some of them like Caelum 1029 that has been developed through Croatian Chamber of Economy Incubator in Split is in a way a hybrid company, both a startup and a production company along with Plurato which is developing electric hydrofoil board.

The case of Sentinel is a good example of startup company that successfully made a transition from startup to success story. The startup started working in Vodnjan, Istria County in 2013 as joint Croatian – Slovenian project, after which it expanded to Zagreb, Ljubljana, and currently has partners from all over the world. The project was declared the best IoT startup in Croatia in 2016 according to the CES Awards[14]. The growth of the company was helped by the investment of the venture capital fund South Central Ventures of one million euros and the capital of several other partners. Sentinel app helps boat owners connect and interact with their boats the same way they do with their connected cars since it allows monitoring of each ship's location (fleet tracking), condition (battery, etc.) and usage information (gas station visits, approximate time of arrival, danger zones). It promises to reduce maintenance costs and increase ship safety, while also reducing the risk of bad weather or faulty equipment by collecting and analysing large amounts of data. This is a great example of cooperation and a link between Croatian and Slovenian ecosystem.

7.2.3.1 Venture capital

There has been a rise in venture capital fonds in Croatia in recent years, but as far as maritime sector in concerned there is no specialized venture capital fund to invest in startups. Croatian Private Equity and Venture Capital Association (CVCA) is the central meeting place for all private equity and venture capital

[14] https://www.netokracija.com/sentinel-investicija-south-central-ventures-141625

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industry members in Croatia. Through its activities, CVCA strives to bring together all private equity and venture capital funds with their headquarters or representative office in Croatia. Regular members of CVCA include among others, Blue Sea Capital, CEE Equity Partners, Enterprise Investors, Feelsgood Capital, Fil Rouge Capital, Croatian Pension Investment Company (HMID), Inspire Investments, Invera Equity Partners, Maverick, Prosperus Invest etc. CVCA members manage capital above EUR 3.2 billion. Private equity and venture capital investments are significant for the Croatian economy, as they invest in propulsive Croatian companies with the potential for rapid growth and job creation. There is investment in maritime sector, but these startups are not located in Adriatic Croatia.

Furthermore, there is the Croatian Business angels' network that is investing in various projects, but so far, we didn't find any companies they invested in maritime companies. This means that there is a large potential source of investment found in venture capital funds that could be directed in maritime sector.

Very important for innovation funding is the Croatian Agency for SMEs, Innovations, and Investments (HAMAG-BICRO). The Agency's activities include the promotion of establishment and development of small business entities, financing operation and development of small business entities by loans and guarantees issuing for approved loans by creditors as well as promotion of investments in small business. The Agency's also provides financial support to innovative and technology-oriented enterprises in Croatia by increasing commercialization of knowledge and awareness about the value of innovations supporting the transfer of knowledge and technological solutions from the scientific sector to economy, promoting the establishment and development of technology infrastructure and participation in the creation and development of venture capital.

Croatian Bank for Reconstruction and Development (HBOR) has the role of a development and export bank established with the objective of financing the reconstruction and development of the Croatian economy. For financing innovative entrepreneurs, HBOR, in cooperation with the European Investment Fund (EIF) and the European Commission under the Investment Plan for Europe is financing various loans in accordance with the prescribed criteria.

7.2.3.2 Startup accelerators and incubators

Startup accelerators and incubators are developed in all counties of Adriatic Croatia to finance startups and help grow new innovative companies. Incubators operate predominantly locally and are financed mostly by local municipalities and accelerators are mainly financed by universities in Rijeka and Split, namely STEPRI and STECH.

One of the most important incubators is Trokut Business Incubator in Šibensko-kninska county, the centre for new technologies and entrepreneurship, with the renovation and reconstruction project of the Development and Innovation of Center AluTech, which acts as a link between the scientific community, private and the public sector and is a reference point for the development of competences in the aluminum - industrial sector traditionally represented in the area of the Šibensko-kninska county and important for shipbuilding and shipyards.

iNavis is an innovation center that gathers and connects entrepreneurs and institutions from the maritime sector, also located in Šibensko-kninska county. It includes companies from the fields of shipbuilding, transport, energy, propulsion machinery, ICT technologies in maritime, innovation, sea and underwater research, and other activities related to the sea. iNavis provides advisory, institutional, and financial support to all the above-mentioned types of subjects and companies, and actively participates in the initiation and implementation of joint projects. A large part of the companies - tenants of the innovation centre is based exclusively on knowledge, high technologies, innovations, and is oriented towards the world market.

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In Primorsko-goranska county, PORIN City of Rijeka entrepreneurial incubator is also significant for maritime sector, and Hestia engineering startup that is working on intercom solutions on vessels has been developed there.

Regarding the connection between startups, companies, and universities Technology Transfer Office of the University of Rijeka (SuR UTT) and Technology Transfer Office of the University of Split (TTO) have been created to encourage and develop and grow commercialization of innovations.

7.2.3.3 Main threats and weaknesses of the Croatian startup ecosystem

The Croatian startup ecosystem is still in the initial stages of development in most of the country, although we see numerous initiatives that want to change that.

Considering the amount of development activities within the startup ecosystem, we can expect a greater number of programs and opportunities for early-stage teams.

Non-cooperation among stakeholders and access to capital funding is one of the weaknesses of Croatian startup ecosystem. It is necessary to better engage the community with more synergy between stakeholders, namely universities and companies and attract a larger number of individuals who will create success stories. It would be beneficial to see greater involvement of medium and large companies that could further strengthen the startup ecosystem by innovating themselves but also by supporting external teams through structured programs.

Although Croatia, and especially Adriatic Croatia is a geographically segmented community with a larger number of generally oriented startup support programs, the large number of local communities and entrepreneurial support institutions are deciding to create a local innovation and startup ecosystem based on specific priority sectors and maritime sector is worth investing. So far there is no specific venture capital fund that would be dedicated entirely to funding maritime sector and that could be seen as an opportunity to development in the future.

7.2.4 Clusters

Clusters can also play an important role of connecting different stakeholders, promoting cooperation, joint projects and apply for EU funding.

In that regard MARINN – Maritime Innovation Cluster is established by Lürssen Design Center Kvarner, Maritime Center of Excellence, and the University of Rijeka. The priority areas of the Maritime Innovation Cluster are smart and green shipbuilding and the development of smart skills. The aim is to bring together the entire eco-innovation system, from the academic community, the business sector, local self-government to non-governmental organizations, and strengthen cooperation in the field of the maritime industry and position itself, both in Croatia and Europe, as a centre of excellence for the development of new technologies and smart skills in the maritime sector and cooperate on future EU projects, primarily in connection with innovation, research and development in the field of the maritime industry.

7.2.5 Classification societies

Classification societies are important in maritime industry as they set standards and supervise rules i.e.,

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whether products and systems on board of a ship comply or not with technical standards relating to the design and construction of ships and in that way, they support the innovative products being implemented in the ship design and construction. The branches of largest classification societies (Bureau Veritas, Det Nordske Veritas, Lloyd's Register) are present in Adriatic Croatia and work closely with shipyards. Although they are not innovators themselves, their support and approval are mandatory when implementing innovative solutions and are therefore classified in the ecosystem canvas in Auxiliary services.

7.2.6 Patents

To find out more about innovative production companies we firstly wanted to inquire about registered patents in maritime and shipbuilding in Croatia. According to European Patent Office there are 74 patents of Croatian applicants from the classification B63 SHIPS OR OTHER WATERBORNE VESSELS: RELATED EQUIPMENT in the period from 1992 to 2023.

It is not known whether any of those patents is commercialized but it does show that there is a culture of innovation among individuals and that represents a great potential for companies, especially SME-s to focus their business activities on commercializing innovative products.

7.2.7 Innovative production companies

In addition to companies developing software for the maritime and nautical industries, startups, and entities in the innovation environment (business accelerators and incubators), as described in the previous paragraphs, some companies involved in product manufacturing have also been identified as innovative.

The product portfolios of these companies are very diverse, also the size of the companies and their business model. They have in common that they use innovative approaches in their development through technologically innovative materials, designs, or other innovative techniques. They are primarily export-driven, selling their products to international market.

To gain a better insight into the performance of innovative product companies, a comprehensive table has been prepared which lists these companies and provides vital information which is publicly available (company's webpage, annual reports, public announcements, etc.) **and information that has been obtained from the interviews in the mapping phase,** namely:

- key innovative products;
- major business partners;
- major projects;
- product awards received;
- appearances at public events (e.g., trade fairs).

By the sheer size of this category (i.e., the number of stakeholders within the class), this group of privately owned companies is the most significant driver of maritime and nautical innovation in the Croatian ecosystem. Out of 285 stakeholders identified within the Adriatic Croatia ecosystem (see "*Ecosystem Canvas*"), there are134 companies categorized as production, which amount to 47% percentage of the

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ecosystem, from which 34 companies are identified as innovative which amounts to 25%.

Among these companies there are 3 of them that are parts of foreign companies, but they are involved in innovation projects together with their headquarters, so we can determine that innovation is also present in Croatia.

Furthermore, 5 companies from software category and 2 startups are also presented in the table because of the importance and innovative character of their products.

Table 7: List of innovative Croatian production companies.

AD BRODOVI d.o.o.	Manufacturer of the well-known Salona sailboats, the company AD Brodovi, is among the first in the world to adapt to the latest trends in the production of sailboats and turn to the production of the Salona models 33, 35 and 380 with electric drive. Thanks to this prototype the company will master the technologies of the electric drive, which will be incorporated into the newest model that is being designed. It is an extremely luxurious version of Salona with the most modern technological characteristics. The existing Salona sailboat models will also be technologically directed towards the use of electric drive. Environmental awareness and the need to implement new technologies in the production of sailboats led to realization of this project. The demand comes mainly from Scandinavian countries where electric drive models are in great demand for sailing on ecologically protected lakes. The company expects more interest on Croatian market in following years.
ADRIA WINCH d.o.o.	Adria Winch is the worldwide supplier of deck machinery. The custom designed AW winches are built to meet demanding technical characteristic and extreme weather conditions in harsh environments. In cooperation with Schneider Electric, the company applies smart, innovative systems for industrial automation and management in shipbuilding. EcoStruxure Machine IoT platform is introduced to easily manage and monitor the operation of the ship's winch. The new platform enables centralized monitoring and management system to have 24-hour insight into the state of the winch, monitoring and analysis of operational work. It also enables an instant view of the malfunctions, so that they can be removed as soon as possible. At the same time, it acts preventively, providing all the necessary information to prevent and avoid defects or malfunctions.
AEDA INC d.o.o.	Construction and production of all types of working vessels and yachts, repair and refitting of old vessels overhaul of main and auxiliary engines, supply, installation of electrical and electronic devices. The company participated in EU project "Modernization and automation of production at Aeda Inc" financed from European Fond for Regional Development which enabled modernization and automation of the production line for the processing of fiberglass and remodelling of part of the existing office space to accommodate the new production line. The realization of the project enabled AEDA to focus on the production of fiberglass boats using the latest technologies.
AITAC d.o.o.	AITAC provides yacht, naval, cruise ship, marine & offshore engineering and Product Lifecycle Management services in shipbuilding and offshore industry. That involves designing ships, military ships and especially mega yachts and cruisers with a high level of complexity and superior requirements. The company continuously implements innovative and intelligent solutions with the use of high-tech tools for the execution of challenging, sophisticated, and complex projects. The company has an entire business segment dedicated to the digital transformation of shipbuilding. By developing innovative approach AITAC bridges the still unresolved design segments in shipbuilding by offering an even more competitive service to its clients through advanced CAD and PLM solutions. When designing the vessel, the process is followed from the input documentation to the class documentation, blueprints, and budgets, which go to the registry office and the shipowner for approval. The final product is a draft, and today it is a very modern process that includes the so-called Product Lifecycle Management. It is no longer just CAD software for designing, it is software that monitors the entire process, from entry, beginning of design, entry of materials, to exploitation itself, when the ship leaves the shipyard.

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ALVEUS d.o.o. - as2con	Alveus d.o.o., is a development and application company, providing engineering solutions in the maritime and offshore industries. The company actively participates in research and development programmes of the European Union as well as international and regional research projects. Alveus is actively conducting research in the field of structural analysis, engineering design and software and life-cycle processes aiming at achieving synergy of their theoretical and practical activities. Research projects include: **COMPA 2GO** - Composite Repairs for Ships: Service Demonstration, Certification and Market Entry - EU Horizon 2020 – SME Instrument Phase 2 To demonstrate the quality of COMPA technology through laboratory and onboard tests, to receive certificates from major maritime classification societies and finally, to license the technology **SHIPLYS** -Ship Lifecycle Software Solution - EU HORIZON 2020 To develop simulation and modelling tools that will minimize the time and costs involved in ship design and construction. **COMPA -** Market study of composite patch repair for marine pipes - EU HORIZON 2020 – S To conduct a preliminary feasibility study of the implementation of COMPA technology through market research in order to determine the market attractiveness of individual COMPA repair cases and the possibility of their application. **COMPA IMPULS COMPA** – Technology for repairing steel ship structures and pipes using composite patches - Hamag - Bicro – Measure B2 Innovation in entrepreneurship Testing and certification of the technology for repair and reinforcement of ship's pipes was carried out, and an HRB certificate was obtained. **ADAM4EVE** - Adaptive and smart materials and structures for more efficient vessels - EU EP7 Development and evaluation of the application of adaptive and smart materials and structures in the shipbuilding industry. Explore the potential of adaptive materials and ship structures and pave the way for industrial application **MOSAIC** - Materials on-board: Steel advancements and integrated composites - EU FP7 Development of relevant guidelines for the design and application of two new concepts in shipbuilding. First, the introduction of High Strength Low Alloyed Steels (HSLA) in specific structural details and second the replacement of specific structural parts of the ship with composite materials.
ANORTI d.o.o.	Anorti d.o.o. yacht service offers complete care of vessels and as such is an authorized service of brands of world-famous vessel manufacturers. The company applies its knowledge and experience, in addition to service, in the construction of new vessels and vessel parts for well-known global vessel brands. During service and construction, only certified, best materials and the most advanced production techniques are used, which preserve the eco system of the environment during construction and service The company uses HotVac which is an innovative and patented process for solving the problem of osmosis on vessels. It removes the anxiety of waiting for the vessel to dry itself due to the influence of atmospheric factors.
BRODOGRADILISTE ISKRA d.o.o.	Iskra shipyard Šibenik is a leading overhaul shipyard on the eastern coast of the Adriatic Sea specialized, which means professionally and technically trained and equipped, for repairs, overhaul, conversion, and maintenance of vessels. The company is the leading ship repair yard on the eastern coast of the Adriatic Sea, specialized in repairs of all types of vessels up to 80 m in LOA, and in new build vessels up to 60 meters LOA. Shipyard offers Repair, Refit, Conversion and New Build Supervision services, as well as complete Technical Management. **Innovation** The company is developing R&D project- Hybrid power split marine propulsion "Blue Drive" in cooperation with Novamina. Blue Drive is innovative concept of propulsion hybridisation for maritime sector to be used in new building project as well retrofit. Project is founded by Innovation Norway. Furthermore, Iskra Shipyard applied as a project partner for the OceanFibreStop project, where project task is the installation and testing of devices and water filters for microplastics in ships. Also, the company is project partner together with Moen Marin, and the project holder is the company ELMAP, which collaborates on the development of the filter itself, together with the company Planet Care, which developed the very technology for purifying microplastics from the water that leaves washing machines. For already 3 years the shipyard is building electro and hybrid aluminium vessels mainly for Norwegian aquaculture market and has delivered 10 vessels with electro propulsion.

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BRODOGRADNJA MONACHUS d.o.o.	Brodogradnja Monachus is an exclusive shipyard for the production of motorboats and yachts. The process of building Monachus yachts and boats using advanced technology relies on the knowledge gathered by their design team who together have several decades of authentic, hands-on sea cruising experience. Monachus Yachts also offers the option of customizing part of the design to meet the personal wishes and individual needs of its customers. The base materials are carefully selected to enhance the team's masterwork. At the same time, sophisticated equipment is judiciously selected from its manufacturer partners and other suppliers for installation in Monachus yachts, in order to achieve the best possible final product. The new model yacht Monachus Yachts 70 Flybridge has incorporated a DPS system (Dynamic Positioning System) which allows to direct the vessel to remain stable in each position, maintaining not only left-right and fore-and-aft movement, but also but also bow-stern action. The new model uses IPS-1200 system which boosts the power of the 1000 hp engine, obtaining results that can be compared to those of a classic 1200 hp shaft drive. In addition to the fantastic performance of the propulsion drive, IPS also significantly reduces fuel consumption by up to 35%, and thus exhaust emissions.
BRODOPLAN d.o.o.	Brodoplan is a ship design, marine engineering and consultancy company that operates worldwide and provides services to the marine and offshore industries. Strong and well experienced team of engineers and naval architects covers the entire field of design from project concept and basic up to detail and production design and complete engineering packages including planning, procurement handling, project management and site support. Brodoplan has developed a flexible design platform for a 400 passengers' coastal vessel which has the possibility of various green drive arrangements, pure electric or hybrid.
BRODOREMONT PUNAT d.o.o.	Brodoremont Punat offers ship repair, production of welding works in shipbuilding, newbuilding of boats for sports and recreation, work boats, smaller passenger boats, work boats and floating pontoons according to the order and ready-made projects of specialized design houses. The company is involved in project "Strengthening the competitiveness of BRODOREMONT PUNAT d.o.o. investments in digital and green transition" that will train the company for digital and green transition in the target market. This investment will speed up internal production processes, increase the quality of the product, achieve energy efficiency and sustainability of the production cycle. This project plans to build an energy-efficient business unit to produce metal parts for ships, with the application of digital technologies and solutions to increase competence and sales on the domestic and foreign markets.
BRODOSPLIT d.d.	The main activity of Brodosplit shipyard is the construction of all types of commercial and passenger ships and a part of special purpose ships, as well as special steel structures. Brodosplit's workshops and ramps cover an area of 560,000 m2 with a total of 110,000 m2 of covered buildings. It has four equipped slipways and numerous machines, equipment, means and facilities with the possibility of building ships up to 300 meters long and 50 meters wide. Excellent engineers, planners and designers realize all the design and engineering requirements of customers and clients from the idea to the final solution using modern welding techniques of steel and other materials, production of products from nodular and gray cast iron, complete architectural interior solutions, automation and management of ship systems, integration, process equipment and many other areas. Brodosplit experts can create a project in a short period of time and start production. Brodosplit shipyard is producing the zero emission' passenger sailing ship co-financed by the EU funds call " Increasing the development of new products and services arising from research and development activities - phase II " which aims to develop and build an eco-innovation in the form of a sailing vessel for optimal 24 passengers, for which alternative propulsion technologies and energy sources have been developed based on an environmentally friendly design that aims to achieve sustainable mobility with zero emissions, supporting environmental sustainability and reducing greenhouse gas emissions and air and noise pollution. There will be one vertical wind turbine at the bow and stern that will supply the ship with electricity when it is in port and the sails are lowered. A photovoltaic solar system will be installed on the roof of the superstructure. The ship will therefore be supplied with electricity and water from completely renewable

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	sources and will obtain all its energy without any CO2 emissions. So not only is the ship 100% "green", but it also has virtually no costs for fuel and propulsion machinery. The keel-laying of the zero-emission passenger sailing ship with electric motors as the main drive, took place at the Brodosplit shipyard in October 2022. Furthermore, Brodosplit Shipyard has commenced the engineering phase of the 753-foot (229 meters) passenger vessel with 547 private residences on board. The ship, to be named MV Narrative, is the first residential ship powered by liquid natural gas propulsion (LNG). This vessel is equipped with various energy saving features, has dual fuel powered engines (fuel oil and LNG) and will be optimized to have the lowest possible emission of harmful particles and gasses. There are many new green technologies and ship systems to be implemented.
BRODOTROGIR CRUISE d.o.o.	Brodotrogir Cruise is a shipbuilding company, established in 2018 as part of the Kermas Group. Inheriting over 70 years of shipbuilding experience in Brodotrogir Shipyard, the company is primarily focused on the construction of small and medium size cruise vessels. Brodotrogir cruise company has the contract for the construction and equipment of a service ship for the Norwegian client Moen Marin. It is a ship 24 meters long and almost the same width, intended for servicing and maintaining fish farms in the North Sea and the Atlantic Ocean. The ship will have a hybrid drive and has a steel hull and an aluminium superstructure.
CADCON d.o.o.	Cadcon d.o.o. is ship a design and marine engineering company with the intensive application of integrated 3D systems for shipbuilding and they offer clients a wide range of technical services. Since 1990, they have been operating on the market with experience in more than 150 different projects, from merchant ships, specialized vessels, passenger ships and luxury mega yachts, on the Croatian and foreign markets. The company is involved in project "Increasing the competitiveness of CADCON d.o.o. by introducing new information and communication technologies" where a modern design software and associated hardware platforms were introduced in order to boost competitiveness in existing and new markets.
CAELUM 1029 d.o.o.	Caelum 1029 is a startup company involved in production of electric autonomous vessel houseboat which has the possibility to be self-sustainable 100% in term of energy efficiency. The innovative project "OASIS MEU" implies the design, construction, and sale of the first Croatian floating module. The body will be constructed of steel and all technical systems, including batteries powered by solar panels, small wind turbines and variable speed magnet generator, will be in the base. The module is autonomous and can accommodate a longer period without changing the location, meaning that all necessary water tanks (technical water, black and gray water) will be of sufficient capacity. With its own propulsion the module can change the place of anchorage - residence. The application of technical solutions in terms of hybrid propulsion and power supply (solar, windmill, variable speed magnet generator) is the basis of the innovation of this project, we dare say in the global market. The project will develop from the start to be ready for both foreign and domestic markets, equally acceptable for use in inland waters (rivers, lakes) as well as the seas, and for this purpose the project will be technically tested for the most unfavourable conditions of static and dynamic stability.
DALMONT d.o.o.	Dalmont is specialized in work on new constructions and overhauls of various types of ships and vessels. New constructions include yachts, ferries, catamarans, fishing boats, chemical tankers - intended for the transport of asphalt, and the construction of stationary offshore facilities - platforms. Dalmont is specialized in work on new constructions and overhauls of various types of ships and vessels. New constructions include yachts, ferries, catamarans, fishing boats, chemical tankers - intended for the transport of asphalt, and the construction of stationary offshore facilities - platforms. **Green ships** The company has successfully delivered the first two "green" ships. These are fully electric aluminum catamarans for the Krka National Park. Ships stand out for their highly developed accumulator batteries and electric motors, which provide enough energy for eight hours of navigation. Ships have autonomy with batteries for 8 hours and including solar panels up to 12 hours at a traveling speed of 5 knots. They are designed for 50 people and will sail on Lake Visovac.

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DE NAVAL d.o.o.	De Naval is a company experienced in all phases of a ship project cycle, from a concept development and basic design to the delivery of production drawings and documentation. The company is expert with wide range of vessel types. Most of recent projects include offshore support vessels, aquaculture, and fish vessels. The company is working on concept design of 30 m Full Electric Passenger Catamaran with battery capacity of 1.2 MWh, propusion of 2x400 kW electric motors and maximum speed of 20 kn for 144 passengers.
EMARINE d.o.o.	Emarine is an independent design and consulting company operating in shipbuilding and offshore which supports shipyards and engineering offices that need additional design capacities on their projects. The company was involved in design of Colorline hybrid the world largest largest plug-in hybrid ship. The ship has a full battery operation in and out of the fjord to Sandefjord inner harbour. This means that the ship has no emissions of damaging greenhouse gases into the air and noise is considerably reduced. 100 meters from the ship, the noise is as loud as a normal conversation between two people. Colorline is Norway's largest shipping line for international passenger and goods traffic to and from Norway and one of Europe's leading short sea shipping lines.
FLOW SHIP DESIGN d.o.o.	Flow Ship Design is an independent ship design company which goal is to deliver innovative design and engineering solutions which provide higher performance and more value for our customers. The company's specialization covers a large range of vessels, including all the phases of the ship design process as well as research and development. The company is in collaboration with Lade AS on the Vindskip® project: • Design development • Structural design including implementation of innovative materials Vindskip® is a hybrid merchant vessel for sustainable sea transport, driven by the wind and LNG. A state-of-the-art design as per 2012 is holding a Norwegian Patent and a WIPO PCT International Patent on the concept. The company is participating in various European projects i.e., Ramsess project "Realisation and Demonstration of Advanced Material Solutions for Sustainable and Efficient Ships" and in project ASH FIRE is an international research project aiming to significantly reduce the risk of fires on board ro-ro ships.
INELTEH d.o.o.	Inelteh is a company specialized in engineering for electronic equipment and systems for shipbuilding industry. The company is involved in the project "**Multifunctional marine electronic system as a platform for the implementation of various marine systems**" financed by European structural and investment funds. The goal of the project is to develop a system that will provide a platform for the realization of different ship systems using the same components (hardware and software) that will be easy to use in all application segments. The system will consist of sensors, specialized for a specific application on board, electronic modules for accepting various sensors, electronic modules for executive functions and central units with a user interface (HMI). All elements of the system will be mutually compatible on the hardware and software side. System components will be tested and certified according to ship standards, which will enable their installation on ships. Software solutions within the system will enable configuration and changes on the device itself, which simplifies design, enables serial production of system components, shorter delivery time, on-site configuration by the installer, simple changes, and maintenance. In addition to the mentioned innovations, within the framework of the complete system, additional innovations are planned within the system itself, and are related to the realization of the systems themselves. The innovation within the user interface (HMI) is related to the separation of the "mimic diagram" of the ship from the executive elements, which enables the appearance of the "mimic" to be changed on the device itself. In addition to the technical innovations of the system itself, the mentioned solution also represents an innovation in the approach to the market because it enables different market strategies adapted to the type of customer.

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KOD SEDAM d.o.o.	Kod sedam - Code 7 marine specializes in design, engineering and manufacturing of Code X which is a hi-tech ultra-light keelboat racer. She is made of full carbon composite construction. The company is involved in the project "Commercialization of an innovative regatta sailboat, KK.03.2.2.04.0029" financed from European Fund for Regional Development with the aim of adaptation of the developed innovative product prototype of Code X sailboat to market requirements and preparation for its launch on the market. The innovation includes significant improvements in technical specifications (design, ergonomics), product components (materials and technological construction process - light composite materials, vacuum construction technology), as well as user acceptability (price acceptability - lower price compared to the competition). The sailboat is built using vacuum construction technology with the use of pre-impregnated composite materials (prepreg carbon fibres with Nomex honeycomb core with polymerization at an elevated temperature in a vacuum), which enables a light and solid construction of the ship's hull. The main features of the sailboat are increased efficiency and safety of navigation, which is achieved through the design, dynamics and configuration of hydrofoils, the result is a significant increase in speed and more advanced control of the vessel. The company successfully launched a 9.2-meter carbon sailboat Code X, which is the first Croatian foiler designed primarily as a sporty crossover cruiser for coastal and offshore regattas up to 500 miles long.
KUB INZENJERING d.o.o.	KUB inženjering is an innovative company that offers a wide spectrum of polyvalent digital services including marine engineering, yacht design, web design, 3D scanning and printing. The company focuses its core business to marine engineering and yacht design. Model Y12.98 was nominated for yacht of the year on BOTTE 2017, Dusseldorf. Working mostly with steel and aluminium our specialties are pre-assembly, large assembly (hull sections), montage (on board) and outfitting (pre-assembly and/or installation). Most of the work is based on turnkey system since the production team is considerably capable and experienced. KUB engineering has created a diverse shipbuilding ability that are combined by engineering and production, enabling us to lead and generate complex shipbuilding hull sections and/or outfitting projects delivered within deadlines and produced at maximum quality level. The company is involved in production of bio-composite vessels.
LUERSSEN DESIGN CENTER KVARNER d.o.o.	Regarding R&D processes in business environment the processes are aimed at creation of products and services related mainly to maritime and shipbuilding sector for our principal German shipbuilding group Lürssen with extensive experience and know-how in special vessels, mega-yachts, and naval vessels delivery. LDCK is cooperating with the Lürssen group in field of development of green shipping technologies and use of alternative fuels for vessel propulsion. Lürssen specializes in the design and manufacture of mega yachts, ships and coast guard vessels and providing comprehensive after sales services to its customers in the form of regular maintenance and global logistics support, conversions, and repairs. It is recognized worldwide as a brand for its high-quality products as well as the continuous use of innovative technologies.
MARITIME CENTER OF EXCELLENCE d.o.o.	For what regards to R&D processes in business environment the processes are aimed at creation of products and services related mainly to maritime and shipbuilding sector. MCOE is connected to German shipbuilding group Lürssen with extensive experience and know-how in special vessels, mega yachts, and naval vessels delivery. MCOE cooperates with Lürssen in-house research and development (R&D) department on joint innovation development projects in the field of green shipping technologies and use of alternative fuels for vessel propulsion. Furthermore, through its business network MCOE cooperates with local and international Companies for joint R&D initiatives both for co-innovative processes and technology transfer in the fields of digital technologies, advanced ship design and green energy technologies.
MARSERVIS d.o.o.	Marservis is a company specialized in ship and boatbuilding currently developing a eco electrically powered passenger catamaran **PROeco.** **PROeco catamaran** It is the first catamaran of its kind in Croatia, and beyond, which represents an environmentally friendly and self-sufficient transport solution. The catamaran is partially made of natural materials, more

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	precisely bio composites, i.e., ecological resin reinforced with bio-fibres, and which will be powered by electricity. The use of bio-fibres and resins in the construction reduces the emission of carbon dioxide into the environment has. The drive is exclusively electric and will be filled with solar panels, and the ship should be self-sufficient, that is, it should be able to sail all day powered by energy obtained exclusively from these solar panels. Its purpose will be to transport passengers on short distances. **Aquapod** The company is also involved in innovative **Aquapod** project - a pontoon designed to receive waste generated at sea. The main objective is to develop an innovative technical solution for removal of marine litter (AQUAPOD+) from enclosed sea-basins and waterfronts, such as e.g., marinas, ports, and working harbours, and introduction of AQUAPOD+ as a new product to the enterprise and to the market. Both projects are financed from EU fonds.
MEP d.o.o.	MEP is taking part in the **ECO SHIP project** which consists of an innovative package of complementary products and services that include the design and installation of ship systems, an application for monitoring consumption and education of seafarers on a uniquely designed ship simulator. The company is responsible for the design and implementation of systems for critical power supply and uninterruptible power supply systems. **Eco SHIP** strives to solve the problem of environmental protection in coastal transport and achieve a transition in the application of environmentally friendly solutions in propulsion systems for passenger vessels. Currently, there is no similar innovative turnkey package on the alternative (environmentally friendly) propulsion market that provides a complete service and meets the stated needs of the market. The project is financed from EU fonds.
MS Tech d.o.o.	MS Tech side in terms of Research and Development processes cooperates with shipyards and shipbuilding related companies, various equipment and/or system makers, and government institutions. The company is engaged in ship design and engineering sector and all operations are directly related to shipbuilding so if they are innovating one part of this process, they to relate it to shipyard common processes. Digital solutions and climate neutral technology represent an important part of the restructuring and development of the maritime industries in terms of R & I processes. Their priority areas of work are smart and green shipbuilding through digital transformation, the development of a unique, unmanned, and autonomous platform, the use of hydrogen and synthetic fuel as propulsion, and the development of technologies such as the transformation of waste into energy and the sterilization of hazardous waste.
NAVIS CONSULT d.o.o.	Navis Consult encourages creativity and innovation and is actively participating in the development of tomorrow's maritime technologies. The long-term strategy is focused on the development of highly sophisticated ship systems, digital technologies in the maritime industry, the use of alternative "green" solutions for ship propulsion, and especially autonomous, robotic vessels. Navis is involved in co-innovation process of supporting the owner company Kronsnsberg in innovation, development, and production of their products. The company is developing an unmanned ship for inspection of offshore wind turbines with Remotely operated vehicle and will produce a Digital twin of this ship. The company also designed electric catamarans for Krka national park.
NOVATEC d.o.o.	Novatec is computer and electrical engineering, process automation, and system Integration company specialized in solutions for control and automation of industrial processes. The company is involved in project "Comparison and the possibility of implementing different technologies of polymer and composite materials for a new product". The main goal of the project was the education of employees and the creation of studies in the field of material selection and methods of their processing in the field of small shipbuilding. The project is financed from EU fonds.
NUIC NAUTIKA d.o.o.	The company specializes in shipbuilding and construction of steel, aluminium, and fiberglass vessels. The company is currently building two hybrid catamarans for Norwegian partners.

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OCULI MARE d.o.o.	Marine Eye is an innovative anchorage and marina monitoring system that combines mechanical, gravity, and optical sensors with advanced software solutions for the surveillance of mooring and departures from moorings. The Marine Eye system is mainly used for the monitoring and surveillance of moorings in anchorages and marinas. The system provides real-time monitoring of the mooring occupancy status, which helps our clients to optimise their business and gives their customers a realistic insight into the occupied or vacant positions in anchorages and marinas.
OTOTRAK d.o.o.	**OtoTrak** is the world's first cloud-based remote-control system for personal watercrafts. With OtoTrak you can track and control unlimited number of watercrafts from any location in the world - with your smartphone. OtoTrak's technology starts with the OtoTrak module, our in-house designed electronic device that connects to the watercraft. The OtoTrak Control app uses smartphone or tablet to get a clear overview of what is happening with watercrafts. It's easy to manually trigger any of the actions, or switch between profiles that can automatically execute action plans prepared by our rental supervision systems. The OtoTrak web app lets the users configure their ride zones, manage operator users and it shows all of the collected data in an organized way through interactive reports. The module links up with OtoTrak cloud services over a cellular network so it's always available. It reports the watercraft's position and status (throttle, fuel level, etc.) in real time as well as performing commands. Inside a sturdy IP67-compliant case, it houses features developed for real usage scenarios by a team with years of experience in marine electronics.
PBM Croatia d.o.o.	T he PBM **Marine Black Box** device monitors and records signals from the vessel engine in real time to determine the source of operational problems in the shortest possible time. The **FIVA/ELFI Test Stand**, a test station for testing FIVA/ELFI valves on modern, electronically controlled marine engines, was developed by PBM's engineers who produced the software. With the support of EU funds, they are currently developing an AI solution for the use of low-calorific fuel in dual-fuel systems for the purpose of better fuel utilization and environmental protection.
PLURATO d.o.o.	Plurato developed an innovative product - Plurato Sailfin an electric hydrofoil board (efoil) designed for beginners as well as experienced water sports enthusiasts. Plurato Sailfin rises above the surface which results in a sense of flying, and lithium-polymer battery powers the silent, emission free electric motor which is easily operated by the wireless hand controller. The electric board is based on foiling technology and is recognizable by the fact that the rider floats above the sea thanks to an underwater wing that creates buoyancy and reduces resistance to movement through the sea, or water. Sailfin drives a quiet electric motor that develops a speed of up to 35 km/h, and is intended for driving on seas, lakes, and rivers.
RIS d.o.o.	Software development company that is currently developing a unique software product called "NAVERIX". It will provide support to all stakeholders and provide digital platform for vessel owners, vessel managers and various maritime institutions requirements for complete Vessel Inspection Process. Joined with some local partners that provide "know-how" and foreign investors that have interest in the software product, the company is currently in-house programming functionalities of the final product that is planned to market and commercialize software in the near future.
SALONA YACHTS d.o.o.	The company is specialized in high tech boat building. Strong and light construction is a consequence of the advanced building techniques, such as vacuum infusion of the hulls and decks, used for many years. Modern building materials varying from multi - axial glass to carbon fibres combined with advance resins make yachts an example of uncompromised construction quality. All models have been reinforced with stainless steel frame structure (the grid forms the structural spine of the boat) which supports the keel, mast, and shrouds, giving our boats an extremely strong but light construction.

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SARDA d.o.o.	Application for monitoring environmentally acceptable types of fuel (LNG, electricity) in order to calculate the average consumption and the projection of the future consumption of the vessel based on the previous same or similar routes and to achieve greater economy of operating the vessel for the EKO Brod project.
SENSE4BOAT d.o.o.	The Sense4Boat is an innovative IoT platform which is used for remote monitoring of ships in marinas. The platform enables the user about the safety of the boat. The platform uses S4B next generation IoT Sensors monitor major risk factors on the boat. The features of the platform are IoT sensors that are connected to the Internet using Sigfox 0G technology. The company is also developing new products that communicate with their Cloud using the NB-IoT network.
SENTINEL d.o.o.	Sentinel Marine solutions is the leading connected boat platform supplier and a recognised enabler for digital transformation of boating industry. Sentinel app connects boat ecosystem with IoT connectivity and cloud-based platform, designed for the world's leading boat builders and marine equipment manufacturers. Software allows monitoring of each ship's location (fleet tracking), condition (battery, etc.) and usage information (gas station visits, approximate time of arrival, danger zones).
TEHNOMONT BRODOGRADILIŠTE PULA d.o.o.	Core business of the company is shipbuilding and ship repairing of the vessels up to 80 m, as well as building of various metal constructions mainly affiliated with shipbuilding. Leading part of the production is concerning shipbuilding of different types of working ships, and shipbuilding of sophisticated special purpose vessels made of aluminium and steel, of the top quality and low exploitation costs and long product life, all customized to client requirements. **Aluminium boats with water jet propulsion** The company is building 2 firefighting ships (the largest aluminium ships built in Croatia). The ships are built entirely of aluminium, and instead of propellant, they will be powered by the so-called water jet powered by three 880 kw engines. Considering the purpose, the ships will have fire pumps on the bow, stern and in the middle of the ship, as well as a foam tank and seawater intake. The specificity is that, given that it is aluminium, the ships will be equipped with a cooling system. Aluminium shipbuilding is a world of its own within shipbuilding because it is a material that has some specifics that should be considered when working with it, especially when welding.
TEMA d.o.o.	TEMA offers complete electric propulsion systems for zero emission boats, serial hybrids, and parallel hybrids. TEMA marine propulsion system is compact, quiet, vibration free, maintenance free, reliable, and environmentally friendly. TEMA e-motors are permanent magnet motors, which enables them premium efficiency – above 95%, high power to volume ratio and small weight. TEMA e-motors are brushless, while the bearings are calculated for the most demanding applications and slightly oversized. This brings the maintenance of the e-motor to a minimum. The motor is air-cooled, so there is no need for pumps, heat exchangers, filters and cooling liquids which require a yearly maintenance. TEMA marine propulsion system is optimal for direct drive, where all the advantages of electric propulsion are most obvious. There is no gearbox, clutch or belt drive. This simplifies the installation and increases the complete boat efficiency. The manoeuvring is done with a drive by wire system, similar to modern cars. TEMA e-motors have full torque Victory Marine is developing a unique and attractive project of an economical and spacious holiday boat VICTORY 59 FA" -ECO-FRIENDLY IMPULSION characterized by an eco-friendly approach powered by electric motors. The batteries are charged via solar panels, at the port in the marina and, if necessary, via the built-in generator. The design was conceived in such a way as to achieve maximum economic efficiency with the aim of an environmentally friendly solution. A pleasant cruising speed is achieved with a highly efficient electric propulsion system. from zero RPM which increases the manoeuvring characteristic even at slow speeds. The entire system is simple plug and play which makes the installation simple and safe. This marine propulsion system is also available with a specially developed sail drive for e-motors.

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VICTORY MARINE d.o.o.	Victory Marine is developing a unique and attractive project of an economical and spacious holiday boat VICTORY 59 FA" -ECO-FRIENDLY IMPULSION characterized by an eco-friendly approach powered by electric motors. The batteries are charged via solar panels, at the port in the marina and, if necessary, via the built-in generator. The design was conceived in such a way as to achieve maximum economic efficiency with the aim of an environmentally friendly solution. A pleasant cruising speed is achieved with a highly efficient electric propulsion system.

7.2.8 Research institutions and academia

Universities and research institutions providing education in maritime studies are present in almost all major cities of Adriatic Croatia and they represent the most important source of skilled workforce in the maritime industry. Strong universities are generators of innovation through scientific projects mostly financed by EU funding and cooperation with private sector. Also, they play a major role in knowledge transfer and are on the forefront of the latest trends and developments in maritime sector, namely autonomous ships, use of artificial intelligence, new materials, electric and hybrid ship design, machine learning etc.

The institutions providing education for maritime sector include (only the specific programmes related to naval architecture and maritime studies are enlisted, although in the industry there is a variety of other occupations):

- Faculty of Engineering at University of Rijeka, Department of Naval Architecture and Ocean Engineering offering programmes of Naval Architecture and equipped with, among others, Laboratory of Computer Engineering in Naval Architecture, Laboratory od Ship Construction and Outfitting, Laboratory of ship Hydromechanics and Laboratory of Ocean Engineering.
- Faculty of Maritime studies at University of Rijeka offering programmes for Nautical Studies and Maritime Transport Technology, Marine Engineering and Maritime Transport Technology, Marine Electronic Engineering and Information Technology, Logistic and Management in Maritime Industry and Transport, Technology and Organization of Transport.

The faculty has established the Centre for marine technologies (CMT) which is focused on the development and application of marine technologies as well as education. Marine technologies include all technological processes and systems related to research, exploitation and protection of the sea, marine environment, and seabed (including renewable sea energy sources; exploration and exploitation of resources from seabed, seawater, and marine organisms; ship design, shipbuilding, and hydrodynamics; underwater technology and engineering; marine environment protection from pollution; safety).

Furthermore, there is Materials and mechanics laboratory (master lab) which focuses on the research of:

- material properties in the different environmental conditions (marine environment, elevated temperature, etc.),
- structural behaviour at the limit stress state (high stress, fatigue, and fracture).

University of Rijeka has established The Center for Artificial Intelligence and Cybersecurity that connects scientists from various fields working on interdisciplinary research projects. The Center is strongly focused on the knowledge transfer from academia to industry and vice versa. It is a polygon for

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multidisciplinary collaboration, starting partnerships, sharing knowledge, and development and testing of innovative ideas with high market potentials. The Center firmly fosters international collaboration with scientists and high-tech companies from abroad.

- Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture at University of Split, Department of Mechanical Engineering and Naval Architecture

Areas of interest of the department are design of mechanical engineering structures, thermal engineering and shipbuilding structures and design. In the department laboratories the students can observe applications of fascinating motor fuels and systems and development of vehicles of the future, study marine hydrodynamics and underwater engineering structures. The faculty also has a Laboratory for naval architecture.

- Faculty of Maritime studies at University of Split

Programmes offered are: Nautical studies, Marine engineering, Marine Electrical engineering and Information Technologies and Maritime Management.

- Maritime Department at University of Dubrovnik

The study programmes offered are Marine engineering and Marine navigation, Electrical Engineering and Communication Technologies for Maritime Industry and Mariculture.

- Maritime Department at University of Zadar, Department of Maritime Sciences that offers programmes of Sea Technology and Protection of the Sea division and has established CIMMAR – Center for interdisciplinary marine and maritime research.

- Faculty of Informatics and digital technologies at University of Rijeka which is important for connecting digital technologies with ship design and production.

Regarding the research centres, there is METRIS - Center for Materials Research of the Istrian County which is the infrastructural base for research and development for innovations and the application of new technologies in production. METRIS is part of the Polytechnic of Istria, founded as a strategically important entity for the implementation of EU and national research and development projects, for the improvement of the economy by improving materials and products, for the legal control of the quality of materials as support for industry, for support in innovation for small and medium-sized enterprises, for the improvement of student programs , support for the scientific sector and for the implementation of the popularization of science and professional education in the STEM field.

METRIS cooperates with shipyards and associating companies, and helps innovations in materials (light materials, advance materials, nanomaterials) and manufacturing procedures and technologies.

University of Rijeka fosters Association of Applied Technical Sciences which is a great example of successful collaboration between students, professors, and companies in designing and producing innovative solutions. The Association's main project is Adria Hydrofoil Solar Boat that the students designed and produced by themselves. In that way innovation culture is fostered through education process by students who will become highly skilled engineers that are needed by innovative companies.

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The role of the universities and research centres within the ecosystem is in a way a double one, they educate future engineers and at the same time they are the ones that do the research and are experts for new technologies which makes them enablers in terms of innovation activities. Knowledge transfer, collaboration with R&D departments of companies and joint projects with SME-s are of crucial importance for the development of Croatian maritime innovation ecosystem.

7.2.9 Infrastructure, logistics and shipping companies

As mentioned in point v.ii.i. (Innovation drivers - general), stakeholders operating within traditional industries such as logistics, shipping, and partially shipbuilding have been found to be, for the most part, not direct drivers of innovation themselves, but an indispensable element of it on the demand side.

The logistics, shipping, and shipbuilding verticals represent a significant part of the overall Croatian ecosystem in terms of size. As such, it is also important in terms of ensuring the future flow of innovation in the Croatian maritime and nautical industry as those sectors, although rather traditional and in a way slow to change are embracing new technologies and trends.

Infrastructure

There are around 350 ports, marinas and piers along the Croatian coast, and the ports of Pula, Rijeka, Zadar, Šibenik, Split, Ploče and Dubrovnik participate in international trade of goods and are of outstanding economic importance. Transportation of passengers is organized between all major harbours and medium-sized harbours. Goods that are transported to and from these ports are following: bulk cargo (Rijeka, Ploče, Šibenik, Zadar,Split), general cargo (Šibenik, Zadar, Ploče, Rijeka), wood (Šibenik, Ploče, Rijeka), liquid cargo (Zadar, Ploče), refrigerated cargo (Split, Rijeka), containers (Rijeka, Ploče, Split) and cement (Zadar). All above listed major ports, excluding port of Dubrovnik, have good supporting railroad and road infrastructure, which eases the later distribution of goods.

Large infrastructure investments co-financed from EU funds in port of Rijeka, the largest Croatian port, in port and railway infrastructure are very important for expansion of port capacity as well as introducing innovative solutions. Construction of a new container terminal in the Rijeka Gateway in Croatia will be the first terminal in the Adriatic region to be operated with remote-controlled, electric container handling equipment managed from a central control room. Furthermore, the construction of access road D-403 and arrangement of accompanying railways hubs in the coming years will significantly influence the attraction of new volumes of cargo and will have multiplier effects on all stakeholders of the transport sector and the entire economy. By changing spatial plans and borders of the port area the new port for nautical tourism in the very centre of Rijeka, in the port of Porto Baroš, Rijeka should become the new nautical centre of the northern Adriatic in the coming years and first smart marina in the Adriatic coast.

Significant traffic potential is represented by the cargo port of Ploče, the first Croatian port at the entrance to the Adriatic Sea and Dubrovnik and Split passenger ports.

Regarding the link with Slovenian ecosystem, Croatian cargo ports, especially Rijeka, are fierce competitors with Slovenian Port of Koper. However, these ports are a part of Hydrogen Valley North Adriatic project together with Italian ports for cooperation in the development of environmentally

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friendly hydrogen production technologies, which contributes to the transition to an integrated ecosystem that includes the energy, industrial and transport sectors, but also enables cooperation in the field of research and innovation.

To support touristic activities, there are 142 nautical tourism ports and 72 of them are categorized as marinas. Marinas in Croatia can be divided into two groups:

1. Marinas operated by the Adriatic Croatia International Club (ACI), total 22 marinas which offer standardised services in all ACI marinas.
2. Privately owned and operated marinas.

They represent important tourist facilities and as infrastructure represent the demand side of innovation companies, meaning that they can implement new smart and clean technologies to improve their services.

Shipping

Ship owner companies can be one of the major forces in implementing innovation since they make orders and requirements about the vessels they want to build and own, meaning that consequently they have the decision power to invest (or not) in innovations. Potentially this allows ship owners to exert a major influence on the innovations that will enter a ship. They can determine the type of engines and drive fuel and other specific marine equipment and thus approve the application of innovations regarding these items.

In Croatia there is significant number of shipping companies and most of them still uses traditional carbon fuel. Recently, as mentioned before national passenger transport company Jadrolinija decided to build electric ferries. Therefore, it can be concluded that there is a huge potential to innovation in the shipping and logistic sector but the transition to smart and green solutions is still very slow due to high cost of investment and traditional character of the industry.

It is also worth mentioning that the major companies involved in container cargo shipping and container terminals in Rijeka are branches of foreign multinational companies present in Croatia, or companies in joint ownership between multinationals and Croatian company or state. Like foreign design offices, they are generally not innovation creators in Croatia, but mainly in their headquarters. They are also mapped in the Appendix Excel file and the ones in the Ecosystem canvas are partially involved in joint innovation process with their headquarters teams. In that case the spill over effect proves to be beneficial for Croatian innovation ecosystem.

Considering the afore mentioned number of international cargo ports in Croatia that are a very important and vital part of economy of Adriatic Croatia, there exist many companies that are related to the supply of ships, towage, pilotage, forwarding, transport, customs clearance, seaman education, maintenance of maritime seaways, etc. They are considered as a part of the maritime ecosystem, and therefore mapped in Appendix Excel file, however, such companies in Croatia are not a part of innovation ecosystem still being traditional in their business activities but represent the potential for innovation in the future.

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7.2.10 Other

Besides the stakeholders identified and listed in previous sections of this report, there are other significant actors and sectors, which do not fall strictly within the categories included in INNO2MARE, but which both have with very high synergetic potential with "blue" sectors, and should therefore be considered relevant. The first one is the (floating) LNG terminal on Krk, which represents a huge asset from several perspectives, among which:

a) strategic geopolitical significance, with potential impact on policy framework, maritime routes and maritime transport dynamics;

b) generator of "blue" goods and services demand. including virtually all sub-sectors in the ecosystem, including innovative products and solutions;

c) generator and testing ground for R&I in "blue" and "blue"-related sectors.

The other two are off-shore (wind) energy, and off-shore aquaculture, which are high-potential sectors, very closely related with the maritime industry.

8 SWOT ANALYSIS

In order to assess and evaluate the internal strengths and weaknesses, as well as the external opportunities and threats of each of the ecosystems, the so-called "SWOT" analysis was prepared. The said analysis comprehensively summarizes some of the key aspects of the ecosystems.

Table 8: SWOT analysis for Slovenian ecosystem.

Strengths:	**Opportunities:**
▪ Port of Koper is the main driver in the maritime industry; ▪ strategic geolocation of Slovenia (Mid Europe with direct access to the sea); ▪ awareness of modernization and digitalization needs in the industry; ▪ strong startup and scale-up ecosystem; ▪ excellence in design, engineering, and construction; ▪ a large percentage of companies from a traditional industry (e.g., shipbuilding) build their solutions by promoting innovation and new technological approaches;	▪ large infrastructure projects in the process (railways, expansion of Port of Koper capacity); ▪ emerging technologies such as automation, digitalization, and alternative fuels; ▪ growing demand for sustainable and eco-friendly solutions in the maritime sector; ▪ rapidly rising venture capital opportunities for Slovenian startups and scale-ups; ▪ EU public funding schemes (e.g. SME instrument); ▪ due to its size, the Slovenian market is ideal for testing new technologies, and products ("proof of concept phase"); ▪ agility in state governance due to the county's size;

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▪ strong manufacturing and technical knowledge base (sound school system, companies with legacy); ▪ high existing awareness of the importance of the green industry (compliance with ESG standards); ▪ a large number (per capita) of filled patents and models (Slovenian and EU).	▪ bringing back to Slovenia the individuals who are successful in entrepreneurship and in other industries (the government is implementing such programs).
Weaknesses: ▪ limited access to funding and capital for maritime industry specialized companies (no special public financing programs for the nautical/maritime industry); ▪ only one for the nautical/maritime industry specialised incubator ▪ maritime/nautical industry not listed as a priority by existing (or any of the past) government; ▪ long administration processes (obtaining permits, negotiations with bigger companies, etc.); ▪ high taxation; ▪ public ownership of Port of Koper (instability in governance); ▪ dependence on Port of Koper (only one large stakeholder in the Slovenian maritime ecosystem); ▪ existing dependence on public financing for startups and scale-ups; ▪ existing infrastructure (railways, roads, capacity in Port of Koper); ▪ no innovation hubs of foreign large companies in Slovenia (mostly only sales departments).	**Threats:** ▪ startup and scale-up "brain drain "due to lack of funding opportunities, unfriendly tax environment and slow changes in the regulatory framework; ▪ economic downturns; ▪ geopolitical instability; ▪ political instability (internal); ▪ regulatory changes (too slow, always waiting for the EU regulation to be adopted); ▪ no government strategy for the future development of maritime/nautical industry; ▪ competition from low-cost producers in Asia and other regions.

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Table 9: SWOT analysis for Croatian ecosystem.

Strengths:	**Opportunities:**
▪ strong maritime heritage and long tradition of high-quality shipbuilding and craftsmanship ▪ strategic geolocation of Croatian ports and their infrastructure ▪ strong maritime ship design engineering companies with state-of-the-art know-how ▪ strong maritime and engineering universities providing excellent education ▪ professional and high skilled labour force (engineers, etc), competitive on global market ▪ region is a traditional Hub for maritime sector workforce due to long tradition and educational facilities ▪ long term presence of Croatian companies on global market ▪ presence of multinational companies branches and subsidies in maritime sector ▪ excellence in ship design, engineering, construction, and production ▪ presence of local IT companies that support maritime innovation ecosystem ▪ awareness and implementation of green technologies ▪ presence of research centre for new materials (light materials, advance materials, nanomaterials)	▪ transition towards niches with higher added value (autonomous ships, green ships, luxury yachts and floating hotels, special purpose ships) ▪ possibility of participating in EU founded R&D projects ▪ large infrastructure projects for expansion in the port of Rijeka (railway, highway, new container terminal) and smart marina ▪ establishment of an effective regional ecosystem and an ecosystem for entrepreneurs through establishment of maritime innovation clusters ▪ creation of knowledge transfer centres between universities and industry ▪ development of smart skills through lifelong learning ▪ digital transformation and application of digital technologies in maritime industry ▪ orientation on services with high added value (R&D, Ship design) ▪ willingness of industry experts to adopt new technologies ▪ emerging technologies such as autonomous shipping, AI, VR, and digital twins and their application in maritime industry ▪ transition of vessels to alternative fuels ▪ IT solutions and production technologies, digitization and automatization of business processes, management and planning etc. ▪ development of ecological sustainable propulsion systems, development of intelligent steering systems, production of green energy for production needs, application of robotics ▪ strengthening the capacity of medium and large enterprises ▪ establishing a supportive startup ecosystem ▪ support of leading maritime companies to public companies in developing modern services and products in maritime sectors

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	▪ attracting the best talents and involving citizens in innovation process ▪ clear focus on profit and/or changes in maritime legislation enforcing application of innovations
Weaknesses: ▪ limited access to funding and capital for R&D projects from the government and venture fonds ▪ dependence on EU funding for innovative projects ▪ SME-s lack in-house funding for innovations ▪ Insufficient investment in R&D&I ▪ weak connection between the business and scientific research centres and universities on innovative projects, insufficient partnerships between them ▪ lack of networking in local/regional value chains ▪ lack of broader strategy for shipbuilding industry (local/state level, EU) ▪ reliance on government subsidies for state-owned shipyards ▪ rigid administrative regulations ▪ competition for highly skilled workforce between companies ▪ brain-drain and import of expat workforce in shipyards ▪ lack of investment in zero emission technologies in traditional shipping companies ▪ lack of supportive infrastructure readiness ▪ outdated technology and infrastructure ▪ lack of smart skills for the industrial transition to new technologies ▪ lack of strong high-tech player in the field of maritime technologies that could lead R&D process in the region	**Threats:** ▪ ▪ climate change and environmental challenges ▪ shifts in global order and demographic ▪ geopolitical instability ▪ political instability ▪ economic cycles/crisis ▪ global competition, namely from East Asian shipyards especially in terms of lower labour cost and financial capacity ▪ existing uncertainties and regulatory challenges/ changes related to green and digital transition in maritime technology (EU regulations to be adopted) ▪ international standards for implementation of advanced ship technology are not in mature stage therefore, a close cooperation and liaising with certifying authorities early in the design phase is needed to enable effective transition ▪ the development and adoption of new technologies is associated with considerable uncertainties, risks, and high costs

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▪ smaller companies existing in the ecosystem do not have strong or any R&D departments ▪ only one nautical/maritime industry specialised incubator ▪ no innovation hubs of foreign large companies in Croatia, only a few local subsidies are involved in collaboration on innovation projects ▪ due to size and complex structures, ecosystems resist embracing innovation and change, and when enforced, innovative performance is brought slowly and with great difficulty ▪ no real effort form governmental sector in sense of legislation change that would be in favour of green transition, for example, shipyards are excluded from any kind of subsidy even for green shipping ▪ outdated infrastructure	

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9 PATH TO ECOSYSTEM MAPPING - KEY CHALLENGES

The ecosystem mapping followed the methodology presented and validated in the document "Methodology for an in-depth mapping of the Western Slovenian and Adriatic Croatian maritime innovation ecosystem." We encountered several challenges in obtaining the information. A few things surprised us positively.

9.1 Slovenian ecosystem

We were undoubtedly positively surprised by the amount of publicly available information. More in-depth searches on the web and in publicly available documents (e.g., annual reports, newsletters, articles, and publications) provided us with information that proved very relevant for preparing the ecosystem map. This was information related to private companies developing their solutions within the maritime and nautical industry.

On the other hand, it was these companies that we needed help to obtain additional information from. In line with the methodology, once we had identified all relevant stakeholders within the Slovenian maritime and nautical industry, we addressed a short questionnaire to all of them, which would primarily serve as our primary source of information regarding the interconnectedness of stakeholders in the ecosystem. We are still waiting to receive responses from representatives of private companies. After further contact, we mostly received the answer that by potentially disclosing their business partners, they are revealing their trade secrets and exposing themselves to the risk of this information being used by competitors. They further pointed out that they did not see any positive added value in participating in such a survey. Therefore, obtaining information beyond publicly available was virtually impossible for private companies.

Other stakeholders proved to be much more responsive. Business incubators, educational institutions as well as public institutions answered our questions. They could have been more responsive to the questionnaire we sent them, but they did reply after we contacted them further.

Given the above, the research methods have enabled us to overview the Slovenian ecosystem comprehensively. In doing so, we could categorize the stakeholders without significant problems, identify those driving innovation and exclude those not.

However, due to the reticence of private companies to provide information on business partners and customers, we needed help to identify and show the interconnectedness of stakeholders within the ecosystem. This is made more accessible because the Slovenian ecosystem has only one large company, which is vital to the maritime industry. Luka Koper is the critical stakeholder connecting most of the other identified stakeholders.

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9.2 Croatian ecosystem

We encountered several challenges in obtaining the information.

The greatest challenge proved to be the non-responsiveness of stakeholders, primarily companies which didn't find the time or the interest to participate in the project i.e., answer the short questionnaire about their business and interaction with other stakeholders within the ecosystem.

That was identified as one of the major risks in the project and we were prepared to find ways to overcome that by using the publicly available information published on company's web sites, articles, publications, and data bases which proved to be a valuable source of information without which the ecosystem map could not be prepared. There were companies classified in the data base that do not have an official web site and there were no findings about them on the Internet, so it is practically impossible to find any details about their business activities. It turns out that these companies are either micro or self-employed entrepreneurs or companies that are subcontractors of big shipyards and therefore exclusively and completely dependent on them.

Due to the size of Croatian maritime ecosystem, where in the public database there is the total of 317 companies in the just in the category of shipbuilding which submitted their 2021 financial reports 80 questionnaires were sent to the most important stakeholders that are involved with innovation (many companies are related to tourist sector which is not in the scope of the project).

We received 20 answers which counts for 25% of answer rate, and even after multiple reminders and phone calls we could not gather any more answers during the three months period. That implies that companies do not perceive this project to be in any way important and relevant to their business.

The main reasons for not responding are the lack of time due to work overload and company deadlines. The companies did not see any benefit or added value for their company in participating in such a survey and even complained that the questionnaire is too long (?!). Furthermore, they have been more than reluctant to share any information regarding their business activities, namely their collaborators and competitors and innovative projects or products that they are involved in for the fear of disclosing their know-how and confidential information to third parties. They estimated that by participating in the survey they expose themselves to the risk of information being used by competitors. The non-responsive companies absolutely showed no interest whatsoever to answer the questionnaire as they do not see any purpose in conducting the mapping of Croatian innovation maritime ecosystem since their business activities are conducted on international market. Some IT companies stated that they sign NDA agreements for all their clients, so it was impossible to obtain any information from them apart from what is published on their web site.

The answers of other stakeholders, namely universities were also difficult to obtain, except from our project partners, other universities did not bother to participate in the survey. Whether that implies the competition between the universities, or their local orientation or just plain disinterest is hard to know.

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On the other hand, we managed to conduct 10 interviews that were very useful and provided us with valuable insight of the overall picture of the Croatian innovation maritime ecosystem. The questionnaire had a positive effect in some companies that expressed their wish to participate in EU projects and they are eager to collaborate with our project partners if there would be another EU project dealing with similar subject in the future. Some of them were not informed at all about the possibilities for EU funding for companies with innovative projects. Therefore, we can conclude that the survey did have a positive impact for the companies that wanted to participate.

Given the above, by using and combining the different research methods we were able to overview the Croatian ecosystem comprehensively. In doing so, we manged to categorize the stakeholders and identify those driving innovation using publicly available information and exclude those that are not.

However, due to the reticence of private companies to provide information on business partners and customers it was not possible to completely identify the interconnectedness of stakeholders within the ecosystem and define their roles in detail.

Nevertheless, the ecosystem has been successfully mapped regardless of all mentioned above and thus provided us with valuable findings that can be used for forthcoming projects and innovation activities.

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10 CONCLUSION

This document focuses on the mapping and analysis of the Slovenian and Croatian maritime innovation ecosystem, aiming to provide a comprehensive understanding of both maritime and nautical innovation ecosystems. The purpose is to offer a valuable tool for policymakers, entrepreneurs, and investors to understand the dynamics of these ecosystems and develop strategies to support innovation and economic growth.

The innovation ecosystem mapping process aimed to create a visual representation of the ecosystem, enabling stakeholders to comprehend its structure and dynamics. This understanding can help identify areas of opportunity and risk, leading to the development of strategies that enhance the sustainability and competitiveness of the ecosystem. The document acknowledges the interconnectedness between the stakeholders within the Slovenian and Croatian maritime and nautical ecosystems. It illustrates how the mapping of both ecosystems provided insights into the level of interdependency between different stakeholders.

The conducted innovation ecosystem mapping revealed several critical aspects divided into nine different blocks: customers, value proposition, stakeholders, resources, activities, networks, regulations and political stability, culture and legacy, and infrastructure. These conclusions are divided into the Slovenian and Croatian ecosystem canvas findings.

For the Slovenian ecosystem, it is evident that the maritime industry gravitates towards the Port of Koper, with many Slovenian companies establishing relationships with this major entity. The fragmented nature of the Slovenian maritime and nautical ecosystem and the absence of a systemic governmental strategy make it challenging to single out a comprehensive value proposition. However, technological innovation emerges as a key value proposition, particularly with the expected influx of venture capital into the Slovenian startup ecosystem. The ecosystem involves a diverse range of stakeholders, making it a smaller version of larger ecosystems, with the Port of Koper being a significant player. Essential resources include skilled labor, high-quality materials, and advanced technologies, though access to funding remains a challenge. Key activities revolve around ship design, engineering, construction, and maintenance, with logistics activities primarily connected to the Port of Koper. Networks and partnerships are also centered around the Port of Koper, which acts in various roles within the ecosystem. Regulatory frameworks affecting the industry include safety standards, environmental regulations, and trade policies, although the amendment process is slow. The cultural context is influenced by legacy companies and a growing startup ecosystem, promoting agility and innovation. Infrastructure, primarily owned by the Port of Koper, supports the industry's physical and digital needs.

In the Croatian ecosystem, international customers include maritime and shipping companies, private yacht owners, marinas, and cruising companies. The value propositions of the Croatian maritime and nautical industry are its strategic location, highly skilled workforce, long tradition in shipbuilding, and competitive labor cost. Key stakeholders include shipbuilders, ship designers, shipping lines, and marine equipment suppliers, among others, with cooperation and collaboration being crucial for innovation. Resources available include port infrastructure, manufacturing facilities, highly skilled human resources, and financial resources, though the latter often depends on EU funding. Key activities encompass design, engineering, construction, production, maintenance, and repair of vessels, with a focus on innovation and sustainability. Networks and partnerships, including clusters, incubators, accelerators, and international networks, play a critical role in driving innovation. Regulatory frameworks include intellectual property laws, government policies, EU regulations, and industry-specific regulations. The

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cultural context is shaped by historical, social, and economic influences, with a cautious approach to risk-taking and innovation. Critical infrastructure includes shipyards, ports, research centers, incubators, accelerators, and digital platforms, with significant investment in modernization and digitalization.

In summary, the document highlights the intricate dynamics and interdependencies within the Slovenian and Croatian maritime innovation ecosystems, providing valuable insights for stakeholders to enhance sustainability, competitiveness, and innovation.

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APPENDIX A

Maritime map Slovenia, Excel table with data, available upon request.

APPENDIX B

Maritime map Croatia, Excel table with data, available upon request.

Funded by the European Union