I-SEAMORE

D8.3 Business Modelling

WP8 Dissemination and Exploitation

Integrated surveillance ecosystem for European Authorities responsible for Maritime Operations leveraged by reliable and enhanced aerial support

Co-funded by the European Union

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D8.3 Business Modelling

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Abstract	I-SEAMORE will generate several overarching Key Exploitable Results (KERs). Those as well as partners' individual exploitable results are both aimed at the identified target customer groups. This business modelling deliverable D8.3 focuses on developing the basic concepts for the referring exploitation activities. These will allow the consortium to articulate a clear route to commercial success by translating the consortium's novel understanding of situational awareness and operational capabilities for Maritime Authorities in charge of surveillance operations, tailored to their requirements, and with clear benefits identified for the society in general.

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DISCLAIMER

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EXECUTIVE SUMMARY

As a European project funded within the framework of Horizon Europe Programme, I-SEAMORE aims to develop an integrated technical ecosystem composed of an advanced platform solution to host and manage the operation of several innovative assets, services, and systems for maritime surveillance. The I – SEAMORE ecosystem will provide its target customers with increased situational awareness and operational capabilities, especially for maritime surveillance operations resorting to aerial and water surface support. To achieve this aim, the activities involve modernization and/or development of a set of services and tools that will enable the users to take advantage from access to heterogeneous data sources as well as data and information processing mechanisms. Among the applied technologies to the I-SEAMORE platform will be AI, Big Data, Copernicus services and others.

I-SEAMORE will generate several overarching Key Exploitable Results (KERs) as well as partners' individual exploitable results that are both aimed to the identified target groups. In this sense, a comprehensive plan and list of activities related with the commercial exploitation of I-SEAMORE results must be implemented. The focus of those actions is to maximize the engagement of the targeted audiences to increase awareness and to clearly understand stakeholders' needs and challenges for future adoption of I – SEAMORE outcomes. These will allow partners of the I-SEAMORE consortium in articulating a clear and sustainable route to commercial success by translating the consortium's novel understanding of situational awareness and operational capabilities into solutions for customers' challenges and pain points, tailored to their requirements, and with clear benefits identified for the society in general.

The development and creation of detailed commercial exploitation scenarios will enhance all the technical tasks performed within the project. For the final market uptake, the consortium will move towards new business and service delivery models that can be enabled by I-SEAMORE. Different applying value-generation chains will be described and formulated into business models; these models will foresee the open access knowledge sharing measures as well as business-oriented exploitation schemes, thus allowing the creation of the so-called front-end and back-end business options. Attention will be paid to long-term exploitation potential offered by I-SEAMORE.

This report represents an initial view on the business and exploitation models in several aspects:

- The I-SEAMORE project has a number of different stakeholders (target groups) and the first step was to analyse these stakeholders and their needs.
- The technical architecture ascertains that different kind of challenges of the main target groups, the maritime authorities, can be solved.
- Value-chain analysis and synthesis tasks helped us to understand the value streams between I - SEAMORE solutions and the identified stakeholder groups, to understand the value generation chains, how the stakeholder's needs are met and what relationships and influences exist between I-SEAMORE and the stakeholder groups.
- All activities were oriented at the defined use cases and user requirements, considering the exploitable results (KERs) that are aimed at the identified target groups.

These activities helped to understand the exploitation options, for the entire architecture as well as for some elements of the architecture. They are several and led to the so-called multi-sided business model as well as to different service delivery options.

Alle these results constitute the input for further exploitation and dissemination actions as well as for the development of the business plan (D8.4 at M30) in a so-called open innovation approach. This task will also contribute to the creation of a business ecosystem, enabling access-to market initiatives. The long-term go-to-market strategy will target realizing the international market opportunities immediately after the end of the project, thus initiating further international application of the project results.

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LIST OF ACRONYMS

AI	Artificial Intelligence
AIS	Automatic Identification System
App	Application
B2B	Business to Business (sales relationship)
B2B2C	Business to Business to Consumer (sales relationship)
B2C	Business to Customer (sales relationship)
B2G2B	Business to Government to Business (sales relationship)
CAGR	Compound Annual Growth Rate
CE	Conformité Européenne
CEC	Commission of the European Economic Communities
CISE	Common Information Sharing Environment
DX.Y	Deliverable number X.Y
EC	European Commission
EO	Earth Observation
EU	European Union
EU27	The 27 European Union Countries
GCS	Ground Control Station
GPS	Global Positioning System
GUI	Graphical User Interfaces
HW	Hardware
ICT	Information and Communications Technology
IOM	The International Organization for Migration
IP	Intellectual Property
IT	Information Technology
KER	Key Exploitable Results
MOC	Maritime Operations Centres
n/a	not applicable
NGO	Non-Governmental Organization
ONAP	Open Network Automation Platform
PoC	Proof of Concept
PPPs	Public Private Partnerships
PTZ	Pan-Tilt-Zoom
R&D	Research and Development
RF	Radio Frequency
RTO	Research and Technology Organizations
S&R	Search and Rescue
SIGINT	Signals Intelligence
SMEs	Small and medium-sized enterprises

SW	Software
TCP	Transmission Control Protocol
UAV	Unmanned Air Vehicle
USP	Unique Selling Proposition
USV	Unmanned Surface Vehicle
UxV	Unmanned Vehicle
WP	Work Package

1 INTRODUCTION

1.1 Scope of the deliverable

I-SEAMORE is an ecosystem composed of an advanced platform solution to host and manage the operation of several innovative assets, services and systems that aim to provide European Authorities with increased situational awareness and operational capabilities for maritime surveillance operations resorting to aerial and water surface support.

The core platform (infrastructure and software layers) is conceptualized to be deployed and operated at Maritime Operation Centres (MOCs) with interfaces to other systems including the UxVs Ground Control Stations (GCSs), as well as external systems. It thus provides end-users with a holistic platform capable of handling several multipurpose tasks including, e.g., wide maritime border and coastal areas monitoring, analysis of potential threats, support to search and rescue operations, detection of illegal activities, among others. Such tasks will be possible since the I-SEAMORE platform provides a complete set of functionalities and capabilities to mission commanders, focusing on four main pillars:

1) Employment and indirect tasking of multiple types of long-endurance unmanned assets (aerial and water surface),
2) Exploitation of heterogeneous data sources, e.g. payload data and open data sources including Copernicus Services,
3) Provision of a common operational picture empowered by a novel and comprehensive suite of data fusion services based on Artificial Intelligence (AI) and Big Data Analysis, for optimal decision making and successful mission execution of the desired missions, and
4) Interoperability within the Ecosystem and its interface with key existing external systems.

Moreover, the project will also generate additional knowledge to support the uptake of the solution at EU level, as well as multi-country, multi-authority collaboration, including novel concepts of operation, standard operating procedures for joint operations, and new methodologies for co-creation and validation of maritime situational awareness and maritime security solutions by end-users.

The main goal of the commercial exploitation tasks is to scope the landscape of the existing market for dissemination purposes and commercialization strategy building. Based on the stakeholder evaluation of task T7.3 and analysis of task T8.2 the interactions and value streams between the different stakeholders are drawn. This led to the illustration of values added by I-SEAMORE's products and services. Consequently, possible exploitation models could be developed, especially the relevant so-called front-end/back-end business models. Based on this general business model design, the commercialization strategy development will be complemented with deliverable document D8.4 "Business and Sustainability Plan", which will describe the market entry strategies, the elements of the so-called marketing mix, and a sustainability strategy. Consequently, the analysis and development activities within this document not only lay the ground for future exploitation of I-SEAMORE systems, products, and services. Moreover, this task also contributed to the creation of a business ecosystem, enabling access-to market and access-to finance initiatives in the future.

1.2 Synopsis of our approach

In line with the goals of the project, our approach covers several topics that I-SEAMORE must explore for its successful market take-up:

Our starting point was to look at the different stakeholders (such as governmental ones, stakeholders from industry, NGOs, academia, etc.) in the value-generation chain and to analyse their needs chapter 2.

Through analysing the stakeholders and the possible consumer acceptance, different elements in the value-generation chains for I-SEAMORE results are documented. Therefore, individual value flows like money flow, information flow and product/service flow are presented in the value-flow analysis in chapter 3, illustrating how the stakeholder groups interact either as providers of input for I-SEAMORE solutions or as consumers of results. As a result of the value-chain synthesis it became obvious that several exploitation options exist, enabling a so-called multi-sided business model (chapter 4). Since the conception of the diverse service delivery models is based on the applying use cases, these core use cases are described and the user requirements for those use cases are documented (chapter 5). This analysis work provides initial value proposition statements that can be accommodated for future exploitation into target markets. Consequently, we compared value propositions with challenges of maritime authorities as main target customer group in the so-called Value Proposition Canvas (chapter 6). This helped us to understand I - SEAMORE's value delivery options and to draw the conclusions (chapter 7). And it also constitutes the input for the development of the business and sustainability plan (deliverable D8.4), in which access-to-market and access-to-finance scenarios will be described. Figure 1 below illustrates our approach:

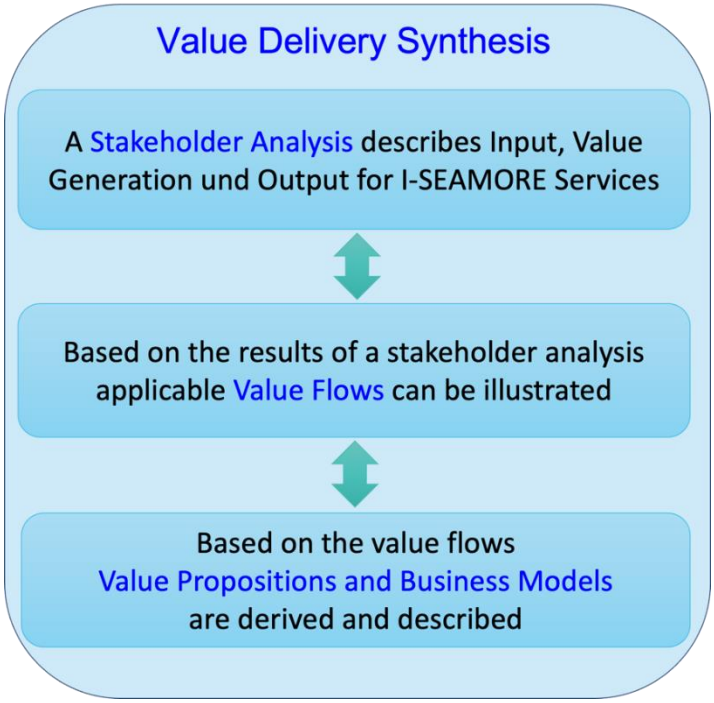

FIGURE 1: ELEMENTS OF THE STAKEHOLDER ANALYSIS AND VALUE DELIVERY SYNTHESIS[1]

1.3 Method

The analysis work is built on a combination of different analytic methods and analytical tools like literature review and secondary data analysis. It is used as a part of trend scanning process, structured around themes and related theories. Moreover, for the use cases and application scenarios considered in the project, appropriate examples were sought via desk research and lessons learned were generated.

In addition, interviews with project partners were conducted as face-to-face interviews or via video conferencing, and information about the user requirements for the described use cases were retrieved and are considered in the report. The partner interview sessions were complemented by external stakeholders' panels. The project partners contributed to the analytical part of the deliverable as well, combined their knowledge and provided "insider" expertise.

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1.4 Review of the document

The following additions have been included in the revised version of the deliverable.

The added value of potential services and products has been detailed at the end of section 6.2 The I-SEAMORE core customer values.

Potential exploitation models have been detailed in Section 6.3 The I-SEAMORE exploitation models.

2 STAKEHOLDER ANALYSIS

While the I-SEAMORE platform offers numerous use cases for Border Authorities and Law Enforcement Agencies, hereinafter collectively referred to as "Maritime Authorities", the platform also has the potential to address the technology challenges of multiple stakeholder groups. In other words, the vast technological capabilities to monitor the water and coastal areas of multiple countries, and to analyze the data stemming from the monitoring assets, will empower various public and private stakeholders to take initiatives that improve the quality of life of communities, provide new business opportunities, or even ensure the preservation of the biodiversity and endangered species.

The I-SEAMORE project is a forward-thinking initiative. Consequently, for addressing different possible commercialization channels, it is also crucial to take a forward-thinking approach: understanding that in addition to the law enforcement agencies and border security authorities, there is a variety of stakeholders potentially interested to ensure successful exploitation, uptake, and long-term sustainable application of the project results.

Stakeholder segmentation is the process of dividing a broad value consumer or value provider community into sub-groups of stakeholders (known as segments) based on some type of shared characteristics [1]. Stakeholder segmentation is critical for the go-to-market strategy and for offering sustainably and successfully value-adding services to stakeholder's needs. Therefore, the relations of the participating entities are described in the following:

Stakeholder groups	ID	Key stakeholder	Primary stakeholder	Secondary stakeholder
Government	G	Border authorities Law enforcement agencies Governmental agencies	Environment protection agencies Traffic/Port authorities Public funding provider EC and nationally funded projects	Regulators, certifiers, standardisation bodies Incubators, venture builders Accelerators
Business	B	Industry (Corporates, SMEs, Startups)	Farmers and agriculture companies Insurance companies Hunting and fishing clubs	Financiers (investors) Tourism stakeholders
NGOs	N	Humanitarian bodies	Environment protection agencies Certifying organisations Standardisation bodies	Associations & lobbying groups Incubators, venture builders Accelerators
Academia	A	Universities RTOs		
Leveraging groups	L			Influencers, newsmakers
Individual consumers	C		Civil society	

FIGURE 2: KEY STAKEHOLDERS IN THE VALUE-GENERATION CHAIN IN THE SURVEILLANCE MARKET[2]

In Figure 2 above, we divide all identified potential stakeholders into two main groups with related subgroups to provide a categorization for the benefit of a better stakeholder overview:

1) According to the influence and impact the I-SEAMORE project generates:
   - Key Stakeholder (High impact, high efficiency, international influence)
   - Primary Stakeholder (Middle impact, middle efficiency, national influence)

[2] © INI-Novation GmbH

- Secondary Stakeholder (Low impact, low efficiency, regional influence)

2) According to their role in the value generation chain:
   - Government (G) = a state institution in maritime and border surveillance sector
   - Business (B) = companies as input providers for consumer/costumer all along the value generation chain
   - NGOs (N) = non-governmental Organizations (Humanitarian Bodies, etc.)
   - Academia (A) = research Institutions (Universities, RTOs)
   - Levering groups (L) = groups like Influencers, manipulators, etc.
   - Individual consumers (C) = general Public

The stakeholder groups categorized this way as well as their potential interest in I-SEAMORE are shortly described below:

1. **Border Authorities (European Maritime Authorities)**, comprising government agencies and organizations responsible for managing and securing national borders, play a pivotal role in enforcing immigration laws, preventing illegal activities, and ensuring the overall security and integrity of a country's borders. They provide valuable insights into the challenges and requirements of maritime surveillance, offering essential data on border activities and potential security threats in maritime regions. The benefit for Border Authorities in this collaboration is substantial. Through their partnership with I-SEAMORE, Border Authorities gain access to enhanced maritime surveillance capabilities. The project facilitates improved border security by providing real-time data, advanced surveillance tools, and strategic insights. This collaboration supports more effective border management and law enforcement activities, reinforcing the overall security measures in place for national borders.

2. **Law Enforcement Agencies**, encompassing various entities responsible for maintaining public order, enforcing laws, and ensuring the safety and security of citizens, play a crucial role in law enforcement activities within their jurisdictions. In the specific context of the I-SEAMORE project, Law Enforcement Agencies contribute by actively engaging in collaborative efforts, sharing valuable data, and contributing to the formulation of effective enforcement strategies. Their participation enhances the project's capabilities by providing real-world insights into the challenges of maritime law enforcement, fostering a more nuanced and informed approach. The benefit for Law Enforcement Agencies in this collaboration is significant. The shared data and improved enforcement strategies facilitated by I-SEAMORE strengthen their capabilities, fostering a safer environment. This collaboration enables more effective responses to security threats and criminal activities, aligning with their mission to ensure law and order within maritime and territorial environments. The symbiotic relationship between technological innovation and practical law enforcement needs enhances the overall security posture in maritime regions.

3. **Government and policy makers**, representing the highest level of authority in a country or region, play a significant role in formulating and implementing laws, regulations, and policies that shape the legislative framework governing various aspects of society. In the context of the I - SEAMORE project, governments and policymakers make contributions by providing crucial policy support, strategic alignment, and financial backing. Their involvement ensures that the project aligns seamlessly with national and regional security goals, demonstrating a commitment to enhancing maritime surveillance and security. Local governing bodies ensure that the implementation is aligned with the specific needs of their jurisdiction Additionally, governments and policymakers may play a role in crafting legal frameworks that govern maritime surveillance practices, establishing a solid foundation for regulatory compliance and ethical standards. The benefit for governments and policy makers in this collaboration is profound. I-SEAMORE supports the implementation of effective policies, providing better control over maritime activities and

contributing to the overall safety and security goals outlined by the government. This collaboration underscores the synergy between technological innovation and policy implementation, fostering a safer and more secure maritime environment.

4. **Industry (Corporates, SMEs, Startups)**: The industry stakeholder category comprises a diverse spectrum of businesses, ranging from large corporations (Corporates) to small and medium-sized enterprises (SMEs) and innovative startups. These entities operate across various sectors, playing pivotal roles in driving economic growth, fostering technological innovation, and generating employment opportunities. Industries make substantial contributions to the I - SEAMORE project by providing technological advancements, operational expertise, and a wealth of experience within their respective domains. Corporates bring established technologies, SMEs contribute specialized knowledge, and startups introduce innovative solutions. This collaborative effort enriches the I - SEAMORE project with a diverse array of capabilities, fostering a comprehensive approach to maritime surveillance. The benefits for Industry stakeholders in this collaborative venture are manifold. Beyond gaining opportunities for business expansion, collaboration, and innovation through their involvement in I-SEAMORE, these stakeholders experience multifaceted advantages. Corporates discover new markets and applications, SMEs contribute specialized skills, and startups receive essential support and visibility, nurturing their growth within the maritime surveillance sector. Collectively, the industry benefits by actively contributing to advancements in maritime security and technology, fostering a collaborative ecosystem that propels the entire sector forward.

   Maritime Industry Stakeholders (including shipping companies, fisheries, and other marine-based industries) benefit, because. their operations are directly impacted by the surveillance measures, and hence, they play a role in providing feedback and ensuring practical application of the technology.

   Technology and data companies are essential for integrating various surveillance data sources, ensuring data privacy, and developing AI-driven analytical tools to make sense of the vast amount of data generated.

   Fishers and Fishing Companies, integral players in agriculture and food production, contribute significantly to the overall sustainability of agricultural practices. Their role encompasses cultivating crops, managing agricultural operations, and contributing to the broader food supply chains. Within the framework of the I-SEAMORE project, Farmers and Agricultural Companies actively contribute by providing invaluable insights into sustainable practices. Their involvement extends to sharing knowledge on responsible land and resource management, serving as a foundation for the development of sustainable maritime surveillance practices within the project. The benefit for Farmers and Agricultural Companies within this collaboration is substantial. By collaborating with I-SEAMORE, these stakeholders actively support responsible maritime activities. This collaboration ensures that maritime surveillance practices align seamlessly with sustainable principles, mitigating potential negative impacts on ecosystems. Additionally, Farmers and Agricultural Companies benefit from the promotion of responsible practices in the broader maritime domain, fostering a holistic approach to sustainability that spans both land and sea.

   Aerial Support Vendors are providers of advanced aerial technologies, be it drones, satellite systems, or other aircraft. They play an essential role in enhancing the surveillance capabilities of the project.

   Insurance Companies, entities specializing in risk assessment and financial protection, operate across diverse sectors to provide coverage against uncertainties and potential losses for individuals and businesses. Their expertise lies in managing and mitigating risks through comprehensive insurance solutions. In the specific context of the I-SEAMORE project, Insurance Companies make a meaningful contribution by offering insights into risk management strategies. Their involvement extends to assessing potential risks associated with maritime surveillance activities and providing essential guidance on effective risk mitigation measures. The benefit for

Insurance Companies within this collaboration is twofold. Primarily, their support enhances the robustness of maritime surveillance operations. By contributing their expertise in risk management to I-SEAMORE, these stakeholders play a role in ensuring that the project is resilient to uncertainties, thereby minimizing potential financial and operational challenges. This collaboration not only safeguards the project but also contributes significantly to the overall success and sustainability of maritime surveillance practices.

5. **Humanitarian Bodies**: Humanitarian Bodies, dedicated to addressing global crises and promoting human welfare, operate with a focus on alleviating suffering and responding to emergencies on a global scale. Operating globally, these organizations play a crucial role in providing aid and support during times of crises. In the specific context of the I-SEAMORE project, the contribution of Humanitarian Bodies could be significant: they actively address humanitarian challenges associated with maritime operations (i.e. in preventing illegal immigration), extending their support during emergencies such as natural disasters or humanitarian crises at sea. Their involvement ensures a comprehensive and coordinated response to crises in maritime environments. The benefit for Humanitarian Bodies within this collaboration is two-fold. Firstly, the collaboration enhances their response capabilities in maritime emergencies. Collaborating with I - SEAMORE ensures that the project's capabilities align seamlessly with humanitarian needs, facilitating more effective and timely responses to crises at sea. Secondly, these stakeholders derive benefits from the advancements in maritime surveillance brought about by the project. These advancements contribute to safer and more efficient humanitarian operations, aligning with the overarching goal of promoting human welfare and addressing crises effectively. Especially Emergency and Rescue Services may utilize the surveillance data in real-time situations, such as search and rescue missions, and thus have a stake in the system's reliability and accuracy.

6. **Environmental Protection Agencies**, whether private or public entities, are dedicated to safeguarding the environment and promoting sustainable practices. They focus on monitoring, assessing, and mitigating the impact of human activities on ecosystems, air, water, and biodiversity. Within the I-SEAMORE project, Environment Protection Agencies make meaningful contributions by overseeing compliance with environmental standards and ensuring that maritime surveillance practices align with sustainable and eco-friendly principles. Their involvement is pivotal in minimizing the environmental impact of surveillance activities in marine ecosystems, underscoring the project's commitment to responsible and sustainable maritime operations. The benefit for Environment Protection Agencies in this collaboration is profound: by ensuring that I - SEAMORE operates within established environmental regulations, these agencies contribute their expertise to shape maritime surveillance practices in harmony with ecological standards. This collaboration fosters responsible and sustainable maritime operations, emphasizing the importance of integrating technological advancements with environmental stewardship for a balanced and eco-friendly maritime surveillance ecosystem.

7. **Universities, RTOs (Research and Technology Organizations** stand as dedicated institutions committed to research, innovation, and education. While universities focus on providing academic programs and conducting extensive research, RTOs specialize in applied research, development, and facilitating the transfer of technology to industry. In the context of the I-SEAMORE project, the contribution of Universities and RTOs is invaluable. They actively enrich the project by providing cutting-edge research, innovative solutions, and essential educational support. Their involvement adds layers of academic expertise, technological advancements, and a solid foundation of knowledge, ensuring the project remains at the forefront of developments in maritime surveillance. The benefits for Universities and RTOs are multifold within the collaborative framework of I – SEAMORE. Not only do they seize the opportunity to contribute practical solutions to the maritime surveillance sector, but the collaboration also enables them to apply their research findings in a real-world context. This engagement fosters innovation. It facilitates knowledge transfer, and, importantly, results in tangible societal and industrial impact. In essence, the collaboration with

I - SEAMORE offers these institutions a dynamic platform for research application and societal advancement.

8. **Traffic and Port Authorities**, governmental bodies entrusted with managing and regulating transportation activities, particularly within ports and maritime regions, play a pivotal role in overseeing the safe and efficient flow of goods and people through these vital hubs. In the context of the I-SEAMORE project, Traffic and Port Authorities make substantial contributions by providing expertise in logistics, port management, and maritime transportation. Their involvement enriches the project's understanding of operational challenges and safety requirements, ensuring that I - SEAMORE aligns seamlessly with best practices within the maritime industry. This collaboration bridges the gap between technological innovation and practical industry needs. The benefit for Traffic and Port Authorities within this collaborative effort is tangible. I-SEAMORE facilitates improved safety and efficiency in maritime transportation, aligning with the goals of Traffic and Port Authorities. The project offers enhanced surveillance capabilities, real-time data, and valuable insights that contribute to safer and more efficient port operations and maritime traffic management. This relationship between technology and practical application directly addresses the core objectives of Traffic and Port Authorities, enhancing the overall safety and effectiveness of maritime transportation within their jurisdictions.

9. **EC and Nationally Funded Projects**, initiatives receiving financial support from the European Commission or national government funding programs, play a crucial role in addressing specific challenges and contributing to broader societal goals across various domains. In the context of the I-SEAMORE project, EC and Nationally Funded Projects contribute significantly by aligning initiatives and fostering potential collaboration. Their involvement brings shared objectives, research findings, or technological advancements that complement or synergize with the goals of I-SEAMORE. This collaborative approach enriches the project with a diverse set of perspectives, resources, and expertise. A collaboration with EC and Nationally Funded Projects results in synergies with broader EU or national goals, leveraging additional resources, expertise, and aligning with strategic initiatives. Simultaneously, this collaboration enhances the impact and reach of EC and Nationally Funded Projects within the maritime surveillance domain. The potential for shared success underscores the mutual benefits derived from collaborative efforts in advancing innovation and addressing challenges in the maritime surveillance sector.

10. **Certifiers and Standardization Agencies**, organizations entrusted with establishing and maintaining industry-specific benchmarks, standards, and certifications, play a vital role in ensuring the quality, safety, and performance of products, services, and practices within their respective domains. Within the realm of the I-SEAMORE project, Certifiers and Standardization Bodies contribute significantly by setting quality and safety standards relevant to maritime surveillance. Their involvement is instrumental in ensuring that the project adheres to industry benchmarks, fostering reliability, consistency, and adherence to best practices. This collaboration aligns technological advancements with established standards, bridging the gap between innovation and industry norms. The benefit for Certifiers and Standardization Bodies in this collaboration is obvious: their engagement assures compliance with established standards within the maritime surveillance ecosystem, enhancing the credibility of I-SEAMORE. Stakeholders are reassured that the project meets rigorous quality and safety requirements, and it facilitates interoperability and compatibility with existing industry practices. This partnership underscores the importance of harmonizing technological innovation with established standards, contributing to a robust and trustworthy maritime surveillance ecosystem.

11. **Regulators**, governmental or authoritative bodies tasked with overseeing and enforcing compliance within specific industries or sectors, hold a role in setting and enforcing regulations. Their responsibilities extend to ensuring fair practices and upholding legal standards. Within the framework of the I-SEAMORE project, Regulators make a contribution by providing regulatory oversight and guidance. This approach ensures that the project operates within legal frameworks

and adheres to ethical boundaries, fostering a transparent and compliant environment. The benefit for Regulators within this collaboration is noteworthy. Actively participating in or monitoring I - SEAMORE, regulators contribute to the assurance of compliance within the maritime surveillance sector. Their engagement helps maintain a transparent and ethical environment, promoting responsible practices. Importantly, their involvement ensures that the project aligns seamlessly with legal requirements and industry standards, establishing a robust foundation for the ethical advancement of maritime surveillance practices.

12. **Associations & Lobbying Groups**, as organizational representatives of specific industries, professions, or interest groups, play a role in advocating for the interests of their members. This advocacy extends to influencing policies, regulations, and decision-making processes that shape the landscape of their respective domains. In the context of the I-SEAMORE project, the contribution of Associations and Lobbying Groups can be instrumental. By actively advocating for industry interests, they contribute to shaping policies related to maritime surveillance. Their involvement can ensure that the project aligns seamlessly with the needs and priorities of the industry they represent, fostering a collaborative and synergistic approach and align with industry goals and regulatory frameworks.

13. **Public and private funding providers**, encompassing entities offering financial support to projects, businesses, and initiatives, play instrumental roles in shaping the trajectory of developments. Private funders coexist with public funders, which can be government agencies, foundations, or international organizations. In the specific context of the I-SEAMORE project, private and public funding providers could contribute significantly by offering financial support for its further development. Private funders may be motivated by seeking returns on investment, while public funders often prioritize societal benefits and innovation. Their combined contributions play a crucial role in funding essential aspects of the I-SEAMORE project, including research, technology development, and overall implementation. The benefits for private and public funding providers are diverse. Private funders stand to gain financial returns, actively contribute to technological advancements, and support innovation within the maritime surveillance sector. On the other side, public funders benefit by addressing societal challenges, fostering innovation, and supporting projects that align with public interests. This collaborative effort, driven by both private and public funding, is instrumental in driving the successful development and implementation of I - SEAMORE, highlighting the synergies between financial investment and societal impact.

14. **Incubators/Venture Builders/Accelerators**, entities dedicated to supporting the development and growth of startups and early-stage ventures, play a role in creating an environment conducive to success. Their offerings typically include resources, mentorship, and a supportive ecosystem to help emerging businesses thrive. In the specific context of the I-SEAMORE project, Incubators and Venture Builders may contribute by providing support and resources to startups or ventures engaged in maritime surveillance innovation. Their involvement may encompass offering guidance, facilitating access to networks, and potentially extending financial support to nurture the growth of new ideas and technologies within the project. The benefit for Incubators/Venture Builders within this collaborative effort is that these entities actively engage in the identification and support of innovative solutions within the maritime surveillance sector. This collaboration not only allows them to contribute to the development of ground-breaking technologies but also fosters entrepreneurship. The potential outcomes include the establishment of successful startups that bring significant value to the industry, underscoring the symbiotic relationship between innovation and industry advancement.

15. **Fishing and Hunting Clubs**, representing enthusiasts engaged in recreational pursuits, actively advocate for responsible and sustainable practices within their respective activities. These clubs play a role in promoting ethical and environmentally conscious behaviour among their members. In the context of the I-SEAMORE project, Fishing and Hunting Clubs could contribute by advocating for sustainable fishing practices and by joint effort to avoid illegal fishing. Their involvement extends

to providing valuable insights into responsible marine activities, supporting efforts to minimize the environmental impact associated with maritime surveillance. The benefit for Fishing and Hunting Clubs is that this collaboration ensures surveillance practices aligning harmoniously with sustainability goals, minimizing adverse effects on marine ecosystems. Additionally, Fishing and Hunting Clubs benefit from the support of initiatives prioritizing responsible maritime practices. This support contributes to the preservation of natural environments, fostering a conducive setting for recreational activities while championing sustainability.

16. **Tourism**: The tourism stakeholder category, comprising entities such as travel agencies, tour operators, hospitality services, and local tourism boards, plays generally considered a role in the travel and tourism industry. These stakeholders collectively contribute to the promotion and facilitation of enriching travel experiences for individuals. Within the framework of the I - SEAMORE project, tourism stakeholders could actively contribute by championing responsible tourism practices. Their involvement ensures that maritime surveillance activities align seamlessly with the overarching goals of promoting safe and sustainable tourism experiences. The benefit for Tourism stakeholders in this collaborative effort is substantial. Collaborating with I-SEAMORE assures them of responsible maritime practices, where surveillance efforts actively contribute to fostering a secure maritime environment. This, in turn, positively impacts tourism experiences, offering travellers a heightened sense of safety. Moreover, these stakeholders derive additional benefits from the promotion of destinations prioritizing safety and environmental sustainability. This promotion enhances the overall appeal of travel destinations, aligning with the industry's growing focus on responsible and sustainable tourism practices.

17. **Influencers, Manipulators, Newsmakers**: In the realm of the I-SEAMORE project, this stakeholder category comprises individuals or entities wielding influence over public opinion, narratives, and discourse. Within this category, influencers leverage their reach and credibility to shape perceptions, while manipulators may seek to influence narratives for specific agendas. Newsmakers, as entities generating news content, play a crucial role in impacting public discourse. The benefit for these stakeholders is embedded in their ability to shape the narrative and public perception of I-SEAMORE. Positive and informed coverage from influencers and newsmakers can significantly contribute to the project's success. However, the presence of manipulators introduces challenges, as they may attempt to align the narrative with specific agendas. Effectively managing these dynamics becomes crucial for ensuring the overall success and acceptance of I - SEAMORE within the broader public sphere.

18. The **General Public** also holds a role in the I-SEAMORE project, representing a diverse community. This encompassing group consists of citizens, residents, and anyone influenced by maritime activities and surveillance. The General Public may actively contribute to the success of I - SEAMORE through providing feedback, expressing acceptance, and indirectly influencing the project's trajectory. Their engagement and understanding shape the societal impact and overall acceptance of the project. In return, the General Public reaps the benefit of enhanced safety and security in maritime environments.

The success of the I-SEAMORE project heavily depends on a harmonious collaboration between these stakeholders. Their collective insights, feedback, and support will determine how effectively the integrated surveillance ecosystem serves European stakeholders needs. Thereby, the most important key stakeholders are the Border Authorities, Law Enforcement Agencies and policy makers, which belong to the Government group. These are the individuals that purchase and use the I-SEAMORE system in the future and thus play a major role. Similarly, the industry and humanitarian organizations also play a big role in the success of the I-SEAMORE project. By contributing to the project via technology advancements, market opportunities or aligning project goals with societal needs they can leverage I-SEAMORE result into different applications.

3 STAKEHOLDER VALUE FLOW ANALYSIS

I-SEAMORE allows it stakeholders to proceed in decision making processes in a more rapid and accurate way, contributing to improved detection rates and improved information basis. To understand what the needs or the mindset of the stakeholders are, a desk research and analysis was conducted, which was complemented by a survey among the project consortium members. This allowed us to fully document the value flow from stakeholders to I-SEAMORE and - vice versa – from I-SEAMORE to its stakeholders. For this purpose, it was analysed how stakeholders would be able and willing to contribute to the value generation and how and why stakeholders would benefit from the value generation.

Therefore, the certain number of flows had to be assumed, each representing a unique pathway through which value is generated, transferred, and received (as illustrated in figure 3 below):

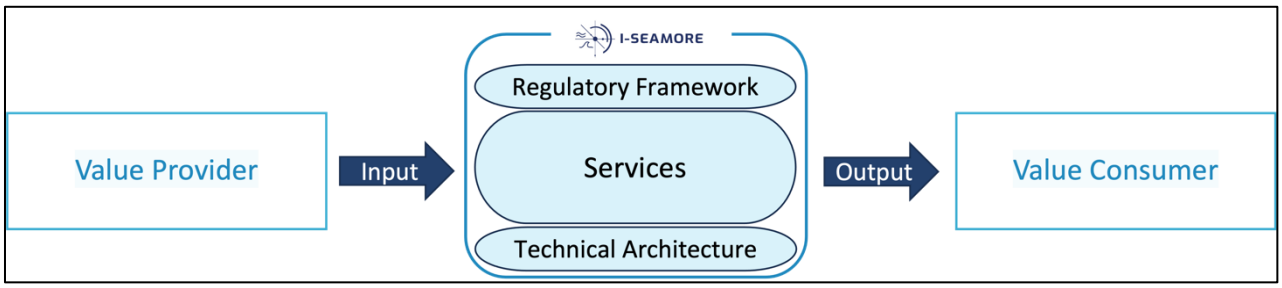

FIGURE 3: VALUE STREAM ANALYSIS – GENERAL FLOW OF VALUES[3]

Each of these flows in the value generation chain model illustrates how the I-SEAMORE project creates, amplifies, and transfers value from and to its community. Based on these definitions the flow of value between the different participants can be described in the following six categories:

- **Information and Decision Flow:** Raw data, analysed data and data aggregations associated with value-generation input or output.
- **Product/Service Flow:** Technologies/Products/Equipment/Software/Services as input for value generation or output from value generation.
- **Quality of Life Flow:** Provision of input to improve modes of operation, shorten documentation processes and relief employees and citizens.
- **Money Flow:** Money associated with payments / investments.
- **Aid Flow:** Assistance and resources provided to support I-SEAMORE value generation.
- **Decision Flow**: In specific cases, in which project beneficiaries are governmental agencies (hereinafter referred to as "Administration"), there is a certain level of "command" involved in the value stream. Administration does not belong to the main characters of the value-chain but is authorized to issue directives.

By understanding and optimizing these flows, the project can maximize its impact and ensure sustained success. Before considering the impact on I-SEAMORE key stakeholders, these value flows are briefly explained in the following sub-chapters, and examples of value realization between I-SEAMORE and its community are provided.

[3] © INI-Novation GmbH

3.1 Information flow

The information flow as part of the value streams is a dynamic process that encompasses the transmission, processing, and feedback of data and information throughout the entire project. It initiates with the meticulous collection of maritime surveillance data using sensors with cutting-edge technologies. This collected data undergoes a thorough analysis, transforming it into actionable insights that hold significant value.

The subsequent stage involves the dissemination of these insights to key stakeholders, i.e. the European Maritime Authorities or Border Protection Agencies, enabling them to make informed decisions and implement strategic measures. However, the flow doesn't conclude here; rather, it fosters a continuous loop of engagement. Stakeholders actively exchange feedback, operational reports, and updates, fostering an environment where the entire ecosystem remains not only well-informed but also adaptive to emerging challenges and opportunities. This iterative exchange ensures a robust and responsive system, enhancing the overall effectiveness of the maritime surveillance project. Examples of value exchange based on information flow are illustrated in the following table:

Stakeholder groups	Information input provided to I-SEAMORE	Information output received from I - SEAMORE
Border Authorities and Law Enforcement Agencies	• Existing raw data or aggregated data • HW/SW interfaces • Suggestions for changes, improvements, updates	• Aggregated data and analysed data feeding their decision systems
Businesses	• Primary data: existing raw data and aggregated data • Analyzed data feeds, i.e. perception and awareness • Use case information • Technology implementation know-how	• Aggregated data and analysed data feeding their management systems • Information about existing innovations, technologies, solutions, enhancement • Final user awareness • Data requirements
NGOs	• Use case information • Information about regulatory framework • Information about funding sources and open calls	• Aggregated data and analyzed data feeding their own decision systems
Government	• Information about regulatory framework and administrative frame conditions (i.e. budget information) • Information about funding sources and open calls	• Aggregated data and analysed data feeding their information systems
Academia	• Existing raw data or aggregated data (i.e. object tracks)	• Aggregated data and analysed data (i.e. analysed tracks) feeding their further R&D and educational activities • Data requirements

TABLE 1: INFORMATION FLOW BETWEEN I-SEAMORE AND ITS STAKEHOLDERS

3.2 Product/Service flow

The product/service flow within the value stream analysis encapsulates both tangible and intangible deliverables that contribute to the project's overarching objectives. At its core, this flow involves the systematic development, testing, and deployment of critical components such as aerial surveillance technologies, sophisticated software platforms, and seamlessly integrated systems.

As these elements undergo a meticulous creation process, they coalesce into a suite of deliverables. These encompass not only the physical tools and technologies but also the intangible outputs that hold substantial value. The culmination of this process results in the generation of comprehensive surveillance reports, real-time threat alerts, and a spectrum of analytical products and services that carry actionable insights.

The journey doesn't conclude with the creation of these deliverables; instead, they are delivered to end-users. This final step ensures that the tangible and intangible outcomes of the project reach the hands of those who can leverage them for informed decision-making and strategic implementation. In essence, the product/service flow in the value stream analysis is a seamless progression that transforms innovative concepts into tangible tools and insights, ultimately serving the needs of the end-users and stakeholders alike.

Examples of value exchange based on product/service flow are illustrated in the following table:

Stakeholder groups	Product/Service input provided to I-SEAMORE	Product/Service output received from I-SEAMORE
Border Authorities and Law Enforcement Agencies	• Access to existing facilities and operation control systems (radars, cameras, sensors, etc.)	• HW, SW, systems and services, i.e. surveillance systems, to emerge detection of high-risk maritime targets
Businesses	• Providing systems, HW, SW and services for procurement (USV, UAV, GCS, payloads, etc.) • Services for anomaly detection, behaviour prediction, intent analysis • Providing training services • Providing web and cloud hosting services	• PoC services and testing for innovative technologies • Enhancement and improvement of provided systems, HW, SW and services
NGOs	• Access to existing facilities and operation control systems (radars, cameras, sensors, etc.)	• Analysis and alert services • Collaborative use of equipment
Government	• Facilities and properties for testing	
Academia	• Services for anomaly detection, behaviour prediction, intent analysis	

TABLE 2: PRODUCT/SERVICE FLOW BETWEEN I-SEAMORE AND ITS STAKEHOLDERS

3.3 Quality-of-Life flow

The Quality-of-Life flow within the value stream analysis focuses on the transformative benefits that the project bestows upon society and individual lives. At its essence, it serves as a beacon highlighting the positive repercussions of the project's endeavours. The heartbeat of this flow lies in the tangible improvements realized through enhanced maritime surveillance. Safer sea routes, as a direct outcome, contribute significantly to the mitigation of piracy, smuggling, and other maritime threats. This, in turn, creates a ripple effect, positively impacting coastal communities and maritime industries.

The dividends of improved security and reduced risks are manifold. Coastal communities experience a newfound sense of safety and resilience, fostering economic and social stability. Maritime industries, too, reap the rewards as they operate within a secure and conducive environment. In essence, the Quality-of-Life flow doesn't merely measure project success in technical terms; rather, it paints a vivid picture of how the project translates into real-world benefits, fostering a safer, more stable, and prosperous society.

Examples of value exchange based on quality flow are of life illustrated in the following table:

Stakeholder groups	Quality of Life input provided to I - SEAMORE	Quality-of-Life output received from I-SEAMORE
Border Authorities and Law Enforcement Agencies	• Real scenario testing opportunities • Use case scenarios for solving law enforcement challenges	• Compliance with ethics principles • Enhanced security and safety • Enhanced decision reliability • Efficiency increase
Businesses	• Use case scenarios for solving business challenges • Secure cloud infrastructure	• Compliance with ethics principles • Enhanced security and safety • Enhanced decision reliability • Efficiency increase
NGOs	• Use case scenarios solving societal challenges • Ensuring Compliance with ethics principles	• Compliance with ethics principles • Enhanced security and safety • Enhanced decision reliability • Efficiency increase
Government	• Ensuring Compliance with ethics principles • Provision of legal framework	• Compliance with ethics principles and law • Enhanced security and safety • Enhanced decision reliability • Efficiency increase
Academia		• Compliance with ethics principles • Enhanced security and safety • Actionable info, informed decision making

TABLE 3: QUALITY-OF-LIFE FLOW BETWEEN I-SEAMORE AND ITS STAKEHOLDERS

3.4 Money flow

The money flow within the value stream analysis is a critical facet that tracks financial exchanges. At its core, this process revolves around the intricate dance of funding sources providing the necessary financial resources to develop and implement the I-SEAMORE system. As these funds are injected into the project, they find purpose in various avenues. The money is strategically spent on vital components such as research and development (R&D), the procurement of cutting-edge technologies, the seamless integration of systems, and the essential operational costs that keep the project moving forward.

The money flow isn't unidirectional. The potential for monetization emerges as an important aspect. Through avenues such as licensing, strategic partnerships, or service fees, there exists an opportunity to recoup investments and, in turn, return financial value to the initial funding sources. This cyclical process not only sustains the project but also introduces avenues for growth and financial sustainability, creating a dynamic and self-reinforcing ecosystem within the broader value stream analysis.

Examples of value exchange based on money flow are illustrated in the following table:

Stakeholder groups	Financial input provided to I-SEAMORE	Financial output received from I-SEAMORE
Border Authorities and Law Enforcement Agencies	• Purchasing price for the technical architecture or components of it	• Royalties, licensing fees or sales revenues from sub-licensing or reselling scenarios • Compensation for non-confidential data sharing
Businesses	• Sponsoring or donation of HW/SW/services etc. • Payments for shared data or shared services • Investment opportunities	• Compensation for provided services, systems, HW, SW, etc.
NGOs	• Sponsoring or donation of HW/SW/services etc. • Payments for shared data or shared services	• Royalties, licensing fees or sales revenues from sub-licensing or reselling scenarios • Compensation for non-confidential data sharing
Government	• Grants and co-funding for development and installation	
Academia		• Joint funding schemes for collaborative research • Funding enhancements of implemented systems

TABLE 4: MONEY FLOW BETWEEN I-SEAMORE AND ITS STAKEHOLDERS

3.5 Aid flow

The aid flow in this value stream analysis encompasses providing a comprehensive range of assistance, support, and resources aimed at ensuring the success of the I-SEAMORE exploitation. This support includes:

- Technical Support: This involves assistance from aerial technology vendors, expert consultations, and the sharing of resources among European maritime entities. It encompasses expertise and resources needed for utilizing advanced aerial technologies effectively within the project
- Collaborative Support: In addition to technical assistance, collaborative support is provided by local governments, municipalities, and other stakeholders. This collaborative effort involves coordination, cooperation, and shared resources to achieve project goals and address challenges collectively.

Together, these elements of support create a robust framework for the project's success, combining technical expertise with collaborative efforts from various stakeholders to optimize project outcomes and ensure effective utilization of resources. However, main stakeholder driving the aid flow is a governmental agency, i.e. applying tax advantages of complementary funding for installation elements of the of I - SEAMORE architecture. Aid flow can also be contributed in form of fast authorization of test flights of UAVs.

3.6 Decision flow

The decision flow in this value stream analysis maps the decision-making processes and channels within the project. Strategic decisions related to technology adoption, system integration, and deployment are made by core project teams. Consequently, feedback loops with stakeholders, like maritime authorities and local governments, shape operational decisions. For successful technology deployment regular reviews and evaluations will guide refinements, upgrades, and expansion decisions. When law enforcement agencies or border protection authorities are considering implementing I-SEAMORE solutions, several key elements of decision support can be crucial in guiding their approach. These decision support elements include:

- Risk Assessment: conducting a comprehensive risk assessment to identify existing and potential threats at maritime borders;
- Risk Analysis: analysing the potential impact of deploying new technologies on mitigating identified risks;
- Technology Feasibility Assessment: considering factors such as cost, scalability, reliability, and compatibility with current systems;
- Cost-Benefit Analysis: performing a thorough cost-benefit analysis to evaluate the financial implications of technology adoption;
- Training and Capacity Building: planning for training programs to equip personnel with necessary skills to operate and maintain the new technologies effectively;
- Data Management and Privacy Considerations: addressing data management and privacy concerns associated with collecting, storing, and processing sensitive information;
- Data Security Management: implementing robust cybersecurity measures to protect data integrity and prevent unauthorized access;
- Regulatory and Legal Compliance: ensuring compliance with national and international laws, regulations, and ethical standards relevant to border protection technologies;
- Continuous Monitoring and Evaluation: establishing mechanisms for ongoing monitoring and evaluation of technology performance and impact on border protection objectives.

By integrating these decision support elements into their planning and implementation processes, law enforcement agencies and border protection authorities can enhance the effectiveness and sustainability of new innovative technologies for securing maritime borders and safeguarding national security. Consequently, this decision flow is reflected in the value stream analysis in a triangle cooperation between I-SEAMORE, governmental agencies and law enforcement agencies/border protection authorities.

All these relations (value flows) between the different participants in the I-SEAMORE ecosystem may vary between each group of stakeholders. Therefore, the essential contributors to the business modelling in this domain have to be considered separately to understand the specific interests of benefits in their participation. For a successful commercial exploitation of the I-SEAMORE architecture it is of utmost importance engaging with a variety of stakeholders to gather and reflect their diverse perspectives. This is addressed in the following chapter.

4 VALUE GENERATION SYNTHESIS

The main point of the Stakeholder Value Flow Analysis is to get an overview about the interaction of the different flows. Which flows are based on other flows? Which flows have contrary aims in their characteristic needs, for example to get what kind of service at what type of compensation (= money flow). Out of the results and models of this value flow analysis one can recognize for example obstacles by or during implementation of I-SEAMORE components and its related services. In addition, the knowledge about the desires, needs, and expectations of each stakeholder group can be very helpful for future technical implementation of value streams as well as for their promotion and sustainable operations.

The flow of information refers to the transmission, processing, and feedback of data and information. It begins with the collection of maritime surveillance data using aerial technologies. Data is then analysed and transformed into actionable insights, which are provided to Maritime Authorities in charge. Stakeholders exchange feedback, operational reports, and updates, ensuring the ecosystem remains informed and adaptive.

The product/service/systems flow represents the tangible and intangible deliverables of the project: Aerial surveillance technologies, software platforms, and integrated systems are developed, tested, and deployed. Surveillance reports, threat alerts, and other analytical products are delivered to end-users.

This leads to the quality-of-life flow, highlighting the benefits to society and individual lives as a result of the I-SEAMORE project: Improved maritime surveillance can lead to safer sea routes, reducing piracy, smuggling, and other maritime threats. Coastal communities and maritime industries benefit from enhanced security and reduced risks, leading to economic and social stability.

Those benefits of value flows impact and motivate money flows, financial exchanges throughout and after the project's lifecycle, starting with funding sources (like the EU or other investors) providing financial resources to develop and implement the I-SEAMORE system. Money is spent on R&D, procurement of technologies, system integration, and operational costs. Potential monetization through licensing, partnerships, or service fees may return investments to the funding sources.

The impact of the money flow can be leveraged by aid flow, mainly provided by governmental agencies. Finally, decision support is an additional flow of values, establishing feed-back loops between I - SEAMORE and its stakeholder groups.

4.1 Value Stream Synthesis

The risk of those complex value generation models is a potential dilution into many different business scenarios. To avoid diluting resources and weakening the impact of the I-SEAMORE commercial exploitation, the implementation and realization strategy hast to identify a clear focus with well-defined steps to access the market actors successfully.

According to the desk research and stakeholder interviews, which were conducted, one of the most important ecosystem stakeholders are law enforcement agencies/border protection authorities (hereinafter also referred to as “Maritime Authorities”). These are the individual – mostly governmental - entities that purchase supplies, hire resources, integrate new components into existing operations control systems, thus playing a major role in the sector. They are also the driver of the maritime safety being the main contributor to the maritime border security. Therefore, we will focus the value generation synthesis mainly (but not exclusively) on the law enforcement agencies/border protection authorities as key stakeholders with orientation on the value created by the I-SEAMORE system especially in the selected use cases.

The figure 4 below shows the flow of values (Data, HW, SW) from I-SEAMORE as value provider (B_1 - in this illustration as a consortium and in a later stage eventually as a commercialization entity) to law enforcement agencies/border protection authorities (G_1). Border Force contributes to value generation by providing regular progress updates. They use data feeds in the program, like satellite imagery, radar tracking, etc. In terms of practical demonstration, they showcase the system's capabilities in real-life scenarios. On the consumption end, they frequently suggest system improvements based on experiences in challenging environments, such as maritime settings, and focus on improving the detection of high-risk maritime targets. So, they incur an Information Flow back to I-SEAMORE as well as a Decision Flow (e.g. on interfaces, cybersecurity requirements, etc.).

Development, installation and testing in this specific case is funded by the European Commission (G_2), which determines the money flow to both actors (B_1 and G_1). I-SEAMORE procures the HW (e.g. UXVs) and the SW (e.g. visualization systems) from industrial partners (B_2) and the platform technology as well as integration services from academic partners (A). They are also financially supported by the European Commissions' project funds and both groups are receiving Information flow back from I-SEAMORE:

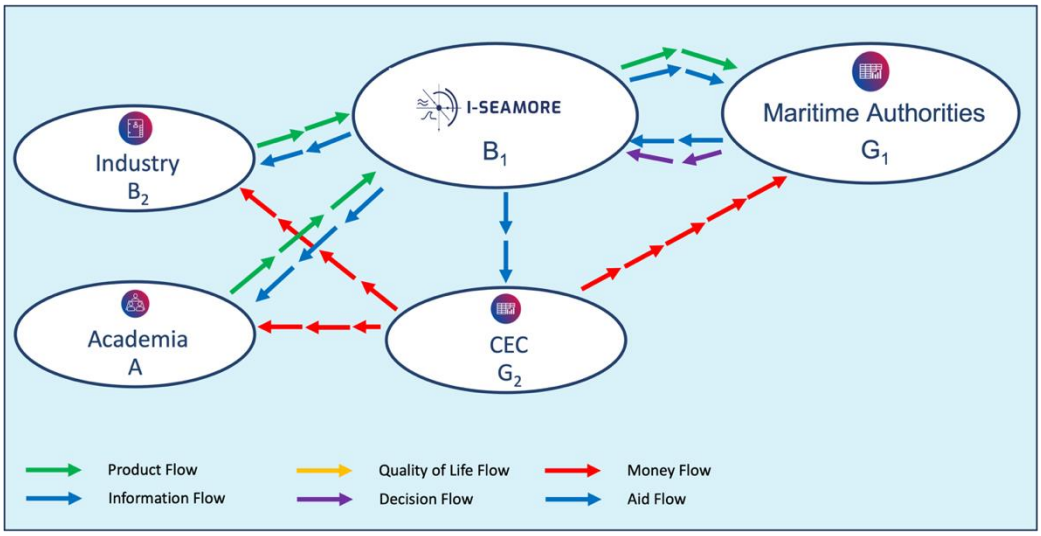

FIGURE 4: VALUE STREAM SYNTHESIS – BASIC INITIAL FLOW OF EXPLOITATION VALUES[4]

This basic initial flow of values will be of higher complexity, especially in a later commercialization stage: law enforcement agencies/border protection authorities (G_1) would reimburse the I-SEAMORE entity (B_1) for delivered HW/SW/systems/services, which constitutes a money flow back from G_1 to B_1. They could be supported by national governments (G_3) through grants or decision support (for instance in procurement processes). Data being generated to support decisions – in cases in which they are not strictly confidential - within these agencies may be partially shared with NGOs (N_1), i.e. for catastrophic prevention or rescue purposes. Data may also be shared with universities and RTOs (A). Academia consumes these data by analysing data tracks, detecting any anomalies, and making informed decisions based on the derived information, i.e. to train deep learning algorithms. The figure 5 below shows these additional flows of values:

[4] © INI-Novation GmbH

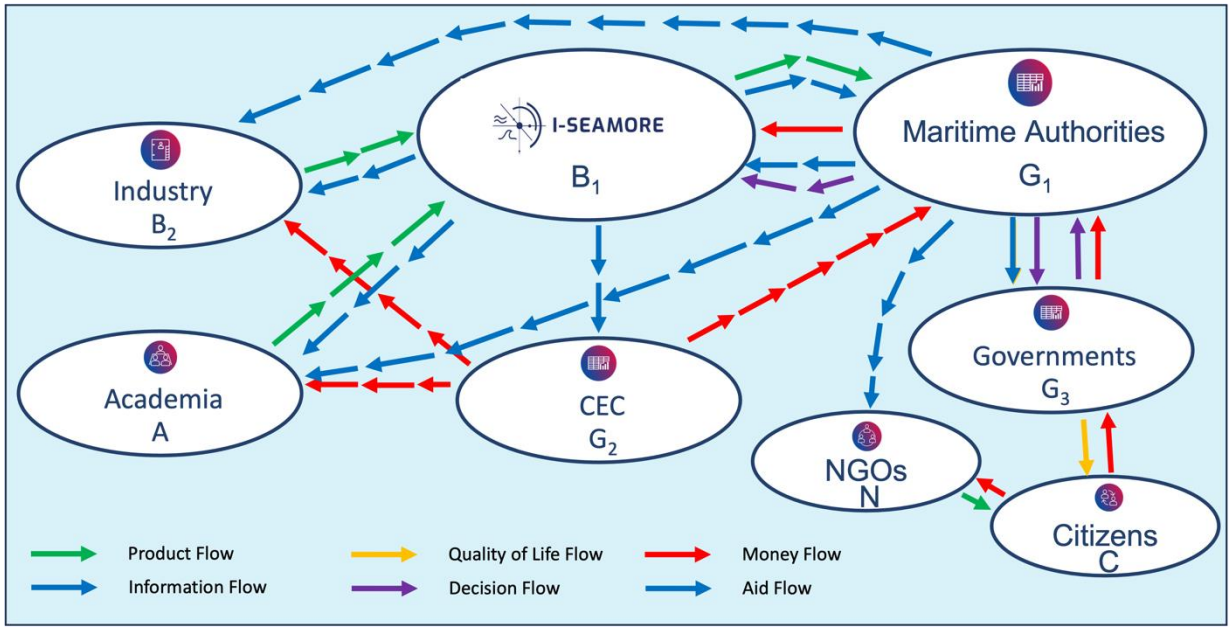

FIGURE 5: VALUE STREAM SYNTHESIS – EXTENDED FLOW OF EXPLOITATION VALUES [5]

One could recognize there are even more bubbles and streams: The installed I-SEAMORE platform and related services may be offered by G_1 to busines entities or to academia for testing purposes, which would constitute a money flow from those stakeholders back to G_1. But also, other business entities are playing an important role: IT services providers (B_2) are not only interested in providing cloud services to G_1 or to the business entities that deploy the I-SEAMORE systems or its components. They might also be interested in data sharing with both stakeholder groups. Data sharing could, for instance, create value streams by providing, for instance, lists of service offerings and service descriptions and to consume e.g. forecasts, benchmarks etc. According to the results of the already mentioned desk research and stakeholder interviews also infrastructure providers (also B_2) expressed significant interest in playing provider and/or consumer roles in the context of communication service offerings and data exchange. Private System Provider (also B_2), operating in the defence and robotics sector, provide use cases, I-SEAMORE architecture system data, and European subventions. Their consumption revolves around sensor data, UxC information, payloads, and support in training and documentation. All bubbles and streams constitute the main value generation opportunities. The connection can even be $B_1 2 B_n 2 C$ or $B_1 2 G_3 2 C$. "C" describes the citizen, who could benefit from a quality-of-life flow in terms of higher security and safety. Even a flow from "N" to "C" could be possible in terms of services from NGOs (i.e. rescue services) to end consumers "C", which is compensated financially either directly by the customers or by a governmental agency (G_3). In return, the tax payment runs from customer and business to the government. It is the foundation for aid.

It becomes obvious that there is a variety of values incurred by I-SEAMORE to many different stakeholder groups. Too many, to capture it easily in a graphical chart. Anyhow, the main point of this value generation analysis and synthesis is to get an overview about the interaction of the different flows, for example how to get the best service and an adequate financial compensation.

[5] © INI-Novation GmbH

4.2 I-SEAMORE 's multi-sided business model

Conclusion of the value generation analysis and synthesis is that all stakeholders in the maritime border protection domain interact in a broad and complex ecosystem. Consequently, in general terms the I - SEAMORE business model could be regarded as a platform specifically targeted to the needs of very heterogeneous stakeholder groups, but with the core focus of responding to the challenges of law enforcement agencies and border protection authorities. So, it must be acknowledged well that the business model will knit together products, people and processes, related to the wide range of additional options for value creation available. Understanding the interactions between different stakeholder groups (segments) leads to the development of so-called multi-sided business model:

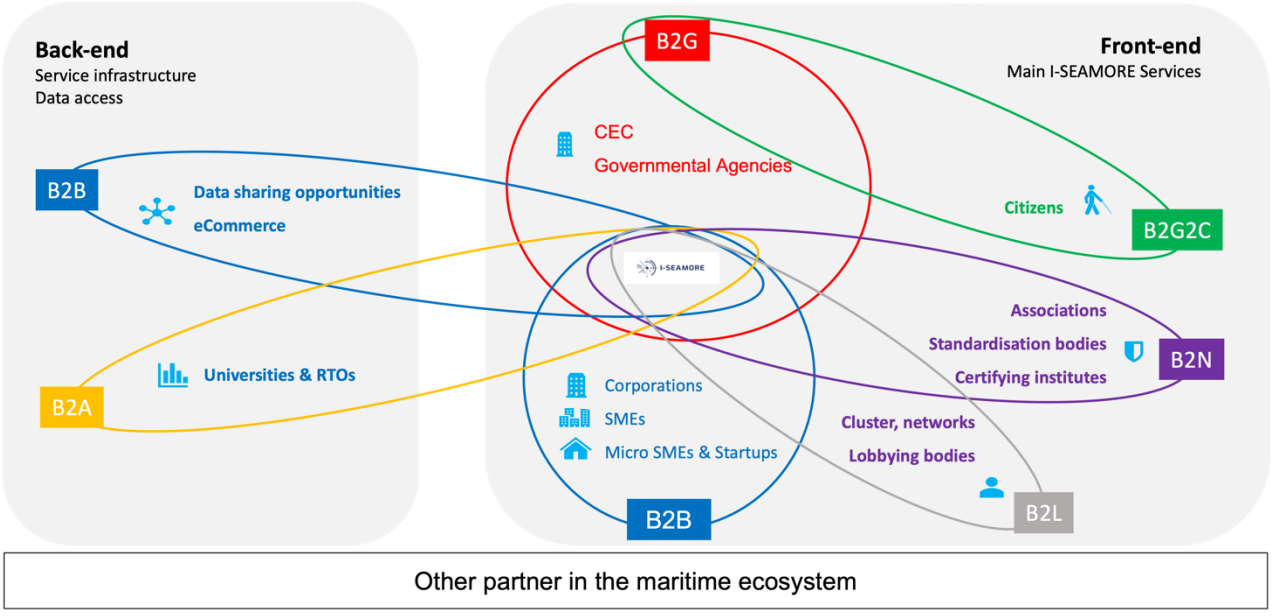

FIGURE 6:: I-SEAMORE'S MULTI-SIDED BUSINESS MODEL[6]

Figure 6 illustrates the consolidated value chains towards value delivery. As result of the value-chain analysis and synthesis tasks it can be stated that the system may enable or contribute to one or several impacts within the very heterogeneous stakeholder groups in the maritime sector. To that end, commercialization activities should aim at delivering results that are directed at so-called "front-end customers", as well as contributing to stakeholder in the so-called "back-end":

These sides differ in the form of general value proposition offered (see "Stakeholder Values" as described in the tables in chapter 3 above). On the front-end there are the several possible main customer segments, which may be addressed individually or combined (e.g., B2B or B2G or B2G2C). The segments are composed by customer groups, which are targeted in a similar manner (e.g., regarding sales and distribution channels). Key partners, strategic partners and regular partners support I-SEAMORE's business model per segment or across segments and sides (e.g., government).

The goal of a commercial exploitation of the I-SEAMORE architecture as a whole or its components is to orchestrate the match and interactions of ecosystem participants and to create customer values, which will impact a "willingness to pay". While products have features, platforms have communities, and, consequently, this future business can be accomplished best in a so-called platform business model. Platforms are often associated with digital technologies and have become prominent in the modern economy due to their ability to leverage network effects and provide innovative solutions for various industries or various industry segments.

[6] © INI-Novation GmbH

The differences of this multi-sided business model (also called “platform model”) to traditional linear business models lie in their structure, value flow, and interactions:

- **Linear models**: A linear business model is a traditional way that businesses operate, scale and grow with the focus on producing and delivering products/services directly to customers via a supply chain. Value flows one way from one entity to another one. Interactions are limited, and revenue comes primarily from product/service sales. Linear business models have been dominant models in world’s businesses.
- **Platform models**: The focus of a platform model is on creating and managing an ecosystem that connects multiple participants and user groups and to facilitate interactions and value exchanges between them. The entity that deploys the I-SEAMORE system acts as an orchestrator and generates revenue from various sources related to the platform's activities.

In this synthesized business modelling approach, the value chains are designed to find out, where the value creation is generated. Porter created “Value Chain” as a term: his value chain consists of a “set of activities that are performed to design, produce and market, deliver and support its product.” [2]To focus more on the delivery, for instance, to ask when the customer would be willing to pay for the I-SEAMORE products or services, the activities before marketing (i.e. production and logistics, etc.) are ignored in this value and service chain design.

For every individual role, it is crucial to understand the value creation and value capturing by individual participants, and the overall value created. This overall value created is a governed secure data and information exchange for an improved surveillance of the maritime environment. In order to make business models sustainable principles such as "sharing" and “smart services" should be considered: “Sharing” in the value chain means to involve all stakeholders who are connected to each other [3]. These identified stakeholders perform interactions and services, and, if those are well combined, added value can be created. To meet the constantly increasing needs and expectations of customers, the principle of “Smart Service” should be regarded as a solution. These are often more complex bunch of services that contribute to improved support for its users. On a platform like I-SEAMORE there is the option that other value adding partners can be included. “The more service you could offer to your customers, the more value can be generated” [4]. Interactions within partnerships are described as value propositions in the referring chapter below.

Before addressing those propositions, special attention is paid in the following chapter to the technical architecture of I-SEAMORE as well as to the enabling use cases to understand better the level of services that could be provided during the interactions of I-SEAMORE with its various stakeholders.

5 I-SEAMORE SYSTEM ARCHITECTURE AND USE CASES

5.1 System Description

The I-SEAMORE ecosystem is a common and innovative environment for the simultaneous and cooperative deployment and operation of various technologies for maritime surveillance. Such technologies could be unmanned aerial and water surface assets, data fusion mechanisms, services and tools, as well as the entire infrastructure required for computation and communication. The primary objective of I-SEAMORE is to bolster European authorities' situational awareness and operational capacities in the realm of maritime surveillance operations.

The central platform, encompassing both infrastructure and software components, is envisioned to be deployed and managed at Maritime Operations Centres (MOCs). These MOCs are equipped with interfaces to interconnect with other systems, including Ground Control Stations (GCSs) for Unmanned Vehicles (UxVs). The platform offers end-users a comprehensive solution capable of performing a multitude of versatile tasks. These tasks encompass extensive monitoring of maritime borders and coastal areas, analysis of potential threats, support for search and rescue operations, and the detection of illicit activities, among other functions.

The core of the I-SEAMORE ecosystem of technologies is the I-SEAMORE Operation Platform, which facilitates the automation of operation cycles, orchestrating various systems and assets in use, including the network and data centres infrastructure. There are various platforms available that provide a solution that integrates the components (e.g., virtualization runtime, container runtime, distributed storage, networking) to run a flexible, scalable, high available cluster. Examples of these potential solutions are Open Network Automation Platform (ONAP), Harvester, OpenShift and Canonical Charmed Kubernetes. Most of these solutions are very well suited for the deployment of containers. However, these solutions are not well fitted for virtual machines. Some of these solutions also require license fees or are overly complicated for the I-SEAMORE purpose. For the afore-mentioned reasons, the choice was made to use Harvester for the I-SEAMORE orchestration platform. Harvester is a Kubernetes managed hypervisor with an additional layer added to run Kubernetes container clusters. Together with their management tool Rancher, this solution provides a solid basis for the I-SEAMORE orchestration platform. Its modular and extendable nature allows for a smoother and faster integration of supplementary assets, data, or tools within the I-SEAMORE Ecosystem, thus enabling the scalability of the platform and advancing the creation of a collaborative and facilitating environment to support future operations carried out by multiple authorities.

By ensuring the open and scalable design of the I-SEAMORE platform from the beginning, the consortium partners aim to develop a complete platform, capable of managing the operation of multiple assets and systems with advanced maritime surveillance capabilities that can be easily deployed and operated at numerous European MOCs. At the beginning, the I-SEAMORE platform will focus on four key areas, which are considered fundamental for the requirements of the MOCs, and which will be fundamental for introducing more advanced applications at a later stage. The four key areas are:

- Operating unmanned assets for continuous maritime surveillance, including long-endurance aerial and water surface platforms;
- Using heterogeneous data sources through innovative sensor payloads and open data sources, including Copernicus-based services;
- Enabling shared situational awareness and operational pictures, empowered by novel and comprehensive suite of data fusion services, based on Artificial Intelligence (AI) and Big Data Analysis; and
- Ensuring the interoperability within the Ecosystem and its interface with key external systems using a Common Information Sharing Environment (CISE).

The pivotal feature of the I-SEAMORE platform is its software layers, which incorporate a range of dedicated services and tools. These elements grant a mission commander access to a complete array of functionalities and capabilities. This includes the provision of a shared operational picture, the ability to activate and indirectly task various types of Unmanned Assets, including those from multiple authorities.

Figure 7 below illustrates the High-Level Architecture of the I-SEAMORE Ecosystem

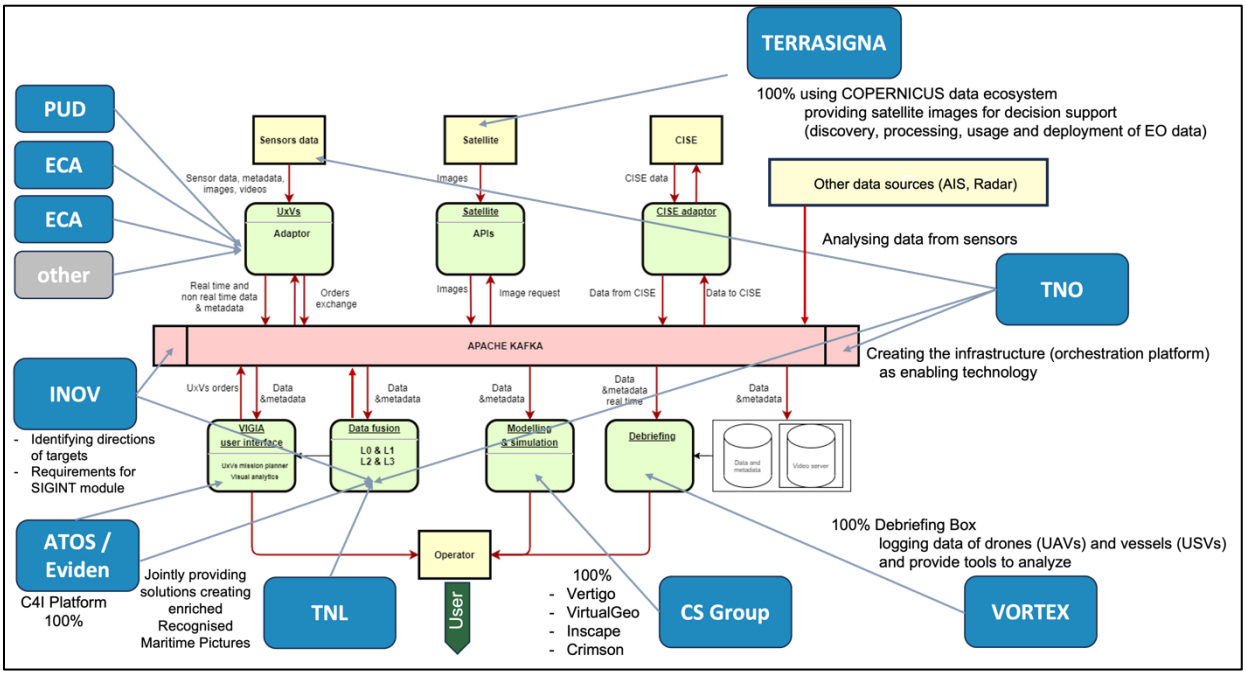

FIGURE 7: ARCHITECTURE OF THE I-SEAMORE ECOSYSTEM[7]

The architecture encompasses a range of components, i.e.

- Data fusion applications that extract valuable insights from the collected data;
- I-SEAMORE 's structural services that ensure data persistence and secure on-demand communication; as well as
- Applications and services that leverage these resources to deliver the essential functionalities required by end users.

To ensure accessibility in diverse contexts, the user-facing services & frontend layer offer web-based interfaces designed for Maritime Operations Centres (MOCs) and assets in operation. These interfaces incorporate user authentication and authorization features, providing different portals and functionalities tailored to various teams, all built on a foundation of secure communication.

These functionalities represent the value added by I-SEAMORE to end users, achieved through the integration of cutting-edge sensing technologies and AI-driven data processing, enabling advanced services for border monitoring. Within this framework, the platform assumes a pivotal role by harnessing automation to facilitate the timely deployment of the entire systems or its components, making them readily available on demand. Thereby, the core focus is put on the use cases briefly summarized below.

[7] © The I-SEAMORE consortium

5.2 Use Cases:

Use cases for I-SEAMORE technological solutions are presented in Section 2 of D3.3 "Operational Concepts, KPIs and User Requirements". This paragraph briefly represents the main content of that chapter for the purpose of the identification and illustration of user requirement and related customer values.

The use cases identified within the project are related to two complex and multifaceted issues that affect the European territory: irregular migration and drug smuggling. Both challenges require enhanced collaboration among authorities, improvements in data sharing and data elaboration, especially in relation to maritime surveillance. In this sense, the setting up of practical scenarios would help in evaluating the efficacy and effectiveness of I-SEAMORE solutions vis-à-vis these challenges.

5.2.1 Detecting unauthorized border crossing:

The occurrence of unauthorized border crossings has become a growing concern in recent years. In 2022, there was a significant surge of 64% in irregular border crossings, marking the second consecutive year of a steep rise in the number of unauthorized entries. This is the highest number since 2016, as reported by FRONTEX, the European Border and Coast Guard Agency [5].

Exploiting the political instability in certain departure countries, organized crime groups have capitalized on the opportunity to facilitate the smuggling of migrants across EU borders. This alarming trend necessitates proactive cooperation among states to bolster detection and response capabilities. The urgency to address this issue has prompted a collective call for enhanced collaboration and concerted efforts to tackle the challenges posed by unauthorized border crossings.

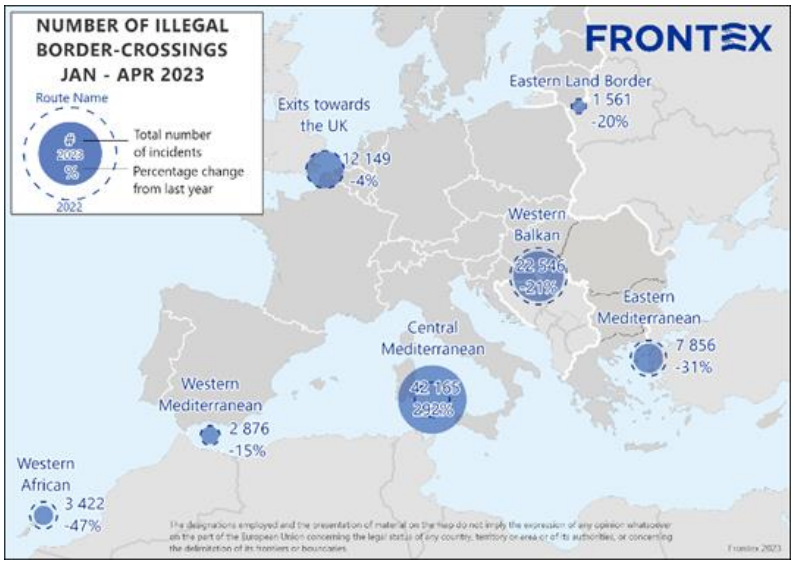

FIGURE 8: NUMBER OF ILLEGAL BORDER-CROSSING JAN-APR 2023

In this use case, the primary focus is on the detection of unauthorized border crossings and propose strategies to mitigate this pressing issue. By leveraging advanced technologies, data analysis, and improved cooperation mechanisms, we aim to enhance the capabilities of border authorities in promptly identifying and responding to such activities. The goal is to demonstrate an efficient and proactive framework that strengthens border security and ensures the integrity of EU borders in the face of evolving threats posed by organized crime groups.

This specific I-SEAMORE use case revolves around irregular migration occurring in the vicinity of the maritime borders between Spain and Portugal. It involves a scenario wherein a vessel carrying migrants attempts to reach the European coast while intentionally avoiding the reporting of AIS (Automatic Identification System) signals to evade detection. The situation unfolds during the early hours of the morning, characterized by foggy conditions and low sunlight.

Within this challenging environment, the primary objective is to demonstrate the employ of advanced technologies that enable the timely detection and interception of the migrant vessel present in the I - SEAMORE system. By leveraging sophisticated surveillance systems, such as radar and thermal imaging, combined with data analytics and pattern recognition algorithms, the aim is to enhance the capabilities of border authorities in identifying and tracking vessels engaged in irregular migration.

Given the foggy conditions and limited visibility caused by low sunlight, the use case emphasizes the need for specialized sensors and enhanced situational awareness tools. By integrating weather data, real-time environmental monitoring, and advanced imaging technologies, authorities can optimize their detection capabilities and effectively counter the efforts of migrants attempting to exploit these conditions for covert entry.

The successful implementation of this pilot use case will not only enhance the functionalities and capacity of the I-SEAMORE ecosystem but also serve as a crucial step towards improving border security and the enforcement of migration policies.

By leveraging advanced technologies in challenging maritime environments, we aim to ensure the safety of both migrants and the communities involved while upholding the integrity of border control measures. The I-SEAMORE system's novel services, running at the Maritime Operation Centres, perform a comprehensive assessment of the situation by combining various types of data. This analysis confirms that the detected target is indeed a vessel carrying migrants, triggering the generation of an alert. The alert is automatically generated by the I-SEAMORE services, employing fusion techniques, anomaly detection algorithms, and threat assessment functions.

The Mission Commander, overseeing the operation in near real-time from the MOC, takes immediate action and instructs the PUD's UAV 'ONE 150' to lower its operating altitude, allowing for the utilization of electro-optical cameras to conduct a closer analysis of the situation. Concurrently, the Mission Commander communicates the predicted path of the vessel to the relevant authorities responsible for interception (interception can be done by use of a fast boat, or a Coastal Patrol Vessel).

Upon analysing the gathered information, it becomes evident that the vessel is overcrowded, posing a significant risk to the lives of its occupants. This crucial insight is promptly communicated to the authorities, highlighting the pressing need for intervention.

As the authorities' boat swiftly moves towards the interception location, which is being continuously updated in near real time, it successfully intercepts the vessel carrying the migrants. Meanwhile, the PUD's UAV remains stationed in the vicinity, gathering valuable intelligence and providing ongoing situational awareness to the MOC. Simultaneously, the Mission Commander tasks the operators of an USV, known as to navigate towards the incident site, actively supporting the search and rescue operations. Equipped with specialized resources like additional lifebuoys and life jackets, the USV plays a vital role in ensuring the safety and welfare of those in distress. The following table summarizes the main aspects of this use case:

Use Case Summary: Preventing Irregular Migration	
Issue in a nutshell	Irregular migration across EU borders has surged by 64% in 2021, indicating a growing concern and the need for proactive measures to detect and mitigate unauthorized border crossings, exploited by organized crime groups. Enhanced collaboration among States is imperative to address this challenge effectively.
I-SEAMORE objective	Detection of unauthorized border crossings and enhancement of timely response by operators, by leveraging advanced technologies, data analysis, and improved cooperation mechanisms.
I-SEAMORE use case scenario	The use case focuses on detecting irregular migration near the maritime borders of Spain and/or Portugal. It involves a scenario where a migrant vessel attempts to evade detection by not reporting AIS signals, exploiting foggy conditions and low sunlight. Advanced technologies like radar, thermal imaging, data analytics, and pattern recognition algorithms are employed to

Use Case Summary: Preventing Irregular Migration	
	enhance border authorities' capabilities in identifying and intercepting such vessels. Specialized sensors and situational awareness tools are crucial in optimizing detection in challenging maritime environments.
I-SEAMORE tested solution	The PUD UAV 'ONE 150' drone detects RF signals indicating the presence of humans in a suspicious maritime corridor, and I-SEAMORE 's services confirm the vessel as carrying migrants, triggering an alert. As the MOC performs a comprehensive assessment of the situation, the Mission Commander directs the UAV to lower altitude for monitoring, combining the activity with EO data analysis and coordinates interception efforts with relevant authorities. Authorities intercept the vessel, while the UAV and EXAIL's USV 'INSPECTOR MK2' provide ongoing support and gather valuable intelligence.
Customer value	Advanced technologies ensure effective detection and response to irregular migration, safeguarding both migrants and communities while upholding border control integrity.

TABLE 5: USE CASE NO 1: PREVENTING IRREGULAR MIGRATION

5.2.2 Smuggling of drugs

According to Giordana Aragno [6], the European Union has been actively promoting collaborative efforts among member states to combat the issue of illicit drug trafficking. The primary objective of this cooperation is to suppress illicit drug trafficking by sea through the enhancement of criminal intelligence and coordinated police action in international waters.

To achieve this goal, several measures are being implemented, including improved monitoring of ship movements and equipment within harbours, increased storage, sharing, and analysis of data collection, and a better understanding of the drug market, including estimations and demands.

When addressing the specific situation in the Mediterranean Sea and the Atlantic, both the Law of the Sea and criminal jurisdiction play important roles in covering the most relevant aspects of drug-related issues. However, in international waters, it is necessary to regulate through international agreements or with the consent of the flag state of the concerned ship.

One notable case scenario involves the transportation of narcotics by sea from Morocco to Europe, which has seen an increase in recent years. This route has been the focus of seizures off the coast of North Africa, with suspicions that some of the drugs were destined for Europe.

Current challenges faced by the end-users:

1. Obtaining early-warning for vessels exhibiting suspicious behaviour, particularly in remote maritime areas where detection is becoming increasingly difficult.
2. Enhancing cooperation and coordination in the utilization of UxVs to improve data collection and dissemination, all aimed towards a common goal;
3. Improving the technology systems employed as UxV payloads, thereby enhancing capabilities in scenarios characterized by low visibility or nocturnal conditions

The primary objective of this use case is to validate the I-SEAMORE solution, which involves the fusion of heterogeneous vessel information. It aims to detect anomalies, risks, and threats associated with the smuggling of illicit goods through persistent surveillance methods. Additionally, the use case aims to optimize the utilization of available resources and assets for mitigation and interdiction operations. Special attention will be given to information sharing and cooperation between adjacent member states, specifically Portugal and Spain, within the context of this scenario. The scenario will involve the integration

of diverse data sources such as UxVs' payload data, coastal surveillance radar data, AIS, satellite imagery provided by Copernicus services, and other relevant open-source data.

The smuggling activity in this scenario unfolds in the waters of southern Iberia and involves the utilization of small, fast boats as well as interaction with a merchant vessel. This illicit activity takes place during night-time, significantly increasing the challenges faced by the authorities in detecting the presence of drug smugglers.

In response to the detected suspicious behaviour, the I-SEAMORE solution initiates its coordinated actions: The merchant vessel, which has deviated from its original route and reduced its speed, is identified through the analysis of its AIS data and analysed by the algorithm that compares it with the normal routes, utilizing the dedicated data fusion services of I-SEAMORE . This comprehensive analysis triggers the generation of a suspicious activity alert, providing the Mission Commander at the MOC with crucial information about the specific area of interest and the observed suspicious behaviour.

The Mission Commander immediately shares the information with the unmanned systems of I-SEAMORE. These UAVs are deployed to survey the designated area of interest. Upon reaching the location, the UAVs successfully identify the presence of an additional smaller boat that is not transmitting AIS signals and is approaching the merchant vessel. These UAVs continuously provide real-time complementary data to the Mission Commander at the MOC, aiding in the situational assessment.

Simultaneously, the Mission Commander tasks a USV to collaborate and perform closer monitoring of the unfolding event. These assets work together to provide the necessary information for the identification of the illicit cargo. Furthermore, the Mission Commander activates the appropriate manned means to carry out the interdiction of the smugglers, effectively responding to the situation.

In this scenario, as the small boat attempts to flee, the Portuguese authorities swiftly initiate a pursuit to apprehend the suspects. During the pursuit, if the situation escalates and enters Spanish territorial waters, the control of the drone can be seamlessly transferred to the Spanish authorities. This cooperative approach ensures a coordinated and effective response, allowing for the uninterrupted monitoring and tracking of the fleeing boat across jurisdictional boundaries.

Use Case Summary: Preventing Smuggling of Drugs	
Issue in a nutshell	The European Union is actively combating illicit drug trafficking by sea, aiming to enhance criminal intelligence and coordinated police action in international waters.
I-SEAMORE objective	Fusion of heterogeneous vessel information in order to detect anomalies, risks, and threats associated with the smuggling of illicit goods through persistent surveillance methods. This will address the main challenges nowadays faced by end-users, namely: a) obtaining early-warning for suspicious vessels b) enhancing cooperation and coordination in the utilization of UxVs c) improving the technology system installed on UxVs, especially those related with potentiated operability in nocturnal and low visibility conditions.
I-SEAMORE use case scenario	The scenario involves the smuggling of narcotics from Morocco to Europe in the waters of southern Iberian Peninsula, focusing on night-time illicit activities with small, fast boats interacting with merchant vessels.
I-SEAMORE tested solution	The I-SEAMORE solution responds to suspicious behaviour by initiating coordinated actions. It analyses AIS data to identify a merchant vessel deviating from its route, triggering a suspicious activity alert for the Mission Commander. UAVs are deployed to survey the area and detect a smaller boat approaching the vessel. Additional UAVs and USVs collaborate to monitor the event, providing data for identifying illicit cargo. Manned means are activated for interdiction, with Portuguese authorities pursuing suspects, seamlessly transferring control to Spanish authorities if needed.

Customer value	This cooperative approach ensures an effective response, enabling uninterrupted monitoring and tracking across jurisdictional boundaries.

TABLE 6: USE CASE NO 2: PREVENTING SMUGGLING OF DRUGS

5.3 User requirements in the value generation chain

In order to capture the value generated for potential customer in the described use cases the requirements of potential customers have to be considered. By responding to the different requirements, the I - SEAMORE system can address specific solutions, that may be turned into customer values. As a result of co-creation workshops (conducted in the course of the project with participation of technology providers and system users), functional requirements were drawn, divided into AI-technology requirements, UXV-technology requirements and data integration/data fusion requirements. In the following tables those requirements for the I-SEAMORE system are listed and the corresponding customer values are assigned to the thus identified needs of the stakeholders:

AI technology requirements turned into customer values		
Requirement	Customer Need	Customer Value
Real-time data analysis	There is a common need of end users reduce human intervention and create alerts mechanics to avoid human continuous monitor process	AI can be used to analyse large amounts of real-time data generated by maritime surveillance systems, such as radar AIS, and satellite imagery, to provide insights into vessel movements, weather conditions and other factors that may affect maritime activities.
Object detection and classification	Detection of small boats	AI can be used to detect and classify objects in maritime imagery, such as vessels, buoys, and other maritime infrastructure, to support situational awareness and thread detection.
Anomaly detection	Reducing human intervention in central command system	AI can be used to identify anomalies in the maritime environment, such as unusual vessel behaviour or unusual weather conditions to support rapid response to emerging situations.
Automation of routine tasks		AI can be used to automate routine tasks, such as data processing and analysis, freeing up operators to focus on more complex and high-value tasks.
Integration of multiple data sources	Improving decision processes	AI can be used to integrate multiple data sources providing a comprehensive view on the maritime environment.
Improve decision making processes through increased awareness	Enhancing situational awareness	AI can be used to announce situational awareness by a more complete and up-to-date understanding of the maritime environment, including the location and movement of vessels, weather conditions and other factors that may affect maritime activities.

Decision-making in dynamic and rapidly evolving situations		AI can be used to support informed decision-making by providing real-time analysis of targe amounts, of data generated by maritime surveillance systems.

TABLE 7: OVERVIEW ON USER REQUIREMENTS AND AI-IMPACTED CUSTOMER VALUES

UAV technology requirements turned into customer values		
Requirement	Customer Need	Customer Value
Search and rescue operations	I-SEAMORE shall include UAV operation increasing the likelihood of a successful rescue.	UAV quickly search large ocean areas for survivors or debris, reducing response times.
Inspection and maintenance	I-SEAMORE Drones shall, reducing the need for human operators to work in hazardous environments.	Drones provide real-time situational awareness of the maritime environment by performing inspections of maritime infrastructure, offshore platforms and vessels.
Object Detection for Monitoring of illegal activities	I-SEAMORE Drones shall have the ability to detect in the maritime environment to monitor illegal activities in the maritime environment, such as smuggling, illegal fishing, and piracy	Drones provide near real-time intelligence that can support rapid response and enforcement operations
Multi-asset mission	The system shall have the ability to support multi-asset mission planning and execution (e.g., UAVs, USVs)	Benefit is multi-domain capability for mission management involving a diverse set of technologies.
Infrared Vision	The system should include Unmanned Surface Vehicles (USVs) with infrared vision for nocturnal detection is designed to enhance the USVs' ability to detect and track objects or activities during low light conditions, such as at night or in low light environments. This infrared vision should allow the USV to identify and track objects that may not be visible using conventional cameras.	USVs with infrared payload for nocturnal detection can detect and capture thermal images.

UAV technology requirements turned into customer values		
Requirement	Customer Need	Customer Value
Augmented SIGINT Capabilities	The system shall provide UAVs with augmented SIGINT capabilities (e.g. receivers and antennas capable of intercepting a wide range of frequencies, Onboard Processing, Secure Data Transmission and Resilience to Electronic Warfare)	UAVs with augmented SIGINT capabilities integrate multiple subsystems and technologies.
Pan-Tilt-Zoom (PTZ) cameras can provide UAVs (Unmanned Aerial Vehicles) with enhanced maritime monitoring capabilities.	The system shall provide UAVs with multiple PTZ for augmented maritime monitoring.	They offer the ability to adjust the camera's direction and zoom level remotely, enabling the UAV operator to focus on specific areas of interest in real-time: • Multi-Camera Coordination; • Advanced Imaging Capabilities • Stabilization and Vibration Reduction • Automated Tracking • Robustness to Weather Conditions • Data Transmission: The system should include secure, reliable, and high-bandwidth data transmission capabilities to send the video feed back to the operator in real-time • Power Management
Debriefing	I-SEAMORE shall have the ability to analyse the data collected during surveillance operations.	These can be a valuable resource for analysing and understanding the data collected during surveillance operations. One aspect of the tool could be the ability to annotate and visualize the data to support identification of trends, patterns and anomalies.
Increase data range transmission	I-SEAMORE drones should act as a relay to increase data range transmission in maritime surveillance operations.	By flying at higher altitudes, drones can establish a communication link with assets on the ground or at sea that may be outside of the range of traditional communication systems, such as radio or satellite communication.

TABLE 8: OVERVIEW ON USER REQUIREMENTS CUSTOMER VALUES IMPACTED BY UAV APPLICATIONS

Data integration and data fusion requirements turned into customer values		
Requirement	Customer Need	Customer Value
Data integration	Integrate Copernicus satellite data for maritime surveillance	Higher capability of receiving and integrating Copernicus satellite data for maritime surveillance.
Data storage	The I-SEAMORE system shall store Copernicus satellite data	Sufficient storage capacity allows managing large volumes of satellite data for maritime surveillance
Data processing	The I-SEAMORE system shall process Copernicus satellite data to create knowledge	Processing large volumes of satellite data in real-time, including images and other sensor data, allows to extract useful information for maritime surveillance.
Data processing	Web Interface for Copernicus satellite data.	Web Interface for Copernicus satellite data.
Unified data model	A unified data model to provide a comprehensive view of the maritime environment.	This unified data model enables improved information analysis and decreases data inconsistencies.
Use open standards for data exchange	Open standards shall be used for data exchange.	The use of open standards for data exchange will simplify publishing, accessing und using data for shared situational awareness and operational images. Seamless Integration seamlessly with other maritime surveillance systems will allow data cooperation, decrease costs for operation and increase information analysis.
Data integration from new sensors	The integration of data from new sensors should allow the system to evolve with information.	This will enable using new and improved payloads.
Data security	The system shall provide data security	This will ensure the confidentiality, integrity, and availability of Copernicus satellite data and other sensitive information related to maritime surveillance.

TABLE 9: OVERVIEW ON USER REQUIREMENTS AND CUSTOMER VALUES IMPACTED BY DATA INTEGRATION

These functional requirements and solutions may be summarized on the I-SEAMORE system level as follows:

- **Automated identification and tracking of vessels**: The system shall allow the automated classification of vessels, verify the correctness of the information gathered and calculate the degree of risk / interest of the vessels. This function will also allow validations, if identified routes of vessels con be considered suspicious.
- **CISE Connector Module**: The CISE connector facilitates the exchange of information between different surveillance systems by sharing data such as vessel positions or trajectories. It provides

information in real-time enhancing the situational awareness and improving the coordination of maritime surveillance across different organizations and borders.

- **Debriefing tool**: This tool supports analysing and understanding data collected during surveillance operations, impacting the ability to annotate and visualize acquired and processed data to identify trends, patterns and anomalies.
- **Visualization tool**: With the visualization tool data can be better understood and interpreted. The tools may include maps, charts, other graphical representations of data, allowing a visually supported overview of vessel movements, patterns and behaviour.
- **Annotation tool**: Annotations can be used to add context and insights to the data such as highlighting specific vessels or areas of interest, marking unusual events or behaviours and notifying incidents. Consequently, analysts are supported to quickly access and review relevant information.

6 THE VALUE PROPOSITIONS

The previous chapters described the I-SEAMORE use cases and their exploitation potentials. On the now following chapter we will focus on the customer values generated by I-SEAMORE. They will be addressed in the so-called "Value Proposition Canvas" for the two I-SEAMORE use cases "Preventing Illegal Immigration" and "Preventing Drug Smuggling".

6.1 Value Proposition Canvas

The Value Proposition Canvas is a strategic tool used in business and product development to design and refine value propositions that resonate with customers. It is part of the broader framework known as the Business Model Canvas, which helps organizations visualize and articulate their business models. The Value Proposition Canvas consists of the two following two main components as illustrated in figure 9 below: the Customer Profile (on the right side of the figure) and the Value Map (on the left side of the figure) [7]:

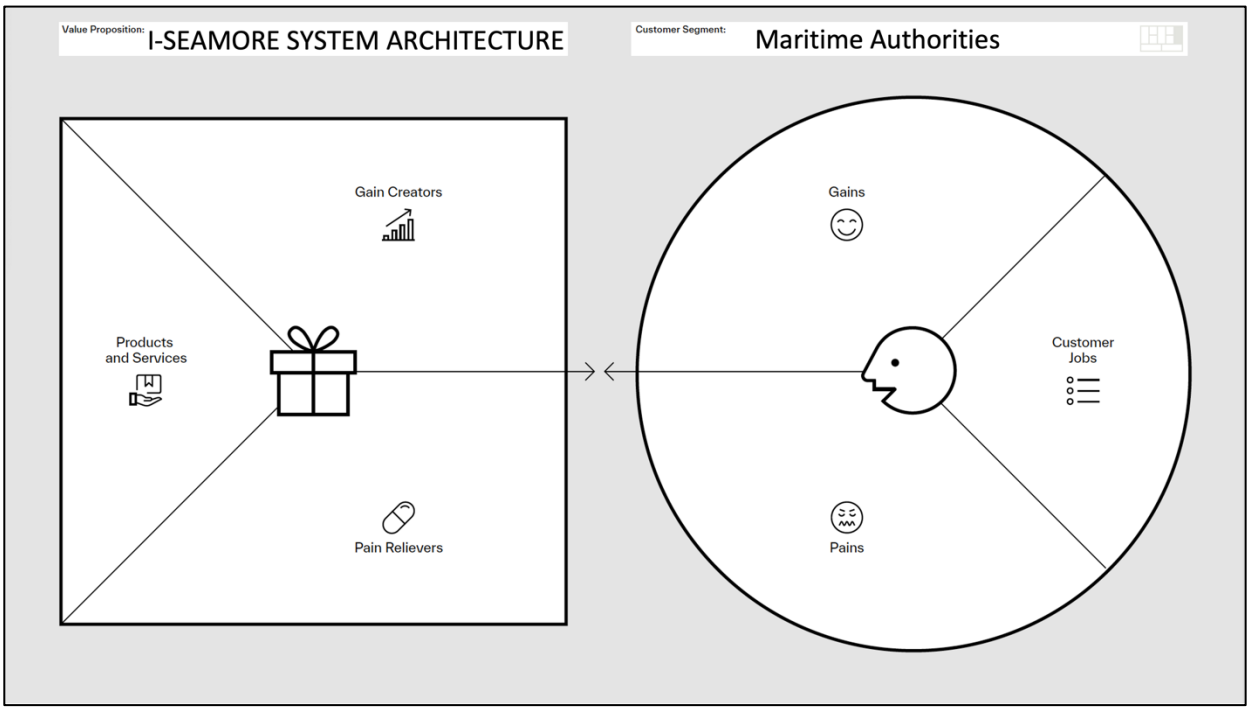

FIGURE 9: THE VALUE PROPOSITION CANVAS – GENERAL VIEW

1. The Customer Profile: focuses on understanding the customer segment targeted by a product or service. This section includes:
   - Customer Jobs: The specific tasks, problems, or needs that a customer tries to address;
   - Customer Pains: The challenges, frustrations, or negative outcomes that customers experience in trying to accomplish their jobs; and
   - Customer Gains: The desired outcomes, benefits, or positive results that customers seek when performing their jobs.
2. The Value Map: represents the value proposition offered by the product or service. This section includes:
   - Products & Services: The specific features, functions, or offerings that address the customer jobs, pains, and gains.

- Pain Relievers: How the product/service alleviates or eliminates customer pains.
- Gain Creators: How the product/service delivers the desired outcomes or benefits those customers seek.

The Value Proposition Canvas is - in this I-SEAMORE business modelling activity - used by cross-referencing elements from the Customer Profile with corresponding elements in the Value Map. This supports identification and articulation how the related products or services addresses specific customer needs, challenges, and aspirations; ultimately, how they I-SEAMORE products and services are creating value, in our case for Maritime Authorities as target customers. Key steps in using the Value Proposition Canvas include:

- Customer Understanding: Gather insights through customer research8 to identify customer jobs, pains, and gains.
- Value Proposition Development: Define and refine the value proposition by aligning product features with pain relievers and gain creators.
- Iterative Validation: Continuously test and validate the value proposition with customers to ensure relevance and effectiveness.

By using the Value Proposition Canvas, we can create compelling value propositions that resonate with the target customers, in this case with Maritime Authorities. Based on the outcome of this analysis, I - SEAMORE can differentiate the offerings in the market, and drive customer acquisition and satisfaction. It is also a practical tool for aligning product development and marketing efforts with customer needs and preferences.

When applying the Value Proposition Canvas to the I-SEAMORE system and its components we aimed at enabling the target authorities to prevent drug smuggling and illegal immigration to understand both the customer profile and the value map components. In the following the results are summarized for both use cases:

6.1.1 Value Propositions for the use case “Prevent Illegal Immigration”

1. Customer Profile (Maritime Authorities):

A. Jobs:

- Detecting and intercepting illegal immigration
- Identifying and apprehending individuals attempting illegal border crossings
- Ensuring national security and public safety at border checkpoints
- Reduce deployment in migration operations

B. Pains:

- Limited resources and manpower to monitor vast border areas effectively
- High risk of missing or overlooking illegal immigration due to manual surveillance
- Complex and evolving methods used by illegal immigrants to evade detection
- Increased human traffic makes border surveillance more difficult
- Need for detection of concrete quantity of people in a boat
- Lack of early detection capabilities

[8] In the course of the project, customer research was accomplished by 1-to-1 meetings of INI-Novation staff with project partners as well as by conducting a “value-proposition workshop” during the consortium meeting in Toulouse on April 4th, 2024.

- Lack of long-range detection
- Lack of detection algorithms modifiable by the authorities as end users

C. Gains:

- Enhanced ability to detect and prevent illegal activities with advanced technologies
- Real-time intelligence and data insights for proactive decision-making (more precise and accurate aerial information directly received, more satellite images, etc.)
- Streamlined and efficient border control processes (reduced number of border crossings)
- Lower operational costs

2. Value Map (I-SEAMORE solutions):

D. Products & Services:

- Advanced Surveillance Systems: Implementing sensor-based technologies (e.g., radar, drones, thermal imaging) for continuous monitoring of border areas
- Better air coverage
- Data Analytics and Intelligence Tools: Utilizing AI and machine learning algorithms to analyse large volumes of data (e.g., satellite imagery, sensor data) to detect suspicious patterns and anomalies
- Integrated Information Sharing Platform: Developing a secure digital platform for real-time information sharing and collaboration among border authorities and relevant agencies
- Mobile Applications for Field Operations: Providing flexible integrated systems – adjusted to customer's needs - for border patrol agents to access critical data and intelligence while on duty

E. Pain Relievers:

- Automation of Surveillance: Reducing the need for manual monitoring through automated systems, minimizing the risk of oversight
- Diverse methods of detection with early detection capabilities
- Early Warning Systems: Alerting authorities to potential threats or suspicious activities in real-time, enabling timely response and intervention more sooner
- Data-driven Decision Support: Providing actionable insights and recommendations based on data analysis, optimizing resource allocation and operational efficiency
- Enabling of persistent and continuous surveillance as well as recording information gathered

F. Gain Creators:

- Increased Detection Rate: Enhancing border security measures to improve interception of illegal immigration attempts.
- Improved Operational Efficiency: Enabling Maritime Authorities to achieve more with existing resources, reducing costs and manpower requirements (resource optimization)
- Enhanced Border Control Effectiveness: Strengthening national security and public safety by leveraging advanced digital technologies
- Increased collaboration among different states
- Utilization of expertise of several different partner organizations

6.1.2 Value Propositions for the use case "Prevent Drug Smuggling"

1. Customer Profile (Maritime Authorities):

A. Jobs:

- Identifying and stopping illegal drug shipments at border crossings
- Monitoring border areas for suspicious activities
- Analysing information to identify patterns and predict smuggling attempts
- Working with other agencies and international partners to combat drug smuggling
- Ensuring compliance with laws and regulations and reporting incidents accurately

B. Pains:

- Insufficient manpower and technology to monitor extensive border areas
- Smugglers constantly changing tactics to avoid detection
- Problems in finding vessels operating in the dark (poor evidence rate)
- Secure detection of abnormal behaviour
- High Risk of Errors: manual processes leading to potential oversight or errors in identifying threats
- Problems of merging radar with other information sources
- Long-time range until detection: lack of integrated analysis of data
- Lack of advanced mission planning
- Difficulty in managing and making sense of vast amounts of data from various sources
- Challenges in coordinating efforts and sharing information across different agencies
- High operational costs of certain equipment such as helicopters

C. Gains:

- Identification of vessels and behaviour context (unusual vessel movement): increased ability to detect and intercept drug smuggling attempts
- Efficiency: Streamlined operations and better use of resources (e.g. such as short distance drones) saving, time, labour and financial resources
- Accurate Intelligence: Reliable, timely intelligence for proactive measures
- Improved coordination and information sharing with other agencies
- Better compliance with regulations and more accurate reporting

2. Value Map (I-SEAMORE solutions):

D. Products & Services:

- Using drones, sensors, and cameras for real-time monitoring and advanced and continuous supply of information
- Implementing AI, machine learning and data fusion for analysing data and detecting patterns as integrated flexible system adjusted to the customer's need
- Secure platforms for information sharing and coordination with other agencies
- Mobile Applications: Tools for field agents to access and input data on-the-go; tracking and detecting phone signals
- Real-time automated triggers and alerts for suspicious activities or potential threats

E. Pain Relievers:

- Reducing the need for continuous manual surveillance through automated systems enabling continuous monitoring of targets
- Using data analysis to predict and prevent smuggling attempts before they occur (causes triggers by weird behaviour and anomalies)

- Providing up-to-date information to enable quick and informed decision-making with the ability to record information gathering and information analysis
- Consolidating data from multiple sources into a single, manageable platform allowing mission planning in advance
- Interagency Coordination: Facilitating easier and more efficient coordination and information sharing between different agencies

F. Gain Creators:

- Automating routine tasks and alerts and providing actionable insights to improve operational efficiency
- Enhancing the ability to detect vessels faster and to intercept drug smuggling with advanced technologies
- Enabling proactive rather than reactive responses through predictive analytics and improved mission planning
- Improving collaboration and information sharing as well as utilization of expertise of several different partner organizations, leading to more effective border control operations
- Ensuring compliance with legal requirements and improving reporting accuracy

6.1.3 The Value Proposition Canvas considering the "Debriefing Module"

The Value Proposition Canvas exercises (as illustrated in the two sub-chapters above) considered the I - SEAMORE system as a whole. By mapping out the elements in the Value Proposition Canvas, we developed a clear and compelling value proposition for the products/services/systems designed to support Maritime Authorities in combating drug smuggling and illegal immigration effectively. This approach helps aligning technology solutions with the needs and priorities of customer segments, driving future adoption and successful implementation of the I-SEAMORE system.

Nevertheless, not only the entire complete system creates customer values and motivates willingness to pay for products/services/systems that are solving their challenges. In the individual meetings of INI-Novation staff and the technology providers in the project consortium, also the values of individual system components were discussed and summarized. As an example, the following figure shows, how the Value Proposition Canvas would apply for the Debriefing Module offered by VORTEX as solution for the customer profile "Law Enforcement Agencies". Consequently, our business development activities within the work package WP8 will consider the exploitation potential of both, the I-SEAMORE system and its components.

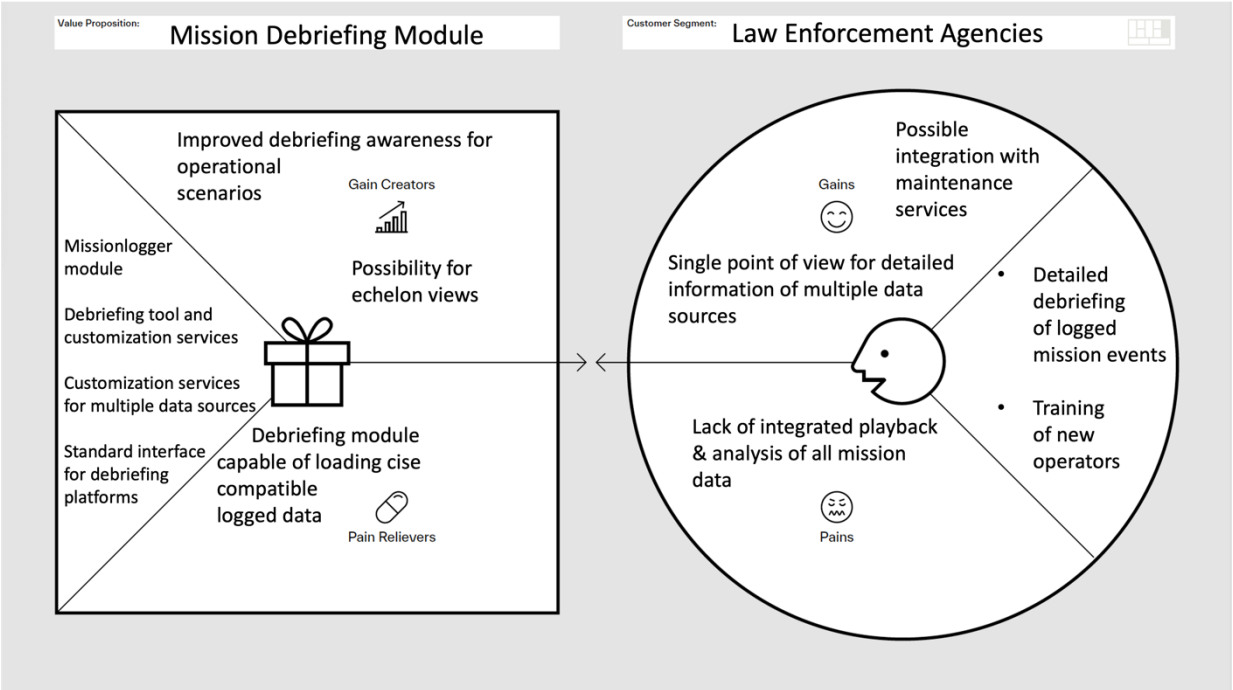

FIGURE 10: VALUE PROPOSITION CANVAS FOR THE DEBRIEFING MODULE FOR LAW ENFORCEMENT AGENCIES[9]

6.2 The I-SEAMORE core customer values

According to FRONTEX, there has been a significant surge in irregular border crossings, particularly within the European Maritime Space [8]. These occurrences are predominantly associated with irregular migration and often result in tragic outcomes. The International Organization for Migration (IOM) reports that, in the first six months of 2021, at least 1,146 individuals have lost their lives while attempting to reach Europe by sea [9]. Regrettably, this number more than doubled in 2021 when compared to the same period in 2020 when 513 migrants were known to have perished in European waters. The data emphasizes that these routes represent some of the most perilous maritime migration routes globally, underscoring the imperative for Maritime Authorities to proactively enhance their detection and response capabilities in such incidents.

Also, drug smuggling at European maritime borders has evolved over the years, with criminals using various tactics to avoid detection and transportation. Some common methods include concealing drugs in shipping containers, hiding them in secret compartments within vessels, using small boats to transport smaller quantities, and even utilizing underwater drones or divers to traffic illicit substances. Organized crime groups often adapt their strategies to exploit weaknesses in border control systems, making it challenging for authorities to intercept and prevent drug smuggling activities. Additionally, the vast expanse of maritime borders poses a significant challenge for Maritime Authorities to efficiently patrol and secure these areas.

In summary, there are some of the major challenges faced by Border Authorities and Law Enforcement Agencies concerning especially the two I-SEAMORE use cases:

1. Detection of uncooperative targets in low visibility conditions.
2. Prolonged operation of aerial assets.
3. Coordination of multi-domain assets for combined search and rescue (S&R) operations.

[9] © VORTEX

4. The absence of meaningful response materials deployable by Unmanned Vehicles (UxVs), such as life jackets from Unmanned Surface Vehicles (USVs).

The primary value that the I-SEAMORE system offers in the considered scenarios is enhanced situational awareness capabilities, enabling the detection of potential human trafficking activities and providing support for search and rescue operations. For instance, smugglers often employ small boats for trafficking, and I-SEAMORE 's solution offers early detection and monitoring capabilities for potential human trafficking activity through its innovative services. These services include detecting and identifying uncooperative vessels, identifying electromagnetic signals (e.g., cell phone signals) to pinpoint traffickers, and actively assisting in search and rescue operations for migrants.

Such application is one of the many similar applications in the I-SEAMORE maritime border protection domain. Many other use case scenarios would demonstrate the benefits of the I-SEAMORE system and its components as illustrated in figure below:

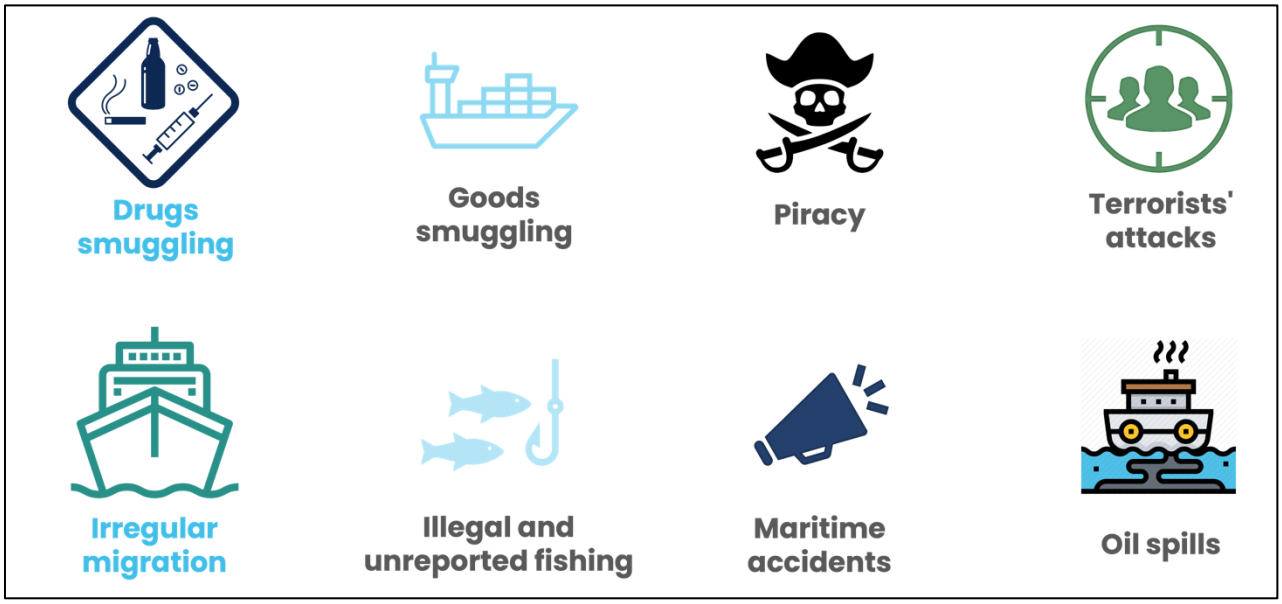

FIGURE 11: POSSIBLE I-SEAMORE USE CASES[10]

Therefore, I-SEAMORE'S customer values are manyfold. And the here considered main stakeholder "Maritime Authorities" is one of many that could use the I-SEAMORE system or its underlying components. Consequently, it is confirmed, that - to manage commercial exploitation successfully - a collaborative multi-sided business model is needed, addressing the different value providing organizations and roles as well as the different potential customers, the value consumers and their roles. Collaboratively, all these value generating organizations will have the above-mentioned growth and network effects and reflect the different objectives, or patterns, like cost and effort sharing, joint value creation or commonly targeted marketplaces. These circumstances drive the vision for a successful commercial exploitation:

Enable a trusted maritime border security surveillance ecosystem
for the benefit of the society.

Providers and consumers of hardware, software, analysed data, infrastructures and value-adding services as well as any other participants in the I-SEAMORE ecosystem will understand the advantages and benefits of the system and its components. And this not only from the pure technical point of view, because the I - SEAMORE core system is complemented by the regulatory ethical and trusted framework, which includes

[10] © ATOS/Eviden

fundamental European principles such as sovereignty, fairness, ethics, security and trust. The I - SEAMORE system will therefore not only serve Maritime Authorities as primary stakeholders, but will also create impact for countless companies and organizations not only in the maritime sector, but also in related sectors such as catastrophic prevention, rescuing support etc. And there is also on option for I-SEAMORE to add values to the European data sharing communities and ecosystems.

Sharing data is technically easy. But when it comes to provide one's data (= IP) to a community, the challenges arise. Up to today, existing difficulties like diverse cloud landscapes, legal uncertainties or technological integration issues hinder the emergence of a strong data cooperation market. Nevertheless, there is a common understanding that data is of high value. Leveraging this value, trading, and sharing data may create huge revenues for the stakeholders involved. However, nowadays the creators of data are benefitting rarely from this value in an adequate way. Often, only the cost for data creation and management remains with them. Furthermore, many give their data away for free or pay with it for the use of a service. And in very often cases, others keep it for themselves without taking advantage of the value.

In many industries, digitalization impacts and changes the traditional business models of companies sometimes serious. Digitalization and the associated ICT solutions bring numerous advantages and opportunities. The basis here is the usability of data. By analysing the data relevant to the academia, business or industry, to private or public entities, internal processes can be made significantly more efficient. This primarily affects the efficiency and effectiveness of value creation also in the I - SEAMORE business creation.

On the market side, a great diversity in customer preferences (both across and within countries), factor prices depending on resilience of international value chains, as well as heightened regulation (notably on data security, data governance, ethics, etc.) further increase the challenges for players looking to gain market share in the maritime surveillance and in related sectors. So, the deployment of I-SEAMORE implies also many risks:

- Procurement in the governmental sector is depending on available budget at national or regional level; therefore, it risks to be financially less affordable than systems with less integrated features, functions and less impacted values;
- There are also technological risks: high maintenance, technical updates, technology advancements, hardware updates, ensuring compatibility, ensuring adequate sensor accuracy, etc.;
- And there are trust risks: can the system be seen as reliable enough that it can be used as the only solution;
- With larger scale adoption, educating the users adequately is also a risk factor.

Taking all these facts into consideration the core customer values of I-SEAMORE can be summarized as follows:

- **Aligning Features with Needs**: Ensures that the architecture system's features (e.g., surveillance technology, data analytics, communication tools) directly address the specific jobs, pains, and gains of target customers.
- **Trusted Information for Decision Support**: Provide the means (=platform) to link currently isolated data and disparate applications, between hardware providers, software providers, service providers and data providers, within countries and across borders, in an efficient manner, adhering to international regulations and interoperability standards. Enable the storage and access of maritime surveillance information in trusted and collaborative infrastructures, with elasticity to scale and with a proper legal basis (consent, anonymization, etc.).
- **Interoperability and multi-dimensional**: in order to enable components of the system to function individually and to interact with each other as well as with other data systems.

- **Adaptability:** The platform adapts to the evolving needs of the various stakeholders across different requirement levels.
- **Scalability:** I-SEAMORE allows integration of further modules thanks to a modular architecture based on standards that allows future vertical[11] and horizontal[12] scalability.
- **Multi-vendor**: The platform allows monitoring several different parameters thus overcoming potential issues of vendor-login. The system, which has been engineered to be intrinsically brand neutral, allows access to data collected by different sources/devices, thus providing an integrated view for decision support on maritime surveillance.
- **Enabling Cooperative Business Models**: Implement clear governance for the use of data/information on individual, regional, national and European level all along value chains in many verticals for research, for commercial and for governmental use by respecting the legal requirements (GDPR. EU Data Governance Act et al.).
- **Ensuring Border Protection, Border Security and Sovereignty**: Provide decision support services as a framework to implement the European Border protection and border security at scale, in a compliant, secure, and trustable manner.
- **Demonstrating Impact:** The system enhances border control effectiveness, improves efficiency, and contributes to national security.

These customer values are impacted by the added-values of I-SEAMORE's future products and services, which can be summarised as follows:

- Enhanced situational awareness;
- Detection of uncooperative targets;
- Electromagnetic signal identification;
- Prolonged operation of aerial assets;
- Coordination of multi-domain assets for search and rescue support;
- Early detection and monitoring of maritime threats such as drug smuggling or human trafficking activities;
- Single point of view for detailed information and multiple data sources;
- Efficient surveillance and response to drug smuggling and human trafficking, alongside maritime safety improvements; and
- Integrated playback of all mission data.

In summary, the applying situational awareness technologies reduce the risk of undetected maritime threats or incidents, not only for maritime authorities. They are also detecting risks and lowering risk exposure for many different stakeholders. This will also in the future lead to continuous improvement and adaptation of surveillance technologies to meet evolving maritime threats.

[11] other application areas in other market segments

[12] other use cases and applications possible in maritime border protection

6.3 The I-SEAMORE exploitation models

All features of the I-SEAMORE architecture represent potential solutions for linking market demand and technological capability. For example, many of the value proposition respond to the fragmentation of different stakeholder preferences and requirements and the resultant demand for more diverse and personalized offerings. Personalization has been made possible by the different elements of the architecture and turned into services, such as decision support services, recommendations, and alerts, which may be different for each group of customers/users. It is important to remind that technology can substitute human factors, but instead it should facilitate it.

Therefore, I-SEAMORE has been specifically designed to be scalable and upgradeable across the whole spectrum of various needs of many different stakeholders and potential customers. Payment models need to be adjusted consequently, shifting towards service delivery fees, time fees (typically quarterly recurring compensation) plus maintenance/upgrade schemas.

Exploitation models for the value propositions of maritime surveillance technologies, especially in contexts like the I-SEAMORE project, could be approached from several angles depending on the technology's capabilities and the primary use cases. Below are possible models for exploiting these technologies to the different key stakeholder groups:

1. Government Contracts & Border Security Agencies

- **Value Proposition:** Enhanced situational awareness, detection of uncooperative targets, prolonged operation of aerial assets, and coordination of multi-domain assets for search and rescue (S&R).
- **Exploitation Model:** Secure direct contracts with maritime border authorities (e.g., FRONTEX, national coast guards) for technology deployment. This could involve ongoing subscription-based models where surveillance technology is provided as a service, continuously monitoring maritime activities and enhancing search-and-rescue operations. Government contracts offer long-term revenue streams and stability.

2. Technology Licensing to Private Security Firms

- **Value Proposition:** Detection of uncooperative vessels, electromagnetic signal identification, and search-and-rescue support.
- **Exploitation Model:** Licensing agreements with private security companies that operate in maritime border protection or anti-trafficking roles. These firms could pay for licenses to use the technology or acquire proprietary hardware with integrated software. Additional service fees could be added for ongoing technical support or software updates.

3. Public-Private Partnerships (PPP)

- **Value Proposition:** Advanced technologies enabling efficient surveillance and response to drug smuggling and human trafficking, alongside maritime safety improvements.
- **Exploitation Model:** Collaborate with governments to form PPPs where the technology is deployed in exchange for co-financing from both public agencies and private sector entities. This could reduce upfront costs for governments while still enabling the deployment of necessary technologies. The private company benefits from government backing and long-term operational contracts.

4. Commercial Integration with Shipping and Logistics Firms

- **Value Proposition:** Early detection and monitoring of maritime threats such as drug smuggling or human trafficking activities.
- **Exploitation Model:** Maritime surveillance technology could be licensed to commercial shipping and logistics firms who wish to enhance their own security protocols. This could involve technology integration into ships and ports, ensuring that these firms have the necessary tools to monitor and

secure their vessels and cargoes. Fees could be based on the volume of usage or on a per-incident response basis.

5. Insurance and Rescue Industry Applications

- **Value Proposition:** Situational awareness technologies reduce the risk of undetected maritime threats or incidents, potentially lowering risk exposure for shipping companies and detecting risks for rescue specialists.
- **Exploitation Model:** Provide surveillance data and technologies to maritime insurance and rescue companies, who could use the enhanced data-driven insights to assess risks more accurately. This could lead to a new revenue stream where the technology provider sells risk assessment data to insurers, who in turn offer better insurance premiums to compliant shipping companies.

6. Data-as-a-Service (DaaS) Model for Risk and Safety Analytics

- **Value Proposition:** Real-time data for detecting suspicious maritime activities, including human trafficking or drug smuggling.
- **Exploitation Model:** Offer data as a service (DaaS) by selling real-time monitoring data, historical analytics, or reports to law enforcement agencies, port authorities, and even private firms operating in high-risk areas. These clients would subscribe to the data feeds on a recurring basis, paying for data access according to specific regions or timeframes of interest.

7. Collaborative Research and Development Initiatives

- **Value Proposition:** Continuous improvement and adaptation of surveillance technologies to meet evolving maritime threats.
- **Exploitation Model:** Participate in co-funded research projects (e.g., Horizon Europe) to further develop the technology in collaboration with other stakeholders like research institutions, technology firms, technology integrators and national security bodies. This could provide access to additional R&D funding while ensuring that the technology remains at the forefront of maritime surveillance innovation.

In each of these exploitation models, the key focus is on leveraging the specific value propositions that I-SEAMORE and similar maritime surveillance technologies offer, whether through direct sales, service models, licensing, or partnerships. This approach ensures that the technology can be adapted to various markets and stakeholders, including both public and private entities, while addressing pressing needs in maritime security and safety. The I-SEAMORE service delivery and exploitation models with the hardware, software and data-integration services are a comprehensive straight solution. In comparison to other providers, it is an all-in-one solution, which means a free flow of data, information, and knowledge directly to the point where it is needed.

7 CONCLUSIONS

Definitions of "business model" vary, but most people would agree that it describes how a company creates and captures value. Our business modelling approach exemplifies how to design collaborative models between different types of stakeholders and an orchestrating entity providing the I-SEAMORE system and related services [8]. The features of the model define the customer value proposition, which then in deliverable D8.4 (Business and Sustainability Plan) will lead to consider the pricing mechanisms, indicate how a value delivery entity will organize itself and whom it will partner with to produce value, and specify how it will structure its supply chain.

The core of the I-SEAMORE 's multi-sided model is the value created by the interactions of multiple organizations, including hardware provider, provider of core services (data fusion, data integration, exchange etc.,), data provider, provider of business applications, provider of compliance services, provider of enabling services, as well as data receivers and consumers of the mentioned services. One could even recognize that there are more relations than the ones illustrated in chapter 4 constituting additional processes of value generation chain, specifically involving many of the various stakeholder groups described in chapter 2.

Principles and rules need to be set according to the business-case pattern to help governing and coordinating the contributing organizations that will use the I-SEAMORE system to meet its objectives and progress through the different life-cycle stages. These rules and principles are set by the architecture framework, which has been developed.

In conclusions, the I-SEAMORE system can exploited successfully if it creates value for the involved organizations that - the following the logic of multi-sided business models - use information and generate knowledge in data-driven applications. Within those settings the I-SEAMORE system – if operated as strong and collaborative platform – is enabled to unlock the potential for following benefits:

- **Multi-Sided Platform**: Platform business models revolve around creating an ecosystem that connects multiple groups or "sides." These sides can include producers, consumers, developers, partners, and more.
- **Two-Way Value Flow**: Unlike linear models, platforms facilitate interactions and value exchanges between multiple parties. Users on one side can interact with and create value for users on the other side.
- **Network Effects**: Platform models often leverage network effects, where the value of the platform increases as more participants join. This encourages growth and can create a self-reinforcing cycle.
- **Facilitator Role**: The entity orchestrating I-SEAMORE value delivery in the future will act as a facilitator that provides the infrastructure, tools, and rules for interactions to occur. It doesn't necessarily produce all the goods or services itself.
- **Diverse Revenue Streams**: Platform businesses can generate revenue from various sources, including transaction fees, subscriptions, advertising, data monetization, and more.
- **Scalability**: Platforms can scale more rapidly because the focus is on expanding the user base and enhancing interactions rather than linear production and distribution.

The combination of object detection as well as detection alerts from other sensors, such as radars, RF sensors and AIS, and a command-and-control dashboard can provide end users with a comprehensive, automated and real-time overview of the under-surveyed spaces. Such capacities could assist the relevant stakeholders to better understand their surroundings and respond more effectively to potential threats or incidents. It can help end users form a more comprehensive outlook of the situation, making it easier for them to make informed decisions in real-time. The solution will offer enhanced situational awareness that will allow end users to utilize resources and respond to incidents as early as possible and in the most efficient manner.

The analysis and synthesis results show that several types of value-generation chains may be built for successful deployment of I-SEAMORE. However, these services and solutions could be beneficial for many different key target groups, i.e. government and border agencies, local authorities, civil protection agencies, etc., interested not necessarily on the entire system solution, but also in elements of the system architecture. Typical delivery of the services includes scenarios that will benefit from the transformation of legacy camera control environment into AI-powered operational control centres providing a high level of automation for the detection of targets from cameras as well as highly comprehensive visualizations using maps and graphical interface elements that are tailored for monitoring critical areas and enable faster reactions times and mission planning. As a result, I-SEAMORE will create reusable and scalable value-added services, based on the integrated playback of all mission data. In this regard, I-SEAMORE will reflect the need of unification of many single technology solutions in the relevant sectors.

The estimated time that it will take the joint exploitable result to reach the market will be long. On the one hand, it will be required to bring the enhanced platform to market include the advancement of maturity of the tool by finalizing the platform's design and functionality and extensive testing in different scenarios. On the other hand, time-consuming public procurement procedures have to be respected. And finally, it requires the development of go-to-market strategy, with segmentation and prioritization of target customers, with a pricing strategy, with a distribution strategy and also with a communication strategy, including the creation of marketing materials.

The multiple exploitation channels to many different stakeholder groups in I-SEAMORE's multi-sided business model will open several distribution opportunities. This will unlock the potential for contributions to a sustainability future use of I – SEAMORE, to be elaborated on in the deliverable document D8.4 "Business and Sustainability Plan". It will complement this initial analysis and synthesis work by a description of the market entry strategies and the strategies addressing elements of the so-called marketing mix. Together with a description of personnel and financial resources needed, these documents will constitute a solid and updated business plan, taking into consideration the variety of different possible exploitation paths. We will also establish a network of potential access-to-market as well as financing actors, thus close links into identified I – SEAMORE markets of interest. And we will provide IP valorisation support for the system and the elements of the architecture. This will include a library of a different set of commercialization agreements (i.e. for licensing, re-selling and for different service levels). We believe in the future commercial success in I-SEAMORE key results and will combine all these different actions to lay the ground for sustainable future operations.

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