Engaging Public Actors in Mission-Oriented Innovation Systems

A study on the EU Mission: Restore our Ocean and Waters

Master Thesis in Management of Technology

Alexandros Baratsas

Delft University of Technology

TU Delft

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Alexandros Baratsas

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Thesis committee:	Prof. dr. mr. ir. N. (Neelke) Doorn,	EPT, TU Delft, Chairperson - 1st Supervisor
	Dr. A. C. (Sander) Smit,	ETI, TU Delft, 2nd Supervisor
	Dr. M. J. (Martijn) Wiarda,	ETI, TU Delft, Advisor - Daily Supervisor

Faculty of Technology, Policy and Management

TU Delft

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Summary

Historically, economic growth has been driven by socio-technical systems based on industrial mass production and reliance on fossil fuels. Recognizing the limitations of these traditional innovation policies, there has been a shift towards addressing social issues, moving beyond the sole pursuit of economic growth and productivity. The contemporary era calls for innovation policies that are not only focused on economic growth but also aim to be smart, inclusive and sustainable. As a result, new streams like mission-oriented innovation policy (MIP), aim to drive transformative change by setting and pursuing ambitious, measurable objectives within specific timeframes. Missions mobilize a wide array of stakeholders, facilitating their involvement in governance and the creation and spread of innovative solutions. From MIP, the mission-oriented innovation system (MIS) emerged that involves not only technological innovations but also political, behavioral and societal transformations among diverse stakeholders. However, while prior studies have predominantly explored the roles of the private sector and governmental bodies within these systems, the engagement of public actors such as citizens, youth and NGOs remains underexamined. Recent social science theories have highlighted the need for a systemic view of these actors' engagement, emphasizing their pivotal role in steering research and innovation processes toward societal transformation and ensuring socially beneficial outcomes. Morover, their participation is defined as a comprehensive approach that enables them to engage in the decision-making process of research and innovation and is essential for the success of MIS. The ecologies of participation framework is particularly useful for analyzing these actors, focusing on the 'what', 'who' and 'how' of participation. This framework helps in understanding the relational dynamics of diverse collective practices and participatory spaces within broader systems and political cultures.

Thus, the research aimed to explore public participation within the context of the EU Mission: Restore our Ocean and Waters through the lens of the ecologies of participation (EoP) framework. The EoP framework is centered on three main aspects, which correspond to the thesis's sub-questions, examining the 'objects' (what), 'subjects' (who) and 'models' (how) of public engagement. By applying the EoP, the study aimed to deepen our understanding of the diverse roles and motivations of public actors in missions, their methods of participation, the benefits of participation and the implications for mission-oriented innovation policies. To collect the necessary information, data was gathered from policy documents, project websites, the CORDIS repository and surveys administered to project coordinators and managers. Following data collection, the coding process was conducted, beginning with open coding and followed by axial coding, which helped identify themes that answer the three sub-research questions.

Regarding the findings, the study addressed the three sub-questions regarding public participation in the EU Mission: Restore our Ocean and Waters. First, six primary themes driving public engagement were identified: education and awareness, community engagement, environmental conservation, economic benefits, social transformation and innovation. Second, six categories of public actors were revealed: users, educators, NGOs, youth, citizens and local media. Third, five interconnected models of involvement were highlighted: educational activities, co-creation, citizen science, active participation and communication.

These findings offer a novel approach to mapping and explaining the roles and connections

between public actors engaged in missions, providing a significant enhancement to the current literature. This research improves the understanding of MIP and MIS by focusing on the often-overlooked area of public actors in missions. It also advances participation literature by analyzing the interconnected nature, benefits and dynamics of such involvement. Additionally, this thesis presents important practical implications, highlighting the need for increased citizen science, co-creation and active participation activities. It also emphasizes the importance of including all public actors due to their diverse perspectives that can make the solutions more democratic, widely accepted and sustainable.

Lastly, the structure of this thesis mirrors its investigation, summarizing each key chapter. Introduction sets the stage by presenting the research problem and objectives. The Theoretical background section delves into existing literature for missions, MIP, MIS, public participation and the selected framework, EoP. Methodology outlines the research design, the case study and the data collection and analysis techniques used. The Results chapter presents the key findings, addressing the 'what,' 'who,' and 'how' of public engagement. Discussion interprets these findings, offers recommendations for future studies and highlights their implications for theory and policy. Finally, Conclusion summarizes the overall insights and contributions of the research.

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1

Introduction

This introductory chapter provides an overview of the research area, focusing on the evolving landscape of mission-oriented innovation systems. It outlines the background of the study, emphasizing the shift towards inclusive and sustainable growth through public participation in missions. Additionally, it details the research problem, scope, objectives and research questions, with a particular focus on analyzing public engagement through the ecologies of participation framework within the context of the European Union's mission-oriented policies.

1.1. Background

The trajectory of economic growth has historically been shaped by socio-technical systems predicated on industrial mass production and consumption, heavily reliant on fossil fuels and characterized by significant resource and energy usage, leading to substantial waste generation. Recognizing the limitations of traditional innovation policies, scholars and policymakers focusing on innovation policy are shifting their attention towards tackling social issues, moving beyond the sole pursuit of economic growth and productivity (Schot & Steinmueller, 2018). The contemporary era calls for innovation policies that are not only focused towards economic growth but are also smart, inclusive, and sustainable (Boon & Edler, 2018) (Janssen et al., 2023). This calls for a new role for government and public policy in promoting an economy focused on smart, inclusive, and sustainable growth. Recognizing that growth depends not only on speed but also on its direction emphasizes the crucial role of industrial and innovation strategies in driving transformative change. By setting and pursuing new missions, these strategies aim to revolutionize production, distribution, and consumption across various sectors, thereby achieving systemic shifts in economic patterns (Mazzucato, 2018a). To grasp the concept of missions effectively, it's essential to recognize them as challenging objectives that are measurable, ambitious and bound by a specific timeframe. These missions are designed to mobilize a wide array of stakeholders, facilitating their involvement in governance, and the creation and spread of innovative solutions (Kattel & Mazzucato, 2018). Given that tackling societal challenges through missions involves changing the dynamics among actors, networks, institutions, and capabilities (Wittmann et al., 2021), adopting an innovation systems approach could enhance the evaluation of mission progress and the precision of interventions. Therefore, following the article of Elzinga et al., 2023, a Mission-specific Innovation System (MIS) is defined as: "the network of agents and set of institutions that influence the development and diffusion of innovative technological and social solutions and the transformation of existing production and consumption systems with the aim to complete a societal mission" (p.2). Thus, the concept of

MIS involves not just technological innovations but also necessitates political, behavioral, and societal transformations among a broad spectrum of stakeholders (Mazzucato, 2018b). While prior studies have predominantly explored the roles of the private sector and governmental bodies within these systems, the engagement of the public —comprising non-traditional actors such as citizens, youth and NGOs—remains underexamined. Recent works in social science theories have highlighted a shift from a mainstream view of these actors' engagement to wider systemic view that needs to be examined (Chilvers and Longhurst, 2016). Their participation is pivotal for steering research and innovation processes toward societal transformation and ensuring outcomes that are socially beneficial (Wiarda et al., 2023). Additionally, research has demonstrated that public participation is both varied and shaped by social constructs. The perceptions and actions of individuals and groups concerning complex topics like the ones the missions are addressing are significantly influenced by the specific sociomaterial settings and practices they interact with, how these settings are structured, and who organizes them (Chilvers et al., 2021).

Given missions aim to align diverse actors towards a unified direction, comprehending the mechanisms of public actor engagement becomes critical for mission success, as highlighted by Janssen et al., 2023 and Schot and Steinmueller, 2018. Public participation is generally defined as a comprehensive approach that enables public stakeholders who may be impacted to engage in the decision-making process of research and innovation (R&I) (Wiarda et al., 2023). In order to analyze and understand these actors, the ecologies of participation (EoP) framework is especially helpful. The definition of EoP refers to the relational dynamics of diverse collective practices and participatory spaces within broader systems and political cultures, serving as a mean to understand their interrelations and impacts). This framework reflects the concept that participatory practices happening within a system focus on three dimensions, the 'what, who, and how'—or the 'objects, subjects, and models'—of public participation (Chilvers et al., 2018; de Looze and Cuppen, 2023). Additionally, in this research project, public participation follows the definition of Chilvers et al., 2018 that explain it as:" heterogeneous collective practices through which publics engage in addressing collective public issues, whether deliberately or tacitly, which actively produce meanings, knowings, doings and/or forms of social organisation"(p.202). This underscores the importance of fostering an inclusive innovation ecosystem that leverages the unique contributions and perspectives of all societal actors to navigate the complexities of achieving mission objectives.

1.2. Research problem

It is important to understand that several studies, including those by Elzinga et al., 2023 and Jütting, 2020, have highlighted the need for more insights into the actors of mission-oriented systems. To date, no studies have been conducted to analyze the societal actors involved in MIP. Additionally, Chilvers et al., 2018 and Wiarda et al., 2023 have advocated for increased research into public participation, citing that existing knowledge falls short of tackling the escalating complexities in public interactions. Thus, the research problem is that, despite the recognized need for a deeper understanding of the actors involved in mission-oriented innovation policies and systems, there has been a lack of studies specifically analyzing public actors. Additionally, there are many calls that request more research into (public) participation in missions, highlighting that current knowledge is insufficient to address the growing complexities of interactions.

1.3. Research objective

As a result, this research investigates the ecologies of participation through which public actors contribute to missions. Furthermore, this study seeks to understand the roles these actors play within the innovation ecosystem and how their participation can be enhanced to steer research and innovation processes towards societal transformation, ensuring outcomes that are socially beneficial such as the 5 main Missions of EU (European Commission & Directorate-General for Research and Innovation, 2021a). The relevance of this research lies in its potential to contribute to a paradigm shift in innovation policies from those solely focused on economic growth to those that are smart, socially inclusive, and sustainable. By exploring the overlooked area of public engagement in mission-oriented innovation policy with the EoP framework, the study aims to provide insights into the specific public actors, their interests and their methods of engagement. This is crucial for achieving the ambitious objectives of European Union and its missions. Ultimately, this study will be a multi-level approach that will bridge the gap between MIS and participation. It will also be one of the first research approaches to analyze the public involvement of the MIS using the systemic and relational approaches to participation of EoP.

1.4. Research question

Considering the points mentioned above, the main research question that will guide this thesis is:

How do ecologies of participation contribute to Missions?

To effectively address and investigate the primary research question, several sub-questions need to be answered. The sub-questions are based on the chosen framework which focuses on the 'what, who and how'—or the 'objects, subjects and models'—of public participation:

1. Who are the public actors that are participating?
2. What are the reasons for public actors to participate in missions?
3. How are public actors involved?

The first sub-question focuses on identifying the different public actors involved in missions. The second one seeks to identify and understand the issues or motivations driving public engagement. Lastly, the third sub-question investigates the methods and approaches used to engage the publics.

2

Theoretical background

This chapter lays the theoretical groundwork by exploring key concepts in mission-oriented innovation and public participation. It begins with an overview of missions, tracing their historical roots and modern application in innovation policy. It then introduces MIP and its role in driving transformative change. The chapter also examines the MIS as a tool to analyze innovation dynamics in missions. Additionally, it addresses the significance of public participation, contrasting traditional and emerging perspectives. Finally, the EoP framework is presented as a novel approach to understanding the 'what, who, and how' of participation. Lastly, this chapter integrates the concepts of MIS with the EoP framework to address the gaps in understanding public engagement within mission-oriented policies by identifying examples from past mission works.

2.1. Missions

Over the past decades, innovation has become a key driver of long-term growth as it is used to fuel productivity and transformation of production, distribution and consumption across entire economies (European Commission and Directorate-General for Research and Innovation and Mazzucato, 2019). This potential of innovation to drive economic growth has been well acknowledged. However, what is less understood is that innovation not only progresses at a certain pace but also follows a specific direction. By steering the direction of innovation, we can leverage the power of research and innovation to meet broader social and policy objectives, in addition to economic targets (European Commission, Mazzucato, et al., 2018). As a result, countries around the world are seeking economic growth in a direction that is smart, inclusive and sustainable. To do this, missions are an effective tool. As Mazzucato notes in the report "Mission-Oriented Research and Innovation in the European Union", published in 2018, missions offers a solution, an opportunity, and an approach to address the numerous challenges that people encountered in daily life (p.11).

2.1.1. Definition

Missions have long been a part of history, serving to guide efforts across the globe. In the 1960s, missions often had a technological focus, exemplified by NASA's Apollo mission which aimed to land a man on the Moon within the decade. This mission required innovation across various sectors, including textiles and aeronautics, involving hundreds of projects, many of which did not succeed. Mission-oriented approaches help transform broad challenges into specific,

actionable problems that require collaboration across multiple sectors and require long-term commitments (Foray et al., 2012). Today, the challenges we face, are more intricate or "wicked" than those of the space race era. These challenges include ensuring clean air in big urban areas, promoting a healthy lifestyle for individuals at every stage of their life, providing enhanced access to digital technologies that improve public services, and making treatments for cure diseases such as cancer and obesity more effective and affordable. Additionally, missions strive to drive innovation in environmental sustainability, aiming to reduce carbon footprint and make our ocean and other water bodies cleaner. As a result, these wicked problems demand a deeper focus on how social issues are interact with political and technological factors, behavioral shifts, regulation, and feedback mechanisms (Mazzucato and Dibb, 2019; Mazzucato, 2018a). The Maastricht Memorandum (Soete and Arundel, 1993) offered a comprehensive analysis of the distinctions between traditional and new mission-oriented initiatives and the article from Mazzucato and Dibb modified in a newer version.

Table 2.1: Modified version of Table 5 in Soete and Arundel, 1993 by Mazzucato and Dibb, 2019.

Old: Defense, nuclear, and aerospace	**New: Environmental technologies and societal challenges**
Diffusion of the results outside of the core of participants is of minor importance or actively discouraged	The mission is defined in terms of economically feasible technical solutions to particular societal problems
The mission is defined in terms of the number of technical achievements, with little regard to their economic feasibility	The mission is defined in terms of economically feasible technical solutions to particular societal problems
The goals and the direction of technological development are defined in advance by a small group of experts	The direction of technical change is influenced by a wide range of actors, including government, private firms, and consumer groups
Centralised control within a government administration	Decentralised control with a large number of agents involved
Participation is limited to a small group of firms due to the emphasis on a small number of radical technologies	Emphasis on the development of both radical and incremental innovations to permit a large number of firms to participate
Self-contained projects with little need for complementary policies and scant attention paid to coherence	Complementary policies vital for success and close attention paid to coherence with other goals

The European Union defines mission-oriented research and innovation projects as large-scale interventions with a clearly stated purpose. Additionally, while research and innovation (R&I) is a significant part of missions, they are sometimes far larger than R&I alone and require additional measures such as regulations, to accomplish their aims. Research and innovation efforts within missions are usually ambitious, exploratory and groundbreaking in character. They are also cross-disciplinary, aimed at a specific problem or challenge, have a significant impact, and have a clearly defined timeline. (European Commission, Chicot, et al., 2018).

Thus, the main characteristics of the these missions include:

- A clearly defined objective, whether it be societal or technological, that is ideally qualified and/or quantified in terms of a percentage increase or decrease, or expressed in more absolute terms (e.g. 50% less plastics in EU waters)
- A specific timeframe. The result of the mission is time-bound, and the progress ought to be tracked in relation to predetermined milestones (e.g. 50% less plastics in EU waters in 2030)

- A bold large scale process that mobilize substantial investments from the public and/or private sectors as well as other resources (human resources, infrastructure, etc.), and a sizable societal and/or economic impact is anticipated. The scale depends on the objective, the theme area and the country.
- Driving systemic or transformative change due to their ambitious and ground-breaking nature. Such initiatives can generally be classified into two main types based on the objectives they pursue: i) Narrow mission-oriented R&I endeavors target a specific, clearly defined goal, similar to the Apollo project's objective of landing a man on the moon. ii) Broader mission-oriented R&I efforts aim to transform entire systems to tackle wicked societal issues such as climate change.
- Cross-disciplinary initiatives. Mission-oriented project involve a wide variety of technologies across different sectors and many different actors across various disciplines.

After outlining the historical origins and the five basic principles of the missions, the connection between the global challenges and the EU missions will be established in the upcoming subsection.

2.1.2. From challenges to missions

Today's most pressing issues that humanity is facing have been expressed through the 17 Sustainable Development Goals (SDGs) (United Nations Department of Economic and Social Affairs (UN DESA), 2023). They have been endorsed by approximately 200 countries, underscoring their pivotal role in promoting mission-oriented thinking. These goals are not only crucial for safeguarding the future prosperity of generations to come and ensuring global well-being, but they also present significant opportunities to guide investment-driven growth. The SDGs also comes with some specific Societal Challenges or Focus Areas. However, these aspects of the SDGs have been criticized for being too broad to be actionable (European Commission, Mazzucato, et al., 2018). The EU has a solution for this. Following the previous Horizon 2020 research and innovation program (2014–2020), the Horizon Europe focuses on solving specific societal problems through innovation-led projects, utilizing a unique mission-oriented approach to research and innovation. With a budget of €95.5 billion, the programme aims to tackle climate change, support the UN's SDGs and boost the EU's competitiveness (European Commission and Directorate-General for Research and Innovation, 2021c).

The scope of European R&I missions lies between big challenges and specific projects. The missions, following the 5 basic principles that explained before, establish distinct and ambitious goals that can be met through a diverse array of projects, along with supporting actions like policy initiatives, practical deployment efforts, and engagement with end-users. Furthermore, missions need to be broad to capture public interest and draw cross-sectoral investments, yet focused enough to involve industry partners and yield quantifiable outcomes. Also missions do not predefine the methods of success but guide the development of various solutions to achieve the specific objective (European Commission, Mazzucato, et al., 2018).

Figure 2.1: From Challenges to Missions, Source: European Commission, Mazzucato, et al., 2018

2.1.3. EU Missions in Horizon Europe

To better understand the concept of missions, the current missions of the European Union will be presented. The European community employed a mission approach for the first time in the Horizon Europe programme for the period of 2021 to 2027 by approving 5 concrete missions (European Commission and Directorate-General for Research and Innovation, 2021c). These missions represent a new method aimed at delivering practical solutions to some of the most pressing challenges we face. By 2030, they aim to achieve their ambitious goals and generate substantial results for the citizens of the region (European Commission, Reid, et al., 2023).

The 5 EU Missions areas are (European Commission, 2021e):

- **Adaptation to Climate Change**: Aims to help at least 150 towns and regions become climate resilient by 2030, supporting climate risk understanding, strategy development for the changing climate and innovative solutions (European Commission, 2021a).
- **Cancer**: Seeks to improve more than 3 million lives by 2030 through cancer prevention, treatment and greater quality of life for those affected from the disease and their family (European Commission, 2021d).
- **Restore our Ocean and Waters by 2030**: Focuses on protecting and restoring oceans and waters through blue investments, research and citizen involvement, using regional "lighthouses" to pilot and implement activities (European Commission, 2021g).
- **100 Climate-Neutral and Smart Cities**: Supports cities in accelerating their digital and green transformation to reduce emissions by 55% by 2030, aiming for cleaner air, safer transportation and reduced noise (European Commission, 2021b).
- **A Soil Deal for Europe**: Aims to create 100 living labs and lighthouses to promote more healthy soils by 2030, emphasizing soil management, protection and a framework for soil monitoring (European Commission, 2021h).

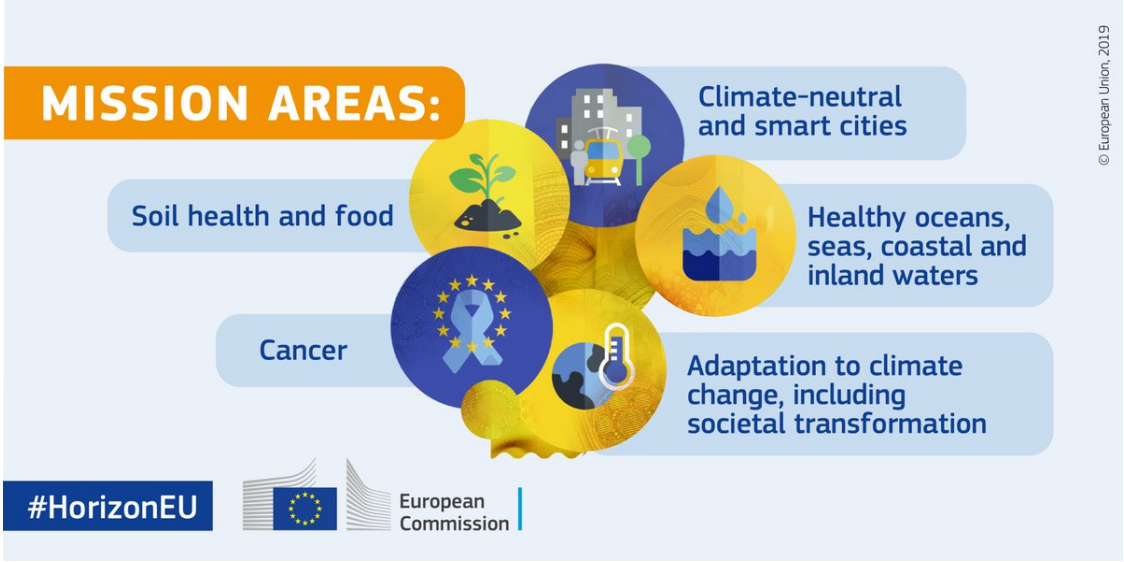

Figure 2.2: Overview of the 5 Mission Areas, Source: European Commission, 2021e

2.2. Mission-oriented Innovation Policy (MIP)

As explained earlier, countries around the world are striving to address the biggest challenges while pursuing economic growth that is smart (innovation-led), inclusive and sustainable. Thus, there is a new era approaching, where policy makers promoting a new generation of innovation policy that recognize the critical need to address societal challenges (Mazzucato, 2018a). As discussed in Chapter 2.1, the European Commission stands out as a leading force behind this significant shift in innovation policy philosophy. The European Union, drawing inspiration from Mazzucato, 2016 deliberately adopted the 'missions' concept to tackle societal challenges that are broadly recognized. Her contributions (Mazzucato, 2018b; Kattel and Mazzucato, 2018; Mazzucato, 2016; Mazzucato and Dibb, 2019; Robinson and Mazzucato, 2019) was also pioneering to motivate the European Commission to now establish the 5 missions (Chapter 2.1) with more clear objectives that will necessitate the participation of numerous stakeholders involved in the socio-technical domains and sectors impacted by the challenge itself. Through these missions, the EU states aims to enhance the effectiveness of research and development efforts and to clarify for its citizens the reasons behind the allocation of funds for innovation. Thus, it is easily understandable that the state's role is evolving. Instead of merely enhancing the ability and connectivity of systems to innovate, the state is once more viewed as a key player in determining the direction of innovation (Mazzucato, 2011). These missions aim at strategic objectives that address significant societal issues or anticipate future societal demands, requiring "the development, diffusion and embedding of technological and/or institutional solutions to accomplish it " (Wanzenböck et al., 2020, p.474). The 'wicked' characteristics of societal problems, as defined by Rittel and Webber, 1973, present novel challenges and questions for those creating and implementing innovation policies. More specifically, the problems that missions aim to address are complex, defy simple explanations and resist straightforward solutions. To be more clear, it is impossible to tackle climate change or cure cancer with one project. Addressing these complex challenges has created new demands on policymakers, leading to the exploration of new rationales, approaches, and tools for innovation policy (Janssen et al., 2021; Kuhlmann and Rip, 2018).

2.2.1. Focus: Transformative change

A new model that is called, transformative innovation is needed to tackle grand challenges that goes beyond the linear model and innovation system approaches (F. Geels et al., 2020). In order to understand this concept better, it is beneficial to first take a look at the other previous dominant innovation policies. The article from Schot and Steinmueller, 2018 note that public policies, especially those focused on science and technology, develop from lessons learned from past actions, considerations of current challenges, and perceptions into future possibilities for action (p.1554). Until now, there are two established frames that are recognized as prevalent in discussions about innovation policy. The first one is called 'innovation for growth' (Schot and Steinmueller, 2018, p.1555). This framework is based on the idea that scientific and technological progress are key to driving economic growth. It started after World War II when governments began to heavily support R&D. They believed this support would boost industrial growth and the economy by overcoming the private sector's shortcomings in producing new knowledge. This approach involves substantial public funding for scientific research, expecting that these funds will lead to innovations that can be turned into products and services by the private sector, thereby enhancing economic productivity and development (Mazzucato, 2011). Essentially, this model focuses on turning scientific breakthroughs into commercially viable products. Moreover, the second frame is called 'national systems of innovation' (Schot and Steinmueller, 2018, p.1560). Developed during the 1980s, this framework addresses the challenges of globalization and increasing international competition by looking at the broader aspects of innovation. It understands that innovation involves more than just technology; it also includes social interactions and institutional cooperation which were overlook in the first frame. This approach emphasizes the need to create and support networks, communities, and ecosystems that promote knowledge sharing and collaborative learning among key groups such as universities, industries, government agencies, and research bodies. The cooperation between academia, industry and government was explained with the term Triple Helix (Etzkowitz and Zhou, 2017). The aim is to boost a country's or region's ability to innovate by enhancing collaboration among these groups. It recognizes that each country has unique innovation strengths due to its specific institutional structure and history and therefore, suggests that innovation policies should be customized to fit local or national contexts (Edquist, 1997).

The contemporary era calls for a new framework that aims to adjust innovation policies so they better meet wider social and environmental goals like those detailed in the UN SDGs and EU missions (European Commission, 2021e). First of all, the main aspect is that these initiatives share a common aspiration and direction that is missing in previous policy models (Weber and Rohracher, 2012).It looks to overcome the limits of past models by not only focusing on economic outcomes but also on fostering innovations that help build a sustainable and inclusive society (Steward, 2012). These challenges typically fall under various functional policy areas like healthcare, agriculture, education, and the environment, rather than under the domain of innovation policy (Diercks et al., 2019). Another aspect of the transformative change policy model is the global orientation. This reflects the vast scope and scale of societal challenges that require a global perspective, necessitating collaborations that cross disciplinary, organizational, and national boundaries as (Smith, 2017). As a result, the transformative change policy model suggests a major revision in how we think about and carry out innovation. It advocates for more broad, experimental, inclusive, and thoughtful approaches that look at long-term impacts on global society and aim for comprehensive changes in our socio-technical systems (Schot and Steinmueller, 2018; Diercks et al., 2019).

2.2.2. MIP and transformative change

After presenting the three main policy models of our age it is imperative to understand that this first literature stream (Chapter 2.2.1) refers to the latest approach as 'transformative innovation policy' (Schot and Steinmueller, 2018), while the second identifies it as 'challenge-led, Mission-oriented Innovation Policy' (Wesseling and Meijerhof, 2021). The MIP was described in various publications of Maria Mazzucato and other scientists (Kattel and Mazzucato, 2018; Mazzucato, 2018a; Robinson and Mazzucato, 2019; Mazzucato, 2016) and played and important role guiding the EU create the five missions. These previously distinct research streams have now merged around the same concept of innovation policy, that this research will focus from now on. This policy framework is driven by societal challenges and highlights: (i) the wicked nature of societal issues; (ii) the critical role of governance across various sectors, disciplines, and regions in providing direction, involving a wide array of stakeholders and balancing both short-term and long-term needs; (iii) the complex nature of innovation policy, which calls for new approaches and strategies; and (iv) the necessity for changes in behavior and society alongside technological advancements (Wesseling and Meijerhof, 2021; Haddad et al., 2019).

2.3. Mission-oriented Innovation System (MIS)

While 'missions' have become a popular term in policy, both analysts and policymakers were finding it challenging to develop and apply MIP. There was a lack of a clear framework that can assess innovation dynamics that support achieving a societal mission, and to then craft suitable intervention strategies based on those assessments. For first-generation innovation policy, the approach was straightforward: track national R&D spending and create policies to boost investment. Second-generation innovation policy, however, is more complex, offering greater flexibility in enhancing various components of innovation systems. Still, a key focus has been on strengthening connections among participants in innovation networks. Even thought there were many other innovation policy frameworks such as the Multi-Level Perspective on technological transitions from F. W. Geels, 2002, the Technological Innovation System perspective from Hekkert et al., 2007 and the Transitions Management from Loorbach, 2010, applicable to the transformative change, there is still no specific framework to design MIP as described before.

Thus, the first framework specifically designed for analysts and policymakers aiming to understand and influence the dynamics of innovation as they relate to prioritizing and addressing societal challenges were introduced by Hekkert et al., 2020. This framework, named the Mission-oriented Innovation System (MIS), is described as "the network of agents and set of institutions that contribute to the development and diffusion of innovative solutions with the aim to define, pursue and complete a societal mission" (p.77). At its core, MIS is a variant of innovation systems, similar to national, regional, sectoral, and technological models. Yet, it distinguishes itself in several key aspects: the method of defining system boundaries, the origins of interactions within the system (for instance, the shift from demand pull to supply push), and its end products, such as novel technological and behavioral innovations. The same article also argued that a MIS is initially organized around challenges rather than predefined solutions, leaving the specific roles of actors in the development and diffusion of innovative solutions during the mission's lifespan ambiguous. The selection of a problem and the formulation of its corresponding mission can draw in actors from varied public and private sectors, all of whom may engage in promoting and testing innovations aimed at achieving a shared objective. Missions often necessitate the combination of diverse technological and non-technological innovations. As the MIS develops, it becomes a space where actors seek out synergies within their proposed

solutions while also navigating the competitive landscape presented by those advocating for different approaches. Some years later, Elzinga et al., 2023 adapted this concept and defined a MIS as: "the network of agents and set of institutions that influence the development and diffusion of innovative technological and social solutions and the transformation of existing production and consumption systems with the aim to complete a societal mission" (p.2). This definition is the one that the current research work will mainly focus on. This article also argues that similar to other concepts in innovation system studies, a MIS can be viewed as a conceptual tool or heuristic designed to examine how various actors and institutions interact in ways that are significant for a defined mission.

2.4. Participation

Tackling missions is itself a significant challenge for policymakers as well as actors in science, technology, and innovation. It demands a willingness to explore both existing and new methods (Kuhlmann and Rip, 2018). Societal engagement is a crucial aspect of R&I, focused on making science, technology, and innovation more transparent, interactive, and responsive. Beyond just mobilizing firms, achieving missions and facilitating transformations also necessitates involvement from a wide range of stakeholders (Anja Bauer and Fuchs, 2021; Diercks et al., 2019; Edler and Fagerberg, 2017) like public actors (Mazzucato, 2018a). As it is discussed in Section 2.1 and highlighted by multiple EU policy documents (European Commission, Mazzucato, et al., 2018), the EU missions should enable participation across different public actors, bottom-up experimentation and system-wide innovation. Since its foundation, the field of science and technology studies (STS) has been driven by an interest in public participation and the democratic involvement in science. This focus, has continued to be a core aspect of the field's dedication to exploring the societal aspects of science and innovation (Chilvers and Kearnes, 2020). In this stage of the research, we reviewed various literatures concerning public engagement that were highlighted in different articles such as Pallett et al., 2017, Chilvers and Kearnes, 2015 and Chilvers et al., 2018. In the end the established conceptual framework that will guide the project, as outlined by Chilvers et al., 2018, will be explained in detail. This work was crucial, given the recent advancements in theories and practices of participation and the project's goal to innovate the way we think about participation in missions from relational and systemic perspectives.

2.4.1. Importance of participation

In recent times, there has been a global trend towards greater public engagement in the decision-making processes of policy-setting bodies, a concept often known as public participation (Rowe and Frewer, 2005). As it is previously mentioned, public participation is broadly described as an inclusive process that allows affected actors to be part of the decision-making process of R&I. But why this is beneficial? The article from Stirling, 2008 aims to underscore the motivation of public participation from normative, instrumental and substantive perspectives. Normatively, it's valued for promoting democracy and ethical practices in decision-making, ensuring inclusivity and fairness. Instrumentally, public participation acts as a strategic means to build trust, manage reputations, and secure decision acceptance, focusing on specific desired outcomes. Substantively, it enriches decision quality by leveraging diverse knowledge and viewpoints, leading to more comprehensive and robust solutions that effectively tackle complex challenges and enhance public well-being. Collectively, these rationales highlight the critical role of public engagement in fostering more democratic, effective, and well-informed decision-making processes that are much needed in missions such as the EU ones.

2.4.2. Residual approaches to participation

The most mainstream perspective in participation within research, policy and practice until now is the so-called ”residual realist” perspective (Chilvers and Kearnes, 2015). It typically involves traditional engagement methods such as behavior change techniques, public attitude surveys, deliberative processes, transitions management and participation in social movements. Despite varying goals, these methods share a common framework: they view participation as involving either individuals or groups in predefined forms, focusing on issues dictated by governing bodies. Thus this approach sees participation as being fixed or pre-given in terms of the form it takes and who is involved (Chilvers et al., 2018). It also treats participation as a technical application, with methods that can be objectively evaluated against criteria like inclusiveness and impact on decision-making. Additionally, these methods are seen as discrete events that can be replicated and scaled up, aiming to engage a specific external public deemed to be homogeneous. This perspective, known as ”residual realist,” assumes that public engagement can be effectively managed through set, standardized approaches (Pallett et al., 2017).

2.4.3. Relational approaches to participation

A different perceptive than the mainstream one, is the relational perspective. Its approaches have become increasingly influential in the STS over the past decade, emphasizing that publics and participation are dynamic and emerging entities and are constructed through collective practices. This approach diverges from the traditional views by asserting that participation does not involve autonomous individuals but occurs through complex relationships that involve people, technologies, meanings, policies and elements. Also, the most significant feature of this perspective is that no individual ever participates alone; participation always occurs through collective practices. Thus, participation is an ongoing, dynamic process where the issues and the roles of participants are constantly being redefined. This framework challenges the notion of fixed and natural participation roles and highlights the emergent characteristics of engagement, where environmental issues and roles are not pre-defined but emerge through interaction. Additionally, relational approaches provide the resources to open up to the diversities, complexities and multiple projects of participatory practices across the mission. However, they tend to focus on individual collectives or instances of participation rather than offering a broader systemic perspective (Chilvers et al., 2018; Pallett et al., 2017)

2.4.4. Systemic perspectives on participation

The review from Pallett et al., 2017 concluded with a third perspective that views participation and publics from a systemic point. This is a view that is very new in academic social science, and has not yet been applied to sustainable policy and engagement practice. These perspectives, extends beyond the idea of discrete events to consider the multiple, interrelating ’ecologies of participation’ that influence and are influenced by broader systems. Scholars on public deliberation have emphasized the need to understand participation in a holistic manner, recognizing the various ways in which deliberative processes interact within a larger system of governance and societal norms. Moreover, transitions approaches have long embraced a systemic view on changes within socio-technical systems, yet they have overlooked the dynamics among actors and the political aspects of these transitions (Grin et al., 2010). Other recent studies have started to explore the democratic participatory elements within socio-technical systems. Additionally, studies have expanded beyond examining practices in domestic environments, shifting focus to how these practices interact across various dimensions and contribute to broader systems, like those seen in an EU mission (Watson, 2012; Shove et al., 2012).

The field of STS offers a number of conceptual resources for explaining systems of participation. Particularly, the co-productionist tradition highlights two systemic perspectives on participation. The first is an object-oriented and pragmatic approach that focuses on how objects, influence and/or are produced by public engagement (Barry, 2012). The second STS approach takes a more institutional and human-centric view, exploring how universally accepted public reasoning solidifies and evolves over time within specific contexts (Jasanoff, 2012). Despite their differences, systemic approaches in STS collectively emphasize the interplay of diverse participatory groups within wider systems (Chilvers et al., 2018), highlighting how these interactions contribute to socio-technical transformation which is the goal of the EU missions (European Commission, Mazzucato, et al., 2018). After this analysis, in the upcoming section, we will explore a framework that integrates both the relational perspective and the systemic approach to participation in practice.

2.5. Ecologies of Participation (EoP)

This section introduces the EoP framework as a tool for understanding and shaping participation within MIS. By integrating key elements of the relational and systemic perspectives discussed earlier, the EoP framework is introduced as a relational and co-productionist approach to understanding and intervening in systems of participation (Chilvers et al., 2018).This framework suggests that participatory activities within a system, consistently shape and update the "what, who and how", - the framework's central inquiries. These three aspects are also the subquestions of this research. Here, 'objects' (what) refer to the issues that stakeholders address and the motivations behind citizens' involvement in a project, even if it means opposition. For example, de Looze and Cuppen, 2023 explain that factors like ecological impact or health concerns can motivate public involvement. 'Subjects' (who) pertain to the individuals and groups who take part, as well as the structures that define eligibility for participation. For instance, Rut et al., 2021 have indicated that "smart: and "green" citizens, among others, participate in achieving transformative change. 'Models' (how) describe the various ways participants can engage, spanning a broad spectrum of participatory techniques from the more passive to the intensely active, including both formal invitations and self-directed involvement. For example, Wiarda et al., 2023 emphasized formal participation as a method of public involvement. Ultimately, it becomes evident that ecologies of participation will guide research towards understanding the public actors engaged in MISs. The subsequent section will highlight the research gaps, integrate the two concepts and clarify the context and the significance of the three dimensions (objects, subjects, models) for the missions.

2.6. Mission ecologies of participation: Integration of concepts

Missions and the concept of MISs are central elements in the evolving landscape of innovation policy, particularly in the context of seeking economic growth that is not only dynamic but also smart, inclusive, and sustainable. As it is previously explained, missions have ambitious, measurable and timebound objectives set to tackle grand societal challenges (Kattel & Mazzucato, 2018). The MIS is defined as the network of agents and institutions that influence the development and diffusion of innovative technological and social solutions (Elzinga et al., 2023). It is evident that MISs necessitate the cooperation of a wide range of stakeholders, with a particular emphasis on the roles of private organizations and government entities. Yet, there has been a noticeable lack of research on the engagement of the public and the roles played by public actors, including citizens, cities, and NGOs (Janssen et al., 2021). This highlights a significant gap in understanding the comprehensive involvement and potential contributions of

these public participants in missions. More specifically, the degree to which a mission-oriented approach fosters public engagement remains uncertain. Also, there is a lack of clarity regarding how public involvement varies between projects with a mission focus and those without, as well as the differences in public participation among various mission-oriented initiatives themselves (Wiarda et al., 2023). Thus, a novel perspective on participation in socio-technical transformation is necessary. To address these gaps, this thesis employs the EoP framework for mission analysis. EoP emphasizes the importance of participatory activities, in shaping the 'what, who, and how' of public participation (Chilvers et al., 2018). This approach is particularly useful in the context of missions, where achieving ambitious societal goals requires the active involvement of diverse stakeholders. The framework can be applied as a lens through which to examine public engagement on missions as causes of public engagement can be categorised in objects ("what is the issue/initiative"), subjects ("who is involved"), and models ("how are actors participating") of participation. Over the last few years, a large body of academic research has investigated missions, their actors and the reasons for participation in achieving them. However, the application of these three dimensions within the context of missions remains unclear. For example, Kirchherr et al., 2023 mention that the 'what' of participation can be to "fill governance capacity gaps" (p.4). Additionally, the article from Sonnier and Grit, 2022 mentions "citizens" and "students" as actors involved (the 'who') (p.7). As a model ('how') of participation, the report from European Commission, Chicot, et al., 2018 discusses that missions need to: "involve citizens in the design or the implementation of missions" (p.10). To illustrate how these concepts connect and relate more clearly, Table **??** presents a summary from various mission-scholars on the role of the public within the domains of objects, subjects, and models.

Lastly, the EoP framework is set to reveal how the public actors effectively contribute in missions. This approach promises a deeper understanding of the systemic and relational dynamics fundamental to mission-oriented innovations, shedding light on the objects, subjects and models of achieving societal missions.

Table 2.2: Connection of EoP with missions.

Ecologies of Participation	**Example**	**References**
Objects (the 'what')	Sustainability transition driving, governance capacity gap filling, distributive justice, democratization of innovation, mission normative stance, transformative systems change rate and direction interests, citizens' values expression, political barrier-induced citizen exclusion from change, nature's inherent challenges, biological and ecological aspects	Kirchherr et al., 2023, Kok and Klerkx, 2023, Elzinga et al., 2023, Hekkert et al., 2020, Rainville, 2022, Sonnier and Grit, 2022, Klerkx and Begemann, 2020
Subjects (the 'who')	Civil society groups, (worried) citizens, communities, public actors, students, consumers, end-users	Al-Jayyousi et al., 2023, Kirchherr et al., 2023, Rainville, 2022, Sonnier and Grit, 2022, Klerkx and Begemann, 2020, European Commission, Chicot, et al., 2018
Models (the 'how')	Formal participation, public engagement, collaborative approach, cooperative organization, innovation promotion and experimentation, knowledge exchange, ownership of problems, inclusion in narrative and solutions, network interactions, involvement in mission design and implementation	Wiarda et al., 2023, Mazzucato, 2018b, Kirchherr et al., 2023, Hekkert et al., 2020, Rainville, 2022, Sonnier and Grit, 2022, Fielke et al., 2023, European Commission, Chicot, et al., 2018

3

Methodology

This chapter outlines the research methodology employed in this study. The analysis details the research design selection, case study selection, data collection methods and the analytical techniques used to interpret the data.

3.1. Research design

The aim of this thesis is to explore mission's EoP by addressing the main research question: "How do ecologies of participation contribute to Missions?". It does so by capturing the subject, object and models of public participation in missions. Thus, a qualitative research design has been chosen to explore how public participation contributes to a specific mission, the EU Mission: Restore our Ocean and Waters (European Commission, 2021f). The adoption of a case study methodology is integral to the research design, given the focus on analyzing the collective efforts behind the EU mission for clean ocean and waters. Specifically, an embedded single case study approach was employed to examine the projects that were part of this mission at the start of the research period in February 2024. This approach allows to consider the chosen mission as the single case, with each of the different projects serving as sub-units of analysis. This design is advantageous because it enables a detailed examination of each project within its unique context, recognizing that while all projects aim towards clean oceans and water, they may operate under diverse conditions, employ different methodologies or face unique challenges.

3.2. Case study explanation

The specific case that this research focused on is the EU Mission: Restore our Ocean and Waters. The detailed list of the projects that consist this mission as of February 2024 can be seen in Table 3.1. By utilizing blue investments, research and innovation and citizen involvement, this missions aims to safeguard and re-establish the health of our waterways by 2030. Furthermore, this mission fosters regional engagement by establishing area-specific "lighthouses" in key sea and river basins such as Atlantic-Arctic, Mediterranean Sea, Baltic-North Sea and Danube-Black Sea. These mission lighthouses serve as central hubs for piloting, demonstrating, developing, and implementing the activities throughout the EU's seas and river basins (European Commission, 2021g). Launched as part of the EU Horizon 2021-2027 programme in 2021, the mission is built around three concrete goals that are explained in the Implementation plan (European Commission, 2023c): a) protect and restore marine and freshwater ecosystems and

biodiversity, b) prevent and eliminate pollution of our ocean, seas and waters and c) make the sustainable blue economy carbon-neutral and circular (p.5). All the three goals have measurable objectives outlined in the mission's Charter (European Commission, 2024e). For example, the aim is to restore at least 25,000 km of free-flowing rivers and to reduce by at least 50% plastic litter at sea. For its success, more than 40 project have already received financing and will be conducted to engage a wide spectrum of stakeholders, from regional communities to international partners across EU.

The restoration of ocean and waters can be categorized as wicked problem as it is "complex, defy simple explanations and resist straightforward solutions" (Rittel & Webber, 1973). This issue stems from a range of factors, including the nature of ecological, economic and social issues, which means actions in one area can lead to unforeseen consequences in another. The dynamic nature of marine ecosystems, which are constantly changing due to natural and human influences, adds to the difficulty of predicting outcomes and crafting lasting solutions. The involvement of diverse stakeholders—governments, businesses, local communities and international organizations—each with their own priorities, complicates the implementation of solutions too. This case study is also relevant due to its emphasis on addressing social and environmental challenges through innovation, promoting socio-technical transformation. Furthermore, it is particularly valuable for the research due to its emphasis on public involvement, providing insights into the EoP aspects. Moreover, this mission was chosen because of the extensive data accessible online and the fact that some projects have already been implemented, allowing their outcomes to be examined and utilized for further analysis. As a result, with this selection, our aim was to explore the participatory models and relationships essential for successful mission-oriented systems. The EU Mission: Restore our Ocean and Waters showcased the power of collective action in tackling environmental challenges, serving as a prime example for this research.

Table 3.1: Projects in the EU Mission: Restore our Ocean and Waters until February 2024.

No.	Title	Source
1	BlueMissionAA	https://bluemissionaa.eu/
2	BlueMissionBANOS	https://bluemissionbanos.eu/
3	BlueMissionMed 3	https://bluemissionmed.eu/
4	EcoDaLLi	https://ecodalli.eu/
5	PREP4BLUE	https://prep4blue.eu/
6	AlgaePro BANOS	https://algaeprobanos.eu/
7	COOL BLUE	https://coolbluefuture.org/
8	LOCALITY	https://www.locality-algae.eu/
9	OLAMUR	https://olamur.eu/
10	ULTFARMS	https://ultfarms.eu/
11	C-FAARER	https://www.c-faarer.eu/
12	FLOW	https://www.flowhorizon.eu/
13	OTTERS	https://otters-eu.aua.am/

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No.	Title	Source
14	ProBleu	https://probleu.school/
15	SHORE	https://shoreproject.eu/
16	Blue4ALL	https://www.blue4all.eu/
17	OCEAN CITIZEN	https://oceancitizen.eu/
18	PROTECT BALTIC 5	https://protectbaltic.eu/
19	DTO-BioFlow	https://dto-bioflow.eu/
20	EDITO-Infra	https://edito-infra.eu/
21	EDITO-Model Lab	https://edito-modellab.eu/
22	AQUARIUS	https://aquarius-ri.eu/
23	iMERMAID	https://imermaid.eu/
24	INSPIRE	https://inspire-europe.org/
25	NETTAG+	https://www.inesctec.pt/
26	PlasticPiratesEU	https://www.plastic-pirates.eu/en
27	REMEDIES	https://remedies-for-ocean.eu/
28	RHE-MEDiation	https://rhemediation.eu/
29	SeaClear2.0	https://seaclear-project.eu/
30	UPSTREAM	https://upstream-project.eu/
31	A-AAgora	https://a-aagora.eu/
32	CLIMAREST	https://climarest.eu/
33	DALIA	https://dalia-danube.eu/
34	DANUBE4all	https://www.danube4allproject.eu/
35	DaWetRest	https://dawetrest.eu/
36	Restore4Life	https://restore4life.eu/
37	Effective	https://effective-euproject.eu/

3.3. Data collection

In this study, four sources was utilized to study how EoP contribute to the specific European Commission's mission. This triangulation approach refers to the method of using multiple sources, types, or methods of data to enhance the accuracy and validity of the outcomes. First of all, data was collected through a designed questionnaire-survey targeted at the Project Managers of the 37 projects constituting this mission (see Appendix B). The questions focused on taking key information that aligns with the EoP framework, specifically addressing the "what", "how", and "who" of the public participation in each project. This includes the issue each project aims to tackle, the participatory methods employed to engage stakeholders, and the type of actors involved in the project's execution. Additionally, it was also important to understand the mission's objective, thus in what ways they think public participation contributes to it. A total of 8 replies were received from the project managers/coordinators. However, it

is important to note that 9 of the 37 projects were primarily focused on technological aspects and coordination activities, without prioritizing public engagement.

To complement and triangulate the primary data collection method, we also delved into three additional sources, namely the projects' online websites, the CORDIS EU data repository and 18 policy documents available for this mission. Websites were analyzed to gather information and resources about public actors, their reasons for participating, and their methods of engagement. Similarly, the CORDIS EU data repository, known for its collection of project results and documentation submitted to the EU, was a crucial resource for accessing detailed reports, project descriptions and deliverables. Lastly, the study examined the 18 policy documents available for the mission (Table 3.2). These documents was scanned to extract relevant data and insights on policy directives, guidelines and frameworks that govern the mission's objectives and the role of public participation within it. This analysis provided a deeper understanding of the policy context and support a more comprehensive evaluation of the EoP in this mission.

Table 3.2: Policy Documents of the EU Mission: Restore our Ocean and Waters.

No.	Title	Source
1	EU Missions two years on: assessment of progress and way forward	European Commission, 2023b
2	EU Missions two years on: An assessment of progress in shaping the future we want and reporting on the review of Mission Areas and areas for institutionalised partnerships based on Articles 185 and 187 TFEU	European Commission, 2023a
3	EU Mission Restore our Ocean and Waters Implementation Plan	European Commission, 2023c
4	Communication from the Commission on European Missions	European Commission, 2021c
5	Portfolio analysis, EU mission "Restore our Ocean and Waters by 2030"	European Commission, Chimini, et al., 2023
6	Research and innovation solutions to tackle marine litter: Report of R&I project cluster analysis	European Commission, Tchompalova, et al., 2023
7	Marine biodiversity modelling study	European Commission and Directorate-General for Research and Innovation, 2022a
8	MarBioME	European Commission, Jessop, et al., 2023
9	Baseline study for the Atlantic/Arctic, Danube and Mediterranean lighthouses	European Commission, Alao Chanou, et al., 2023

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No.	Title	Source
10	Baltic and North Sea Baseline study	European Commission and Directorate-General for Research and Innovation, 2023
11	Emotional disconnect with Europe's aquatic environments	European Commission, McKinley, et al., 2021
12	Foresight report for Mission Area Healthy Oceans, Seas, Coastal and Inland Waters	European Commission, Lacroix, et al., 2021
13	Restore our ocean and waters: What's in it for me?	European Commission and Directorate-General for Research and Innovation, 2022b
14	Restore our ocean and waters: A synergy info pack by CORDIS	European Commission et al., 2022
15	EU Mission Restore our Ocean and Waters factsheet	European Commission and Directorate-General for Research and Innovation, 2021b
16	Proposed Mission: Mission Starfish 2030, restore our ocean and waters	European Commission et al., 2020
17	Interim report: Regenerating our ocean and waters	European Commission and Directorate-General for Research and Innovation, 2020
18	Mission area summary - Healthy oceans, seas, coastal and inland waters	European Commission, 2024d

3.4. Data analysis

As a first step, the study incorporated content analysis to examine the textual content within project documentation and websites. For the analysis of the collected data, the study initially employed open coding—a qualitative analysis technique to break the data into discrete parts and label them with codes. For this, we thematically coded the policy documents, data found on websites, CORDIS information and survey results using ATLAS.ti (version 24). Our themes were derived from the EoP framework and our literature review of public participation in missions, as discussed in Chapter 2. Additionally, we added some codes inductively when new themes emerged that were not yet reflected in Table **??**. As a second step, axial coding was incorporated into the research to complement the open coding process by organizing the codes into coherent themes, allowing for the identification of coherence and patterns between the data. Instead of focusing on individual observations, we searched for patterns and commonly recurring themes. As coding rules, we created codes that helped us answer the three questions of EoP.

Through this analysis, coding was not only helped identify themes and answer the questions

but also allowed for the triangulation of data across different sources, thereby strengthening the validity of the findings. Reliability was improved by maintaining a record, documenting every step from data collection through to analysis. This includes the process of how codes and themes were derived, ensuring that the research process is transparent and reproducible. Reliability was also enhanced by discussing with Dr. Martijn Wiarda and the supervisors throughout our meetings the selected codes from the data. Lastly, it is important to note that we used a similar approach to analyze and present the data, as utilized by de Looze and Cuppen, 2023. Thus, in Chapter 4, we will elaborate on the general patterns regarding public participation in the EU Mission: Restore our Ocean and Waters regarding objects, subjects and models of participation as found in the data.

4

Results

In this chapter, we elaborate on the general patterns regarding public participation in the EU Mission: Restore our Ocean and Waters regarding objects, subjects and models of participation as found in the data.

4.1. Objects

In our data analysis, we identified a total of 42 codes that capture the objects of public participation within the EU mission: Restore our Ocean and Waters. These codes were categorized into six main themes that are presented in Table 4.1, each highlighting a distinct interest for engagement.

Table 4.1: Objects of public participation.

Theme	Codes	Description
Education and awareness	To increase knowledge on environmental issues, to increase knowledge on ocean literacy, to connect youth with oceans and waters, to inform other actors, to increase mission's awareness, to integrate their knowledge/input in our restoration activities	Lack of knowledge is the most important reason for the citizens to engage in the mission. This category is vital for building a foundation of knowledge and awareness necessary for meaningful participation. Regarding their motivation, it focuses on empowering communities and individuals to advocate for and implement sustainable practices effectively.

Continued on next page

Table 4.1

Theme	Codes	Description
Community building	To build a community, Networking, to strengthen democracy, to create an environmentally-conscious community, to make a tangible contribution, to participate in scientific research, to become an active citizen, to make connections with stakeholders, to improve resilience of the local communities, to inform other actors, to define policies, to address public concerns	This theme underscores the efforts of the mission to build a community around it. With this, it strengthens ties and enhances public involvement across each initiative, fostering networks that boost environmental advocacy. Also, this category emphasizes the importance of collective action and involvement in policy making.
Environmental conservation	To protect the environment, to protect water biodiversity, to clean waters, to improve water quality, to reduce tourism consequences, to reduce plastic pollution, to build human-waters relations	The public is engaged in order to address sustainability challenges. In this category, citizens directly address the mission's core objective of restoring and protecting ocean and water health through conservation efforts, sustainable resource management, and pollution reduction.
Economic benefits	To make money, to develop business models, to create new products, to build a market, to strengthen their food sovereignty, to promote tourism	Economic initiatives is another important driver for participation. This theme emphasizes economic growth opportunities that arise from the mission through sustainable practices that capitalize on the mission's objectives, providing new opportunities for local and broader economic development.

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Table 4.1

Theme	Codes	Description
Social transformation	To promote social transformation, lack of opportunities for young people, to reduce corporate interests, to reduce bureaucracy, to provide local insights, to provide cultural context insights, to maintain an adequate drinking water supply, to ensure human well-being, to become an active citizen, to ensure the emotional connection with aquatic environments, to engender emotional connections	Focuses on the social dimensions of the projects to ensure that the benefits of the new practices are widely distributed and contribute to public's well-being. Additionally, this theme addresses the impacts of the projects such as tourism and other economic activities on locals.
Innovation	To participate in innovative activities, to collect data, to share data	The reason behind the engagement of the public in such actions is to participate and support the advancement of digital and data-driven solutions.

In analyzing the objects driving public engagement in the EU mission: Restore our Ocean and Waters, we saw various connections between the main themes: education and awareness, community engagement, environmental conservation, economic benefits, social transformation and innovation. These interconnected elements not only answers the first sub-question of why individuals choose to engage in this mission but also illustrates how different motivations/issues support, enhance or overflow with each other.

At the center of public engagement is the education and awareness theme, which addresses a critical issue: the lack of knowledge and awareness about the issues that each project addresses. Specifically, three Project Managers noted in the survey that "raising awareness about plastic pollution" is a fundamental motivation for citizens' engagement. Additionally, analyzing the majority of the project's data, we saw that many projects are specifically focused on Education activities such as FLOW, ProBlue and SHORE. To address this focus, educational 'models' such as webinars, workshops, and school programs offer vital information on environmental stewardship and ocean literacy. From the data, the motivation of this theme is clear—people are more likely to engage in environmental actions when they understand the issues and feel capable of contributing meaningfully. This is highlighted by the OTTER project in CORDIS (European Commission, 2024b), which states: "...it is important to have an understanding of scientific practices and processes. This understanding also helps students to become active participants...". It is also important to note that this object overlaps and empowers each and every other category. For instance, before the publics can engage effectively in addressing marine life challenges or seizing economic opportunities, they must first learn about the issues and then learn how to overcome knowledge barriers.

Reasons in community building theme emphasize the importance of citizens forming networks and actively participating to address mission's challenges and concerns. This theme is capturing the drive for individual participation that starts from a desire to contribute to a collective effort, reflecting a natural human tendency toward community involvement and cooperation when facing shared challenges such as the ocean and water ones. An example of this theme can be seen in in an article for ProBleu project from Ceccaroni et al., 2023 which highlights one of the mission's objectives as "to mobilize and engage the broader community through the activities of the Network of European Blue Schools" (p.2). Additionally, this theme interrelates with the Education category, as engaging in community initiatives often serves as an opportunity to gain knowledge and increase awareness. This is evident in the data, as shown by the description for SHORE project in the CORDIS repository, which states: "will focus on engaging and mobilizing students, teachers, and schools to implement the Mission Ocean objectives by increasing ocean literacy through community activities." (European Commission, 2024c) Furthermore, environmental protection often becomes a core value within these new communities, tightly integrating community building with the Environmental Conservation theme. Also, initially, individuals join community efforts for social reasons, but these interactions can lead to economic opportunities as citizens collaborate to develop products or engage in new business models as we saw in projects like C-FAARER and COOL BLUE. Thus, motivations can evolve from community involvement to economic incentives over time.

The environmental conservation category directly addresses the mission's core objectives of restoring and protecting the waters. Public engagement in this category is driven by a direct concern for the environment and a desire to see tangible outcomes in their locations. This includes reasons such as habitat restoration, pollution redaction and water quality, which not only improve environmental conditions but also provide participants with a sense of direct accomplishment and stewardship. This theme is foundational to the mission and is evident in numerous projects within the data set. But more specifically, projects like iMERMAID, INSPIRE, NETTAGPlus, REMEDIES, RHE-MEDiation, SEACLEAR and UPSTREAM focus primarily on pollution prevention and environmental impact. Similarly, the interconnection of this category with the other categories enhances the overall mission by grounding every activity in the mission's primary goal of restoring the health of our waters. For instance, community building efforts are focused around a shared environmental goal, such as organizing clean-up events or developing local strategies for pollution reduction, which strengthens communal ties and deals with climate change in the same time. Also, economic activities also overlap and connect with environmental reasons, particularly through the promotion of green business practices and eco-friendly economic models. Thus, the motivation for participation can be for both categories. This can be seen in projects like OCEAN CITIZEN, whose description on CORDIS (European Commission, 2024a) states that "...an advanced restoration program must conjoin ecological perspectives together with societal commitment and clear economic benefits for local communities." Lastly, this category benefits from and supports the educational efforts, as well-informed citizens are more effective conservators.

Economic benefits is a theme that provides a practical motivation for engagement by aligning marine restoration and protection goals with blue economy opportunities in the different locations. Initiatives under this category promote economic growth through environmentally friendly business practices, new business models and co-created, community-driven economic models. This category is the main object in projects like C-FAARER, AlgaePro BANOS, OLAMUR, LOCALITY and ULTFARMS. By ensuring that economic activities are integrated with the blue economy objectives, this category offers a financial incentive for the objects, illustrating how environmental stewardship can coexist with and even enhance economic prosperity.

The social transformation category act as a motivation of engagement for different social issues. This theme focuses on addressing the social dimensions of projects' efforts, such as reducing bureaucracy, integrate cultural insights, and mitigating the impacts of tourism and other economic activities on local waters. Engagement in this category is often driven by the desire for social justice and prosperity for the society, ensuring that all community members can enjoy the improvements brought about by the mission. It is also directly related to the community building category and environment protection, as it demonstrates a commitment to both ecological and social well-being. By integrating these social aspects into the projects, the mission fosters a more inclusive and supportive community environment, which is essential for the success of the projects that we analyzed. The European Commission, 2021c document emphasize this importance of the social aspect, stating that "focusing on social impact increases the chances of finding solutions for the complex societal challenges that the missions address." (p.4)

Innovation is another emerging reason what drives involvement of the public. Novel activities such as data collection and sharing through digital platforms of the mission, can enhance issues and capabilities across all other themes by providing insights. Thus, there is a continuous overlap with this object and the other categories as well. These technologies support educational programs, policy formulation, and economic activities and thus can enhance the mission's effectiveness. Furthermore, while individuals may initially participate due to an interest in the technological aspects, their increased exposure to the mission's objectives often heightens their environmental awareness. This aligns with the policy document from European Commission, Tchompalova, et al., 2023, which states: "Relying on the data collection technologies developed, policymakers, other scientists and the general public will be able to gain a better understanding of the current state of affairs in marine pollution and human impact on the marine environment" (p.19).

In summary, the interconnections among these categories create an ecosystem of participation where multiple objects support and are supported by the others. From the aforementioned data analysis, we highlighted that it is not possible to understand each object in isolation and it is vital to explain the interdependencies with each other. This approach aims to maximize the effectiveness of the mission, ensuring that public engagement is sustained and impactful. Through education, community building, policy development, environmental action, economic integration and innovation the mission tries to address both the motivations and issues that inspire public participation.

4.2. Subjects

Through the analysis of the subjects, we found 24 codes that illustrate the various actors of public participation within the selected mission. These codes were systematically categorized into six main categories, which are detailed in Table 4.2.

Table 4.2: Subjects of public participation.

Theme	Codes	Description
Educators	Educators, teachers, schools	People involved in this theme are dedicated to raising awareness and understanding about the importance of marine and water ecosystems. These actors are disseminating knowledge about the specific challenges and solutions related to each project through educational programs and various initiatives.
Users	Fishers, farmers, consumers, sailors, divers, tourists, restaurants, tour guides, innovative citizens	Consists of individuals and groups whose activities are directly linked to the marine and aquatic environments. Their involvement is critical as they implement sustainable practices and contribute to conservation efforts that directly impact the health and sustainability of these ecosystems.
NGOs	Environmental groups, cultural groups, tourism organizations	Non-governmental organizations focused on advocacy and the implementation of the projects. These groups are instrumental in mobilizing community support and action for the restoration and protection of marine and aquatic environments, ensuring that sustainability practices are deeply rooted in community efforts.

Continued on next page

Table 4.2

Theme	Codes	Description
Youth	Kids, students, university students	This theme encompasses children, school students and university students focusing on engaging young people in mission activities. These young participants are crucial as they represent the future stewards of marine environments.
Citizens	Local opinion makers, parents, local citizens, artists	This group includes all community members who actively participate in, without being organized in any other form. Their involvement is crucial for fostering community-driven responses and ensuring that project activities align with the ecological and social needs of the area, thereby supporting the broader mission objectives.
Local Media	Local media, journalists	Media actors play a pivotal role in promoting the mission by broadcasting the progress, challenges, and successes of conservation efforts. Effective communication by this group helps gain broader community support and engagement in the mission, enhancing its overall impact and visibility.

Man-made changes are putting our waters at a serious risk that demands a clear understanding of the complex relationships between different actor groups in the EU mission: Restore our Ocean and Waters (European Commission et al., 2022). Here, we consider how six key 'subject' categories work together to achieve the goals of the different projects. By examining how the various groups involved in the mission have been changing their roles and how they relate to each other, we can get a better understanding of how each group contributes to the overall success of the mission and how they all work together to make it more effective.

First of all, users are directly engaged with the marine environments through their daily activities or professions. These actors such as farmers and consumers are engaging motivated by financial initiatives as we saw in projects like C-FAARER, where various users were supported

to develop community-driven business models. Additionally, users can evolve into educators, as demonstrated in the BLUE4ALL project, where local fishers educate tourists on fish gastronomy. Users also play a crucial role in innovation. As highlighted in OTTERS project website, "data collected by citizens, particularly fishers, can be used to augment existing efforts, bridge data gaps...". This involvement not only provides valuable data but also enhances the scientific foundation of the mission. By participating in data collection and sharing their unique insights, users help drive innovation and ensure that restoration activities are based on accurate information.

Educators were another theme that was created based on the data analysis. Different projects have different goals but the educational aspects and the raising of awareness was at most importance. As we saw, schools and universities play a pivotal role in cultivating a deeper understanding of marine ecosystems and assist in the dissemination of this knowledge throughout projects. This foundation is crucial for empowering all objects-actors' categories of the public, facilitating informed decision-making and project development. Also, this theme is directly associated with citizens especially students, youth and kids. The younger population through these instructors get exposed to marine and water ecosystem complexities and issues. By targeting educational efforts specifically towards these groups, the foundational environmental awareness is built from an early age. This connection is vital as it prepares youngsters to become informed advocates for such issues, equipping them with the knowledge and skills needed to take meaningful actions as they grow. Additionally, educators can indirectly transfer their knowledge to users and citizens. This can happen in activities in where parents are participation with their children such as the CLIMAREST project.

Another important subject, that was mentioned many times in the surveys, with a center role in the system are NGOs. These organizations participate in direct action and advocacy, working to educate citizens, mobilize community support and influence policy. Their involvement ensures that local needs and viewpoints shape actions that not only restore marine ecosystems but also promote social and economic equality. NGOs support users by providing resources, training, and advocacy needed to implement the mission effectively. In the exploration of the subjects within the EU mission "Restore our Ocean and Waters," the Youth category emerges as a central theme, reflecting the mission's strong emphasis on activities for them. The European Commission et al., 2020 policy document of the mission specifically mentions "address the youth as a priority" (p.29). Engaging youth is vital as it ensures that the foundational environmental awareness is built early. Unlike other citizen groups, youth—comprising children and students—often engage with these projects with less prior knowledge and experience, making their education and development a focal point of the mission. Many projects such as DANUBE4all are tailored towards educating the youth, aiming to transform them into well-informed citizens who will carry forward the goals of environmental stewardship. Educational initiatives such as workshops, school programs, and games are designed not only to impart knowledge but also to inspire a lifelong commitment to environmental conservation. As a result, youth objects are Education and awareness and Environmental conservation.

Citizens represent a diverse group of individuals who live in, participate in or are impacted by the mission. They interrelate with all other categories, both influencing and being influenced by other actors. The level of their participation can range from passive, such as children who are primarily recipients of knowledge and awareness, to highly active, like local opinion makers who can lead projects. They can contribute to shaping the educational agenda, suggesting areas of research and collaborate in actions with users based on community needs, thereby creating a feedback loop that enriches both educational content and community engagement. This category has the most objects of interest as citizens can be interested and motivated in

both six objects of Chapter 4.1.

Lastly, local media is essential for disseminating information, raising awareness and shaping public perceptions about the mission's goals and progress. Initially, their role might focus on reporting in websites, TV, etc. but over time, they take on a more interactive role by hosting panel discussion with NGOs, users and citizens that engage the community in dialogue about regional issues. The dominant interest for them is Education and awareness.

In conclusion, the interrelated actions of these subjects create a dynamic system of participation. This system is characterized by a continuous exchange of knowledge, resources and support, facilitating the mission that is responsive to both environmental needs and community aspirations. The dynamic interplay among educators, users, NGOs, youth, citizens and local media ensures that the mission's goals are pursued in a holistic way, making the collective endeavor greater than the sum of its parts. This interconnectivity is crucial for the success of the mission, demonstrating that effective participation is not merely the sum of isolated efforts but a summary of various interactions.

4.3. Models

Finally, the data analysis identified 43 unique codes representing the different models of public participation in the mission. These codes were organized into five main themes, outlined in Table 4.3, with each theme highlighting a distinct way of involvement.

Table 4.3: Models of public participation.

Theme	Codes	Description
Educational activities	Workshops, summer school, challenge-based learning, open schooling, innovative teaching, webinars, educational content, online training platform, virtual reality (VR)	This theme is building an informed and engaged community by providing diverse educational tools and environments. It empowers the public through knowledge, enhancing their capacity to actively participate in environmental stewardship.
Active participation	Meetings and discussions, advising, interviews, games and gaming approach, clean-ups, campaigns for collecting plastic waste, hands-on experiences, brainstorming, networking, community events, competitions, feedback sessions, swimming lessons, public opinion surveys	Involves the public in direct actions and decision-making processes that increase community involvement and assist policy development, fostering a supportive community of practice for mutual learning and best practices exchange.

Continued on next page

Table 4.3

Theme	Codes	Description
Co-creation	Co-design and co-develop, open innovation community, apps, design thinking, test and optimize a process/product/method, spin-offs participation	This theme encourages involvement between citizens and scientists, policymakers, and other stakeholders to develop innovative solutions and products that support the mission's objectives.
Citizen science	Data collection, data sharing platforms, experimentation, digital twin, science shops	Focuses on incorporating data collected by the public and other scientific outcomes into the broader mission strategies, emphasizing the role of citizen science and community-gathered data in enhancing the scientific basis of conservation efforts.
Communication	Publications, media, social media, website, emails, newsletter, posters/leaflets, documentary film, mission forum	Focuses on using various media and digital platforms to enhance public understanding and engagement, ensuring the mission's goals, events and progress are widely communicated and accessible.

As the EoP framework suggests, we have to explain the interdependencies between the models-participation methods in order to properly understand public engagement in this mission. First of all, Educational activities serve as a foundational element in creating informed citizens and youngsters. Five out of eight Project Managers indicated in the surveys that activities such as workshops and webinars are essential for providing individuals with the knowledge needed to understand the scientific and socio-economic aspects of the mission. Many projects prioritize this method because educating the public and especially younger generations about the importance of water's health is seen as the most critical step in cultivating long-term environmental stewardship. Also, this understanding is crucial for empowering the public to participate actively in all the other restoration efforts that will lead to the mission's goal. As a result, these educational efforts are interconnected with all other 'method' themes, as education act as the first step that can push people to be more involved.

The theme of co-creation emphasizes collaborative involvement between citizens, scientists, policymakers and other stakeholders to develop innovative solutions and products that support the mission. This approach encompasses various activities, including co-design and co-develop projects, participation in open innovation communities, the use of apps, applying design thinking methodologies and the testing and optimization of processes, products or methods. Addi-

tionally, it includes the participation of spin-offs in further developing and scaling innovative solutions. Co-creation is crucial in bridging the gap between theory and practice. By involving a diverse range of participants, this theme fosters a collaborative environment where ideas can be exchanged freely and innovative solutions can be developed. This collaborative process is particularly effective in ensuring that the solutions created are not only scientifically sound but also practically applicable and socially acceptable. PREP4BLUE, UPSTREAM, COOL BLUE and BLUE4ALL are some examples of projects that used this method. Co-creation often starts with educational activities, which lay the groundwork for informed participation. The policy document from European Commission, Chimini, et al., 2023 recommends to the missions: "raise awareness and incentivize non-scientists to invest time in these exercises of co-designing..."(p.62). As a result, education activities can provide citizens with the necessary knowledge and skills to contribute effectively to co-creation efforts. Active participation is inherent to co-creation, as it involves direct engagement from the public in meetings, discussions and brainstorming sessions. New ideas can arise from direct participation initiatives that can inspire the development of new approaches or products. Also, co-creation is closely linked with citizen science model as well. The data that are collected through citizen science initiatives provide a valuable foundation for developing innovative solutions. By integrating this data into co-creation processes, subjects can ensure that their solutions are based on real-world observations and evidence, enhancing the relevance of their innovations.

Citizen science represents another way to involve the public in the mission, integrating their contributions throughout various stages of the project. This approach includes activities such as data collection, usage of digital twins, conducting experiments and participating in science shops. By engaging in these activities, citizens provide valuable data and insights that enhance the scientific basis of restoration efforts. As it is emphasized from a policy document of European Commission and Directorate-General for Research and Innovation, 2020, it addresses knowledge gaps by supplying missing data to the scientific community while simultaneously inspiring behavioral change and social innovation. Also, the involvement of citizens in data collection and experimentation enriches the educational content of the mission, enabling deeper understanding of marine ecosystem complexities. Projects like FLOW, OTTERS, ProBleu, and SHORE exemplify the mission's focus on citizen science. These projects leverage community-gathered data to address specific knowledge gaps identified, raising awareness and motivating others to take action. The use of digital twin technology and science shops allows citizens to visualize and experiment with data, fostering a hands-on understanding of environmental issues and solutions. As a result, through citizen science theme of the models, participants become citizen scientists, actively bridging the gap between science, policymakers and society.

Active participation is another model observed in this study, emphasizing the importance of hands-on interaction and/or direct experience for public actors. This model promotes early involvement from the beginning of the project through methods such as interviews or surveys, as seen in initiatives like ProBleu-CS, helping to shape better policies by integrating public input from the start. Furthermore, this category refers to active forms of engagement, such as beach clean-ups in project like REMEDIES and PlasticPiratesEU that do not necessarily result in tangible outputs, distinguishing it from the co-creation model. The mission also uses various other ways to involve people, such as meetings, games and campaigns for collecting plastic waste. Having these different kinds of models means more people can participate in ways that suit them best, making every project more inclusive and open. This way of involving everyone from the start ensures that the policies really reflect what's needed to protect our waters and marine life.

Lastly, although communication represents the most indirect method of participation, its role

in raising awareness and engagement cannot be overstated. This method was observed in all projects' websites as it serves as the initial step for engagement. Also, seven out of eight Project Managers mentioned this model in the surveys. Media acts as a catalyst that encourages citizens to learn and understand the mission, and then actively participate in one of the other more valuable methods. By broadcasting successes, challenges and opportunities for involvement, media ensures that the mission's narrative reaches a broad audience, thus maximizing engagement and support across all levels of participation. Additionally, the use of different media platforms caters to various demographic groups: social media tends to attract a younger audience, while newspapers and TV are more effective at reaching older generations. This diverse media approach is essential as it ensures the mission's objects and additional models are accessible to all segments of the population, promoting inclusive participation across the entire community.

To sum up, the analysis emphasized five main models of participation that are connected with each other. Educational activities are providing crucial knowledge through workshops and webinars, and laying the groundwork for active participation. Co-creation involves collaborative development of solutions among diverse stakeholders, starting with educational activities. Citizen science integrates public contributions through data collection and experimentation, enhancing the scientific basis of projects. Active participation emphasizes hands-on interaction from the project's onset, utilizing methods like beach clean-ups and events. Lastly, communication, is vital for raising awareness and encouraging participation, using various media platforms to engage different demographic groups.

5

Discussion

This chapter synthesizes the study's findings within the broader context of mission-oriented innovation policies. It begins with a summary of the main findings, emphasizing key subjects, objects and models of public participation. The chapter then discusses the theoretical contributions by comparing the results with existing literature and exploring the evolving dynamics of participation. It also considers the policy implications, offering suggestions to enhance public engagement in future missions. Finally, the chapter acknowledges the study's limitations and proposes directions for future research.

5.1. Main findings

Our results section suggest six key themes as the 'objects' of participation. Education and awareness emerged as a foundational element in many projects, crucial for informing and empowering the public to engage. Community engagement emphasized the importance of community and collective efforts. Environmental conservation was identified as the core objective of all projects and policy documents, with public participation driven by a direct concern for environmental outcomes. Economic benefits provided practical incentives, demonstrating that environmental stewardship can coexist with economic growth. Social transformation addressed broader social issues, integrating cultural insights and promoting social justice. Finally, innovation introduced novel methods and technologies in the mission, enhancing the effectiveness and inspiring deeper public involvement.

Furthermore, the analysis of the 'subjects' revealed six key categories. First of all, users such as fishers and consumers have various roles across projects. Educators focus on raising awareness and disseminating knowledge, particularly among the youth. NGOs play a central role in advocacy and direct action, bridging gaps between mission's stakeholders. Youth is prioritized in many projects, with tailored educational initiatives fostering early environmental awareness and lifelong commitment to water issues. Citizens showed different participation levels (high and low), influencing educational agendas and actions, driven by a wide range of motivations spanning all six themes. Local Media is essential for disseminating information and shaping public perceptions, evolving from reporting to facilitating community dialogue.

The analysis of the 'models' underscores the vital role of the main five interconnected methods. First of all, educational activities serve as the foundation, equipping citizens with the knowledge needed to engage meaningfully in restoration efforts. Co-creation emphasizes collaborative development between citizens, scientists and policymakers, leading to innovative solutions that

are both scientifically sound and socially applicable. Citizen science involves the public in data collection and experiments providing essential inputs that address knowledge gaps and inspire social innovation. Active Participation ensures inclusive engagement from the project's outset, incorporating diverse methods like meetings and beach clean-ups to shape policies and drive the mission. Lastly, communication plays a critical role in raising awareness and encouraging involvement across all subjects.

The findings related to the three aspects of the EoP framework answer the three sub-questions. Additionally, these findings represent one of the first approaches to mapping and explaining the roles and connections between publics engaged in missions. This approach contributes to both MIP literature and MIS literature by providing a detailed understanding of public actors' interactions and relationships within the system (Mazzucato, 2018a; Elzinga et al., 2023; Schot and Steinmueller, 2018). By zooming in on these actors, the analysis showcases how they act, collaborate and influence the mission's progress. Furthermore, this examination enhances our understanding of societal engagement with socio-technical change, thereby enriching the public participation literature (Rowe and Frewer, 2005). Through this framework, we gain valuable insights into the dynamics of public participation, fostering a deeper appreciation of how societal involvement drives and shapes missions in this new era of policy (Chilvers and Longhurst, 2016; Chilvers et al., 2018).

5.2. Comparison with the literature review

The results' section (Chapter 4) of public engagement provides a understanding of the objects, subjects and models in missions. By comparing these findings with the ones identified in the current literature of missions in Chapter 2, we can highlight both alignment and difference, offering valuable insights into the dynamics of public participation. Our empirical findings identified six primary themes driving public engagement. Education and awareness align with the literature's focus on democratizing innovation and citizens' values expression by emphasizing the importance of informed participation, with a specific focus on ocean literacy. Community building aligns with governance capacity gap filling, distributive justice and democratization of innovation. It emphasizes the role of social capital in fostering collective action, highlighting how building community networks can enhance democratic participation and support mission objectives. Environmental conservation corresponds with sustainability transition driving and biological and ecological aspects, emphasizing tangible environmental outcomes. Social transformation aligns with transformative systems change, distributive justice and overcoming political barriers objects that we saw in the literature. However, economic benefits that were found in the data, did not show similarities with the objects identified in the literature review. Additionally, the innovation theme, which was found in our data, was not evidenced in the literature; there was no indication that people participate because they want to be part of innovative activities.

Additionally, the results provide a detailed understanding of the subjects involved, revealing both alignment and divergence when compared with the current literature on missions. The literature review identified key subjects such as civil society groups, (worried) citizens, communities, public actors, students, consumers, and end-users. In contrast, our empirical findings identified six primary categories. Educators, although not found in the literature, emerged as a significant category in our study, highlighting their pivotal role in raising awareness. Users, encompassing fishers, farmers, etc. correspond with the literature's categories of consumers and end-users, providing a more detailed breakdown. NGOs align with civil society groups, emphasizing their role in advocacy and organizing community efforts. This alignment under-

scores the importance of NGOs in mobilizing public participation and ensuring that diverse voices are heard in mission-oriented initiatives. The youth category directly aligns with the literature's focus on students, underscoring the importance of engaging young individuals. Citizens expand on the literature's focus on (worried) citizens and communities, offering a nuanced understanding of diverse roles within the society. This category reflects the broad spectrum of public participation, from passive engagement to active leadership in mission activities. Lastly, local media is not explicitly covered in the literature but the data showed their crucial role for disseminating information, raising awareness, and fostering community dialogue.

Our analysis of the models provides a comprehensive view of how the public is involved in mission activities. The theory identified some general models such as innovation promotion and experimentation, knowledge exchange, inclusion in narrative and solutions, network interactions, and involvement in mission design. In addition, our empirical findings identified five primary models. Educational activities align with the literature's focus on knowledge exchange, emphasizing the importance of informing the public. These activities provide the foundation for meaningful participation, ensuring that citizens have the necessary knowledge to engage with mission objectives. Active participation, encompassing activities like meetings and clean-ups, corresponds with formal participation, public engagement, and network interactions, showcasing diverse ways to involve the public. Co-creation aligns with collaborative approaches and innovation promotion, highlighting the collaborative and innovative nature of engagement. Citizen science corresponds with innovation experimentation and inclusion in narrative and solutions. This model emphasizes the importance of public involvement in data collection and experimentation, providing valuable insights that enhance the scientific basis of mission activities. Communication aligns with knowledge exchange and public engagement, emphasizing the role of diverse communication methods in engaging the public. Effective communication is essential for raising awareness, promoting participation, and ensuring that mission objectives are understood and supported by a broad audience. While the models found in the data analysis are more focused and provide more detailed insights, they generally align with the ones identified in the literature review.

5.3. Theoretical contribution

As Chilvers et al., 2018 emphasized in the EoP framework, participation should not be viewed as isolated, discrete events. Instead, it should be considered a relational and systemic concern, focusing on how individual practices interrelate and connect with broader spaces and systems of participation. The insights from the projects that are already in progress provide an understanding of the dynamics of participation and how systems of participation evolve over time. The analysis reveals that motivations for participation evolve from community involvement to awareness or economic incentives over time. Additionally, community building is crucial for policy making, creating an informed foundation that supports the development of sustainable policies. Over time, new policies can further strengthen communities, necessitating gatherings and activities that bring together the publics. Over time, this growing awareness can inspire them also to engage more in community-building efforts or to explore economic opportunities, demonstrating the transformative impact of innovation on participant motivation and engagement. Regarding the subjects, it is also important to understand the interdependence of users with NGOs, who ensure adherence to ecological preservation goals. This interplay ensures that all their activities align with the mission's main focus, which is the health of the waters in EU, and not contradict for their interest. As these stakeholders gain a deeper understanding of environmental issues and witness the benefits of sustainable practices, their roles shift towards advocacy or/and leadership in promoting sustainability within the mission. As awareness in-

creases and educational initiatives progress, the role of educators become more specialized, focusing on cutting-edge research and initiatives. As we also saw in our data, educators are involved in training other educators to ensure a broader impact. NGOs often bridge the gap between government, academia, policymakers, users and citizens. As the mission progresses, their role can expand to include partnership building with governmental and international organizations and evaluation of the results produced. As a result, their focus can shift from local to global issues, aiming to replicate successful local models on a larger scale. Citizens have the potential to transition into various roles as we saw in the data within the mission over time, reflecting the dynamic nature of their involvement and the fluid boundaries between categories. About the models' analysis, active participation in the mission contains a variety of methods, such as meetings, events, clean-ups and other hands-on activities. Initially, these activities serve to engage people directly. Over time, the knowledge and experience acquired from these engagements can influence and transform educational methods, making them more adaptive and relevant. Also, this interaction can inspire novel ideas, leading to innovative approaches or products that further strengthen the connection between community involvement, co-creation, and educational engagement. As these activities evolve, they establish an overflow process where community insights and innovations are continuously collected, shared and integrated. This process not only enhances the mission's impact but also ensures that public participation remains dynamic and responsive to emerging challenges and opportunities. Additionally, as different models change, the role of communication also evolve. With the emergence of new engagement methods such as a new workshop or a new event, there are varying needs for communication channels to disseminate information. Initially, traditional communication methods such as newsletters and local media might be sufficient. However, as the mission progresses and becomes more complex, there is a greater reliance on digital platforms, social media and forums to reach a younger audience and maintain engagement. This adaptability in communication strategies is crucial for supporting the evolving models of participation and ensuring that all stakeholders remain informed and involved. Thus, the models of participation are not static; they develop and adapt over time, reflecting the contributions of the participants, as well as the changing needs for effective communication. In conclusion, the findings emphasize the importance of understanding objects, subjects and models of participation as dynamic and interconnected processes. Understanding the evolution of roles and the interdependencies among various aspects of the framework contribute significantly to the mission's success and to the new literature stream of participation (Chilvers et al., 2018; Chilvers and Kearnes, 2020; Chilvers et al., 2021).

Regarding the maturity of the selected mission, one of the significant factors influencing the findings is the early stage of the EU Mission: Restore our Ocean and Waters. Since the mission has recently started, with many projects still in their initial stage or yet to begin, the full impact of participation cannot yet be fully assessed. This early stage presents both opportunities and limitations. On the one hand, it allows for the establishment of novel objects and models that encourage dynamic engagement from diverse public actors. On the other hand, it means that the study's findings capture a short period of the mission at its inception, rather than reflecting long-term trends or outcomes. As these projects mature, we can expect the three aspects of participation to overlap differently and evolve significantly like we analyzed in the previous paragraph. The roles of publics will become more defined, and the models of engagement can be refined based on initial successes and challenges. Additionally, the mission's ability to adapt its strategies in response to early feedback and evolving contexts will be crucial in determining its long-term success. As a result, these findings contribute to the MIP and participation literature as the policymakers can leverage the findings of this analysis to make informed adjustments even for this mission. By proactively refining objects, actors and engagement

models based on initial insights, they can ensure that the mission or future missions evolve in a way that maximizes its impact and addresses emerging challenges.

The transformative change policy and MIP suggest a major revision in how we think about and carry out innovation. We saw in the Chapter 2 that MIP advocates for more broad, experimental, inclusive and thoughtful approaches that look at long-term impacts on society. The findings from the models' analysis contribute to the MIP (Mazzucato, 2018a) by revealing several aspects of engagement that diverge significantly from traditional methods such as communication. One of the most striking differences is the emphasis on both co-creation and citizen science methods. Unlike traditional top-down approaches where public input is often solicited at the end stages, data reviled many projects that actively involve citizens from the outset, incorporating their contributions throughout the project lifecycle. Subjects co-design and co-develop new products, create apps, participate in science shops and assist in testing and validation processes. This ensures that their contributions are real and highly significant, enhancing participation and the effectiveness of the mission. These initiatives not only enhance the development of new solutions but also build a sense of ownership and commitment among participants. Furthermore, integration of input or data collected by citizens into the projects marks a transformative shift as well, blurring the lines between traditional actors in innovation like scientists and citizens. However, participation alone does not guarantee knowledge generation, which represents a challenge for citizen science (Pelacho et al., 2021). Utilizing data sharing platforms, digital twins and conducting experiments not only validates and refines innovative solutions but also makes the research process more inclusive. This, brings in diverse objects with different views and ideas, enriching the project and the participation process with fresh and varied perspectives. Active participation is another aspect of this mission, utilizing varied methods such as meetings, interviews, games, VR activities, clean-ups, campaigns for collecting plastic waste, hands-on experiences, brainstorming sessions, community events and competitions. These activities ensure broad and inclusive involvement, contrasting with traditional methods that often rely on less interactive means, such as surveys or media coverage. By fostering a more interactive and engaging environment, these methods help to shape better policies and ensure that public input is included early on. The use of communication tools is another modern twist, leveraging both social media and traditional outlets to reach a wider audience and foster a more informed public. This includes publications, media coverage, website updates, emails, newsletters, posters, leaflets, documentary films, and mission forums. By broadcasting successes, challenges and opportunities for involvement, media ensures that the mission's narrative reaches a broad audience, thus maximizing support across all levels of participation. Collectively, these findings highlight a dynamic and multifaceted approach to public participation that not only enhances the mission but also sets a new standard for future policy initiatives.

As we saw earlier, participation in the mission: Restore our Ocean and Waters is driven by a variety of objects that were explained in Chapter 4.1. This motivation of the publics can be explained by using arguments that are categorized into three main perspectives: normative, instrumental, and substantive (Stirling, 2008). These perspectives help to understand better the benefits and the underlying reasons of why publics choose to engage in this mission and thereby enhance participation literature. Normative motivations focus on the ethical and democratic values of public participation, emphasizing inclusivity, fairness and the promotion of ethical practices in decision-making processes. The theme of community building underscores the democratic value of collective action and participation. Codes in this like "networking" and "to create an environmentally-conscious community" reflect the ethical commitment to social justice and inclusivity. Also, engaging citizens in policy-making aligns with the normative

motivation to enhance democratic governance. The education and awareness theme promotes inclusivity by ensuring that all community members have the knowledge and tools necessary to participate meaningfully, thereby fostering a fairer decision-making process. Instrumental objects are strategic, focusing on achieving specific outcomes such as building trust, managing reputations, and securing decision acceptance. The theme of education and awareness is instrumental in empowering communities to take action by increasing knowledge on environmental and water issues. Similarly, the theme of economic benefits provides incentives for participation through the development of business models, creation of new sea-based products and market building, aligning with the objective of blue economy-investments. The innovation theme also supports this perspective, as participation in innovative activities such as data collection and sharing enhances the mission's overall effectiveness and helps achieve specific desired outcomes of some projects that are focusing on data. Substantive objects enhance the quality of decisions by incorporating diverse knowledge and viewpoints, leading to more robust and effective solutions. The environmental conservation theme addresses the mission's core objectives of restoring and protecting waters, showing the substantive impact of public participation. Efforts to protect the environment, improve water quality and reduce plastic pollution not only align with the mission's goals but also demonstrate how public engagement leads to actual environmental benefits. Additionally, the themes of community building and social transformation highlight the substantive value of integrating local and cultural insights into the decision-making process. These themes show how diverse perspectives enrich the overall project, leading to more effective solutions. For instance, engaging communities around environmental conservation efforts strengthens the ties and addresses broader social issues, such as reducing corporate interests and ensuring human well-being. The interplay between these categories and themes highlights once again the multifaceted nature of participation that is also seen in the result section. Normative motivations often overlap with instrumental and substantive motivations. For example, building a community around environmental conservation efforts not only promotes democratic values but also strategically enhances the mission's outcomes and decision quality through collective intelligence and shared experiences. Economic activities, such as developing sustainable business models, can also connect with environmental and social goals, demonstrating the interconnections of these themes. In conclusion, understanding the objects-motivations behind public participation through normative, instrumental and substantive lenses, and aligning them with the themes that were found in our analysis, provides a complete view of why public actors engage in this mission. This categorization underscores objects critical role in public engagement by fostering a more democratic, effective and well-informed decision-making processes, ultimately contributing to the mission's success.

Hekkert et al., 2020 work in MIS discussed that: "Since a MIS emerges around problems rather than solutions, it is not clear from the outset which actors play a role in developing and diffusing innovative solutions during a mission's runtime" (p.77). Additionally, Elzinga et al., 2023 have emphasized the need for more insights into the actors within mission-oriented innovation systems literature. MISs consists of many actors from academia, government, business and the general public but this study addresses this gap by specifically focusing on the often-overlooked public actors. In examining the actors-subjects (Chapter 4.2) of participation in the EU mission: Restore our Ocean and Waters, the evidence suggests that while the mission is focusing more on the society and the number of public actors has increased, it has not necessarily diversified. The majority of the projects and policy documents highlight citizens and youth as the primary themes of engagement, often overlooking the perspectives of users. This homogeneity in participation could be a significant oversight, as effectively addressing complex environmental challenges like ocean and water restoration relies heavily on incorporating a

wide range of perspectives and solutions (Cuppen, 2012). Diverse views are essential to enrich the dialogue and innovation necessary for tackling such wicked problems. Without the input from a broader spectrum of society, including those most affected by like the users and citizens or knowledgeable about specific aspects of these challenges, there is a risk that solutions may be less effective or sustainable (Wanzenböck et al., 2020). This could result in strategies that fail to consider all potential impacts or that are unable to gain widespread acceptance and implementation, undermining the mission's objectives (Wanzenboeck and Frenken, 2020). Moreover, local media is often involved in only a few projects, potentially limiting the reach of mission communications. Similarly, NGOs, while active, may not always connect effectively with local communities, potentially overlooking local needs and insights which are critical for the adaptability and acceptance of mission's solutions. As a result, the involvement of public actors in missions often aligns more closely with predefined agendas set by government, business, or academia, rather than using the diversity of societal insights. This alignment frequently leads to a top-down approach to decision-making, where actions and strategies are dictated by these "traditional" entities, neglecting valuable input. Consequently, in missions with limited stakeholder diversity, it is not surprising that initiatives continue to be shaped largely by these traditional power holders, potentially sidelining the varied and critical contributions that a more inclusive public engagement could offer.

Based on the key concepts outlined of public engagement with science explained in an article from Michael, 2009, an analysis of the subjects identified in the mission can be approached by exploring how these subjects both define and are defined within the socio-technical context. As a result, the themes identified can be further categorized and explained based on two concepts, the Publics-in-General (PiGs) and Publics-in-Particular (PiPs). PiGs can be seen as the broader audience or general public whose engagement is often based on more general motivations and lacks specific scientific or technical knowledge. This includes groups like the youth, citizens and local media, whose involvement is more about education, active participation, communication rather than detailed technical engagement. On the other hand, PiPs are more specifically engaged due to their direct interests or impacts from the mission's outcomes. This involves groups like educators, NGOs, and users (fishers, farmers, consumers, etc.), whose activities and livelihoods are directly intertwined with marine ecosystems. These stakeholders bring specialized knowledge or interests to the project, influencing and being influenced by specific issues like marine protection, water quality improvement, and sustainable economic practices related to the blue economy. Their models of engagement involve mainly co-creation activities and research integration. This differentiation helps to understand the layered nature of public engagement in the mission, emphasizing the need for both broad support and targeted involvement to address complex the challenges effectively.

5.4. Policy implications

The findings from this study highlight several policy implications for enhancing public engagement in MIPs. Firstly, there is a need to incorporate more citizen science and co-creation activities and initiatives in missions. Although such activities were found in some projects, it is of utmost importance for missions to adopt more these novel models of engagement. By involving the public from the outset in data collection, co-design and the development of solutions, policymakers can ensure that the contributions of non-scientists are valued and can impact all the other actors invlolved. This approach not only democratizes the research process but also fosters a sense of ownership and commitment among participants, ultimately enhancing the effectiveness of the mission. Additionally, our findings reveal that active participation methods, such as gaming approaches and the use of VR or other hands-on activities, offer

exciting and easily implementable strategies for future policies. These engagement techniques provide interactive experiences that can boost public involvement and interest, suggesting that policymakers should integrate these methods into their frameworks to foster more dynamic and inclusive participation.

Secondly, the analysis showcased that it is important to ensure that all actors, including educators, users, NGOs, youth, citizens and local media, are included in the mission with a mutual sharing of responsibilities and insights. While the role of each group may vary depending on the project's focus, their collective participation is crucial. For example, in projects focused on education, youth may take on a more central role, while other projects may prioritize the practical knowledge of users. However, it is important for all subjects to be involved, as each group contributes unique perspectives and expertise. The data analysis demonstrated that this diversity enriches the mission, making solutions more democratic, widely accepted and sustainable.

5.5. Limitations and future research

In this section, it is important to stress a few limitations of this study as well as opportunities and guidelines for future research. Firstly, the focus on this specific mission within the European Commission's mission arena, may limit the generalizability of findings to other contexts or missions. Moreover, the geographical and cultural context of the study may further limit the applicability of the findings. Public participation practices that work well in the European Union context may not translate directly to other regions with different political, social and cultural environments. Another limitation is that the mission under study is still in its early stages, with many projects having just begun. This limits the ability to capture the full scope of public participation and long-term trends, as these elements are still in development. Time constraints during data collection might also affect the comprehensiveness of the findings, as they may not fully capture long-term trends or changes. Additionally, this study did not involve interviews with any stakeholders, which could have provided deeper qualitative insights into the processes and challenges of public engagement. Finally, the evolving nature of public participation models and the rapid development of new technologies mean that the findings might quickly become outdated as new methods may emerge in the upcoming years. Future research should aim to address these limitations and provide new research avenues. Novel work should aim to build upon the findings of this study by conducting a follow-up comparison after the mission's conclusion in a few years. This would allow for an analysis of new results, differences and similarities over time, providing insights into the long-term impacts and evolution of public participation practices. Additionally, comparative studies across the other four missions within the European Commission's framework would be beneficial to understand the results and effectiveness of public engagement strategies in all the other missions. Moreover, future studies should consider employing mixed methods approaches, including interviews with the Project Managers, to gather richer qualitative data. Future research should also consider categorizing data into three other sub-categories that were mention in the article of Chilvers et al., 2018. Firstly, dominant participatory practices, which are mainstream, well-established methods central to the mission framework. Secondly, diverse participatory practices, which are established but more marginal or niche methods within the broader participatory landscape. Lastly, decentred participatory practices, which are emerging approaches that exist outside of the missions but have the potential to influence future practices.

6

Conclusion

The conclusion chapter summarizes the study's key findings, addressing the research questions and reflecting on the relevance of the research. It begins by answering the main research question and sub-questions. Then outlines the research's academic and social contributions and relevance. Finally, this part aligns the research with the MOT program, demonstrating the integration of technology, innovation and societal aspects.

6.1. Answering the research questions

The aim of this research was to investigate public participation within the context of the EU Mission: Restore our Ocean and Waters using the ecologies of participation framework. Accordingly, the main research question driving this thesis was: "How do ecologies of participation contribute to Missions?" To address this question, three additional sub-questions were formulated to examine the 'objects (what)', 'subjects (who)' and 'models (how)' of public engagement. By employing the EoP framework, this study enhanced our understanding of the diverse roles and motivations of public actors in missions, their methods of participation, the benefits of such involvement and the implications for mission-oriented innovation policies and systems.

Our results identified six key themes that address the first sub-question: "What are the reasons for public actors to participate in missions?". The driving factors for public engagement include education and awareness, community engagement, environmental conservation, economic benefits, social transformation, and innovation. Education and awareness emerged as a foundational element, underscoring the need for enhanced knowledge. Community engagement emphasized the importance of collective efforts, while environmental conservation was identified as the core objective, driven by a concern for environmental outcomes. Economic benefits demonstrated that environmental stewardship can coexist with economic growth. Social transformation integrated cultural insights and promoted social justice, while innovation introduced novel methods and technologies, enhancing mission effectiveness. The second sub-question: "Who are the public actors that are participating?" revealed six categories: users, educators, NGOs, youth, citizens and local media. Users, such as fishers and consumers, played varied roles. Educators focused on raising awareness, particularly among youth. NGOs bridged gaps between stakeholders, advocating and taking direct action. Youth engagement was prioritized, fostering early environmental awareness. Citizens were included in the majority of the projects, influenced actions, driven by diverse motivations. Local media shaped public perceptions, evolving from

reporting to facilitating dialogue. The third sub-question: "How are public actors involved?" highlighted five interconnected methods: educational activities, co-creation, citizen science, active participation, and communication. Educational activities equipped subjects with the necessary knowledge. Co-creation fostered collaborative development of innovative solutions. Citizen science involved public data collection and experiments, addressing knowledge gaps. Active participation ensured inclusive engagement from the project's outset. Communication raised awareness and encouraged involvement across all subjects.

6.2. Academic relevance

Academically, as we explained in Chapter 5, this thesis contributes to the growing body of knowledge on Mission-oriented Innovation Policy (MIP), Mission-oriented Innovation Systems (MIS) and participation literature. It addresses a notable gap in existing literature by focusing on the often-overlooked role of public actors in these systems. By employing the ecologies of participation framework, the study provides a detailed analysis of the objects, subjects and models of public engagement in missions, offering new insights into the dynamics of participation. The research enriches the theoretical understanding of how public involvement can drive socio-technical transformations and influence innovation policies. It also expands the participation theory by highlighting the benefits and complexities of engaging these non-traditional actors. These contributions are crucial for developing more inclusive and effective innovation strategies that align with broader societal goals.

6.3. Social relevance

This thesis holds significant social relevance as it delves into the public participation in an emerging field, missions. By exploring why and how diverse public actors engage in mission-oriented innovation systems, the study highlights the crucial role of community involvement in achieving sustainable environmental goals. Understanding and enhancing participation not only democratizes the research and innovation process but also fosters a sense of ownership and commitment among the public, which is essential for the success of environmental initiatives. Additionally, the findings underscore the importance of inclusive and collaborative approaches to policy-making, which can lead to more effective and widely accepted solutions for societal challenges. This contributes to social justice and ensures that the voices of all stakeholders, especially those directly affected by environmental changes, are heard and integrated into decision-making processes and policies.

6.4. MOT relevance

Applying the EoP framework to understand how public actors contribute to the European Commission's missions is aligned with the Master of Science in Management of Technology. This topic integrates a scientific study within a technological context by exploring the societal and participatory dimensions crucial for the successful implementation of novel innovative technologies, such as the ones that are involved in these projects. It embodies the perspective of technology as a corporate resource, emphasizing the role of public engagement and social values in leveraging technology for sustainable innovation. This relevance extends to the domain of technology and innovation management by illustrating how collaborative efforts between technology, society, and policy can drive forward such missions. Furthermore, the topic employs methods and techniques such as innovation systems analysis, stakeholder analysis and understanding the impact of social values on technological adoption and policy-making, which are

central to the curriculum. This approach not only demonstrates the practical application of the curriculum's theoretical aspects but also underlines the importance of integrating technology management with societal needs and participatory governance to address pressing technical, social and environmental challenges.

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A

Human Research Ethics Committee (HREC) approval

A.1. Participant Information/Opening Statement

You are invited to participate in our study on public participation in EU missions. This study is being done by researcher Alexandros Baratsas from the TU Delft.

More specifically, this study examines how public actors contribute to the EU mission: Restore our Ocean and Waters, and takes +/- 10 min to complete. The data will be confidential and used for academic purposes, including publications on the topic of public actors in EU projects. We will be asking you to describe your role within the project, identify the various public actors involved, explain their reasons for participation, and detail the methods through which they engage with the project.

No personal data will be asked and anonymous responses will be stored securely in the secured university data storage, accessible only by the research team. The publications will only contain aggregated level information. All data will be preserved for up to 2 years to support potential additional scientific publication, in which you will be anonymous as well. Your participation in this study is entirely voluntary and you can withdraw at any time. Please note that if you decide to withdraw from the study, you may request the removal of your data within two weeks of your participation. After this period, data will be aggregated and anonymized, making it impossible to remove individual data points. For any questions, concerns, or additional information, please feel free to contact the Corresponding researcher: Alexandros Baratsas (a.baratsas@student.tudelft.nl) and Responsible Researcher: Martijn Wiarda (M.J.Wiarda@tudelft.nl)

By clicking through to the online survey, you are indicating your agreement to the terms presented in this Opening Statement.

A.2. Risk Assessment and Mitigation Plan

III. Risk Assessment and Mitigation Plan

NOTE: *You can find more guidance on completing this checklist here*

Please complete the following table in full for all points to which your answer is "yes". Bear in mind that the vast majority of projects involving human participants as Research Subjects also involve the collection of **Personally Identifiable Information (PII)** and/or **Personally Identifiable Research Data (PIRD)** which may pose potential risks to participants as detailed in Section G: Data Processing and Privacy below.

To ensure alighment between your risk assessment, data management and what you agree with your Research Subjects you can use the last two columns in the table below to refer to specific points in your Data Management Plan (DMP) and Informed Consent Form (ICF) – **but this is not compulsory**.

It's worth noting that **you're much more likely to need to resubmit your application if you neglect to identify potential risks**, than if you identify a potential risk and demonstrate how you will mitigate it. If necessary, the HREC will always work with you and colleagues in the Privacy Team and Data Management Services to see how, if at all possible, your research can be conducted.

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
A: Partners and collaboration						
1. Will the research be carried out in collaboration with additional organisational partners such as: • One or more collaborating research and/or commercial organisations • Either a research, or a work experience internship provider[1] *[1] If yes, please include the graduation agreement in this application*		**X**				
2. Is this research dependent on a Data Transfer or Processing Agreement with a collaborating partner or third party supplier? *If yes please provide a copy of the signed DTA/DPA*		**X**				
3. Has this research been approved by another (external) research ethics committee (e.g.: HREC and/or MREC/METC)? *If yes, please provide a copy of the approval (if possible) and summarise any key points in your Risk Management section below*		**X**				
B: Location						

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
4. Will the research take place in a country or countries, other than the Netherlands, within the EU?	**X**		Risk 1: Misinterpretation of survey questions by participants due to language differences Risk 3: Difficulty in recruiting a sufficient number of participants across countries due to varying levels of interest and accessibility.	Mitigation 1: Ensure survey materials and consent forms are written in clear and concise English, easily understandable by participants with varying levels of English proficiency. Utilize straightforward language and avoid jargon to minimize misinterpretation and enhance accessibility across diverse cultural backgrounds. Mitigation 3: Leverage TU Delft networks and collaborations with local universities. Offer acknowledgments for participation, if necessary.		
5. Will the research take place in a country or countries outside the EU?		**X**				
6. Will the research take place in a place/region or of higher risk – including known dangerous locations (in any country) or locations with non-democratic regimes?		**X**				
C: Participants						
7. Will the study involve participants who **may** be vulnerable and possibly (legally) unable to give informed consent? (e.g., children below the legal age for giving consent, people with learning difficulties, people living in care or nursing homes,).		**X**				
8. Will the study involve participants who **may** be vulnerable under specific circumstances and in specific contexts, such as victims and witnesses of violence, including domestic violence; sex workers; members of minority groups, refugees, irregular migrants or dissidents?		**X**				
9. Are the participants, outside the context of the research, in a dependent or subordinate position to the investigator (such as own children, own students or employees of either TU Delft and/or a collaborating partner organisation)? *It is essential that you safeguard against possible adverse consequences of this situation (such as allowing a student's failure to participate to your satisfaction to affect your evaluation of their coursework).*		**X**				
10. Is there a high possibility of re-identification for your participants? (e.g., do they have a very specialist job of which there are only a small number in a given country, are they members of a small community, or employees from a partner company collaborating in the research? Or are they one of only a handful of (expert) participants in the study?	**X**		1.Risk of Social or Professional Stigmatization: Re-identified, participants might face social or professional stigmatization or discrimination based on their views, status, or the information they provide.	Mitigation 1: Implement strict confidentiality measures and secure data storage practices. Ensure participants are aware of their rights and the protections in place to safeguard their identity.		

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
D: Recruiting Participants						
11. Will your participants be recruited through your own, professional, channels such as conference attendance lists, or through specific network/s such as self-help groups		**X**				
12. Will the participants be recruited or accessed in the longer term by a (legal or customary) gatekeeper? (e.g., an adult professional working with children; a community leader or family member who has this customary role – within or outside the EU; the data producer of a long-term cohort study)		**X**				
13. Will you be recruiting your participants through a crowd-sourcing service and/or involve a third party data-gathering service, such as a survey platform?		**X**				
14. Will you be offering any financial, or other, remuneration to participants, and might this induce or bias participation?		**X**				
E: Subject Matter *Research related to medical questions/health may require special attention. See also the website of the CCMO before contacting the HREC.*						
15. Will your research involve any of the following: • Medical research and/or clinical trials • Invasive sampling and/or medical imaging • Medical and *In Vitro Diagnostic Medical* Devices Research		**X**				
16. Will drugs, placebos, or other substances (e.g., drinks, foods, food or drink constituents, dietary supplements) be administered to the study participants? *If yes see here to determine whether medical ethical approval is required*		**X**				
17. Will blood or tissue samples be obtained from participants? *If yes see here to determine whether medical ethical approval is required*		**X**				
18. Does the study risk causing psychological stress or anxiety beyond that normally encountered by the participants in their life outside research?		**X**				
19. Will the study involve discussion of personal sensitive data which could put participants at increased legal, financial, reputational, security or other risk? (e.g., financial data, location data, data relating to children or other vulnerable groups) *Definitions of sensitive personal data, and special cases are provided on the TUD Privacy Team website.*		**X**				

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
20. Will the study involve disclosing commercially or professionally sensitive, or confidential information? (e.g., relating to decision-making processes or business strategies which might, for example, be of interest to competitors)		**X**				
21. Has your study been identified by the TU Delft Privacy Team as requiring a Data Processing Impact Assessment (DPIA)? *If yes please attach the advice/ approval from the Privacy Team to this application*		**X**				
22. Does your research investigate causes or areas of conflict? *If yes please confirm that your fieldwork has been discussed with the appropriate safety/security advisors and approved by your Department/Faculty.*		**X**				
23. Does your research involve observing illegal activities or data processed or provided by authorities responsible for preventing, investigating, detecting or prosecuting criminal offences *If so please confirm that your work has been discussed with the appropriate legal advisors and approved by your Department/Faculty.*		**X**				
F: Research Methods						
24. Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g., covert observation of people in non-public places).		**X**				
25. Will the study involve actively deceiving the participants? (For example, will participants be deliberately falsely informed, will information be withheld from them or will they be misled in such a way that they are likely to object or show unease when debriefed about the study).		**X**				
26. Is pain or more than mild discomfort likely to result from the study? And/or could your research activity cause an accident involving (non-) participants?		**X**				
27. Will the experiment involve the use of devices that are not 'CE' certified? *Only, if 'yes': continue with the following questions:*		**X**				
• Was the device built in-house?						
• Was it inspected by a safety expert at TU Delft? *If yes, please provide a signed device report*						
• If it was not built in-house and not CE-certified, was it inspected by some other, qualified authority in safety and approved? *If yes, please provide records of the inspection*						
28. Will your research involve face-to-face encounters with your participants and if so how will you assess and address Covid considerations?		**X**				

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
29. Will your research involve **either:** a) "big data", combined datasets, new data-gathering or new data-merging techniques which might lead to re-identification of your participants **and/or** b) artificial intelligence or algorithm training where, for example biased datasets could lead to biased outcomes?		**X**				
G: Data Processing and Privacy						
30. Will the research involve collecting, processing and/or storing any directly identifiable PII (Personally Identifiable Information) including name or email address that will be used for administrative purposes only? (eg: obtaining Informed Consent or disbursing remuneration)	**X**		No names will be collected and stored. The email address of the correspondent to the survey will be collected and stored for administrative purposes only (the address in which the survey will be send on). Risks: 1. Risk of Data Breach: The most significant risk is the unauthorized access to or disclosure of PII, leading to a data breach. 2. Risk of Accidental Disclosure: There's always a risk of accidental disclosure of PII due to human error or system failures.	Mitigation 1: Implement robust cybersecurity measures and use trusted and secure platforms for data collection and storage (like TUD's OneDrive). Mitigation 2: Regularly review and update passwords in the platform that the is stored data to minimize the risk of accidental disclosure. Mitigation 3: Collect only the PII necessary for this project's purposes and anonymize or pseudonymize data where possible to reduce the impact of potential breaches. Mitigation 4: Inform participants about their rights regarding their data.		
31. Will the research involve collecting, processing and/or storing any directly or indirectly identifiable PIRD (Personally Identifiable Research Data) including videos, pictures, IP address, gender, age etc and **what other Personal Research Data** (including personal or professional views) will you be collecting?	**X**		No videos, pictures, IP address, gender, age etc data will be collected. About the personal and professional views, the survey answers of the respondents may contain personally identifiable information. 1. Risk of Data Breach: The most significant risk is the unauthorized access to or disclosure of PII, leading to a data breach. 2. Risk of Accidental Disclosure: There's always a risk of accidental disclosure of PII due to human error or system failures.	Same as above (Issue 30)		
32. Will this research involve collecting data from the internet, social media and/or publicly available datasets which have been originally contributed by human participants	**X**		The emails and roles of the survey participants will be gathered from the projects' websites. Risks:	Mitigation 1: Always use citations to refer the source. Mitigation 2: Acknowledge any limitations regarding the representativeness of the data in research findings.		

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
			1.Privacy and consent risk: Individuals may not have consented to their data being used for research purposes, even if it's publicly available, leading to privacy concerns. 2. Bias and Representativeness risk: Data from internet may not be representative of the broader population, leading to biased research findings.	Where possible, supplement with data from other sources to address potential biases.		
33. Will your research findings be published in one or more forms in the public domain, as e.g., Masters thesis, journal publication, conference presentation or wider public dissemination?	**X**		1. Risk of misinterpretation of findings: Research findings might be misinterpreted by the public or other researchers, leading to misinformation. 2. IP and copyright risks: Using copyrighted materials without permission or failing to properly attribute sources can lead to legal and ethical issues.	Mitigation 1: Ensure clear, concise, and accessible presentation of research findings. Include limitations and context to guide interpretation. Mitigation 2: Ensure all used materials are appropriately licensed or cited.		
34. Will your research data be archived for re-use and/or teaching in an open, private or semi-open archive?	**X**		Risk 1: revealing participants identity in the supplementary material	Mitigation 1: We only share protocol related data (survey questions)		

H: More on Informed Consent and Data Management

NOTE: You can find guidance and templates for preparing your Informed Consent materials) here

Your research involves human participants as Research Subjects if you are recruiting them or actively involving or influencing, manipulating or directing them in any way in your research activities. This means you must seek informed consent and agree/ implement appropriate safeguards regardless of whether you are collecting any PIRD.

Where you are also collecting PIRD, and using Informed Consent as the legal basis for your research, you need to also make sure that your IC materials are clear on any related risks and the mitigating measures you will take – including through responsible data management.

Got a comment on this checklist or the HREC process? You can leave your comments here

IV. Signature/s

Please note that by signing this checklist list as the sole, or Responsible, researcher you are providing approval of the completeness and quality of the submission, as well as confirming alignment between GDPR, Data Management and Informed Consent requirements.

Name of Corresponding Researcher (if different from the Responsible Researcher) Alexandros Baratsas

Signature of Corresponding Researcher: 

Date: 09/04/2024

Name of Responsible Researcher (print) **Martijn Wiarda**

Signature (or upload consent by mail) Responsible Researcher: 

Date: 09/04/2024

V. Completing your HREC application

Please use the following list to check that you have provided all relevant documentation

Required:

- **Always:** This completed HREC checklist
- **Always:** A data management plan (reviewed, where necessary, by a data-steward)
- **Usually:** A complete Informed Consent form (including Participant Information) and/or Opening Statement (for online consent)

B

Survey questions

After the Participant Information, the following questions were asked to the project manager-s/coordinators of the 37 projects:

1. **What is the name of your project?**

2. **Is your project engaging the public (e.g. local citizens, local communities, teachers, students, NGOs, etc.)**

3. **What kind of publics is your project engaging?**

4. **Why is your project engaging with the public?**

5. **What are the issues that the public is interested in during the engagement?**

6. **In what ways does your project engage with the public?**