

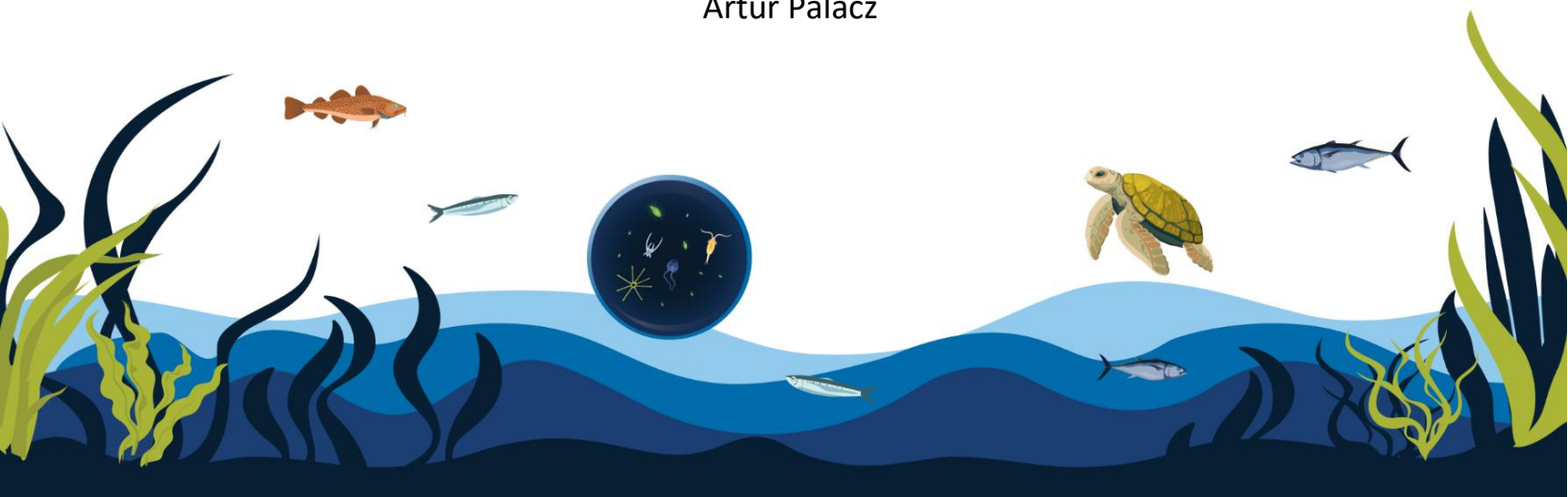
Deliverable 2.2

Initial conceptual design of the Blueprint for Integrated Ocean Science

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Executive Summary

The sustainable management and conservation of the ocean depend increasingly on our ability to observe and understand biological and ecosystem processes. While global coordination around physical and biogeochemical ocean observing has advanced significantly over the past decades, biology and ecosystems (BioEco) observations remain fragmented, unevenly implemented, and often disconnected from policy needs. The BioEcoOcean project seeks to address this gap by developing a Blueprint for Integrated Ocean Science - a practical, co-created support tool to strengthen collaboration, integration, and impact across the ocean observing system.

The Blueprint is not a prescriptive manual, but a question-based framework designed to help and encourage users to think holistically and work collaboratively. It supports all stages of ocean observing: from reviewing existing knowledge and planning monitoring efforts, through data collection and management, to analysis, product development, societal application, communication, and evaluation. The Blueprint is intended to foster cross-sector collaboration and serve as a flexible tool for diverse users - from scientists and data managers to policymakers, civil society actors, and marine practitioners.

Since the project's inception, the Blueprint has undergone substantial evolution. Initially conceptualised as a linear process in the proposal phase, it has now matured into a "spiderweb" model of nine interlinked components, reflecting the complex, non-linear reality of ocean observing. The framework has expanded from seven to nine components, to enable a more inclusive ocean observing system. These developments have been shaped through a co-creative process, involving interdisciplinary input from surveys, interviews, workshops, and feedback loops.

This deliverable presents the initial conceptual design of the Blueprint. It is grounded in a comprehensive overview of the BioEco ocean observing landscape and informed by several co-creative workshops, where experts critically examined and contributed to the Blueprint components and their interconnections. The results highlighted the need for interoperability, multi-level governance, and meaningful stakeholder engagement, particularly in under-resourced regions.

The Blueprint is being developed to align closely with global frameworks such as the Global Ocean Observing System (GOOS), the Marine Biodiversity Observation Network (MBON), and the Ocean Biodiversity Information System (OBIS). It integrates the use of Essential Ocean Variables (EOVs) to promote standardisation and comparability, and it supports the implementation of Findable, Accessible, Interoperable, Reusable (FAIR) data principles.

The next steps for the Blueprint co-creative process include broad community consultation, expert workshops, and real-world testing to ensure it becomes a practical, inclusive, and enduring tool for advancing coordinated biological and ecosystem ocean observing.

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Abbreviations

Abbreviation	Definition
AI	Artificial Intelligence
BioEco	Biology and Ecosystems
BIOS	Blueprint for Integrated Ocean Science
CBD	Convention on Biological Diversity
EMODnet	European Marine Observation and Data Network
EOV	Essential Ocean Variable
EV	Essential Variable
FAIR	Findable, Accessible, Interoperable, Reusable
GCOS	Global Climate Observing System
GOOS	Global Ocean Observing System
IMCC	International Marine Conservation Congress
MBON	Marine Biodiversity Observation Network
MSFD	Marine Strategy Framework Directive
OBIS	Ocean Biodiversity Information System
OTGA	Ocean Teacher Global Academy
SDG	Sustainable Development Goal
SWOT	Strengths, Weaknesses, Opportunities, Threats
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
UU	Uppsala University

1. Introduction

The sustainable management and conservation of ocean ecosystems hinge on our capacity to observe, understand, and respond to their complex and dynamic biological and ecological processes. While ocean observation has made significant strides in the physical and biogeochemical domains, biology and ecosystems observations — vital for tracking biodiversity, monitoring ecosystem health, and informing ecosystem-based management — remain less coordinated, less comprehensive, and less accessible (Miloslavich m.fl., 2018; Muller-Karger m.fl., 2024).

Today's landscape of biological and ecosystem ocean observing is characterised by a mosaic of initiatives that have developed over decades in response to diverse scientific questions, management needs, and regional priorities. Efforts range from long-term ecological research stations and fisheries surveys to biodiversity monitoring programmes and citizen science campaigns. These activities span a variety of spatial and temporal scales, target a wide range of taxa and habitats, and apply diverse methodologies. However, despite their richness, these initiatives are often fragmented and unevenly connected, limiting the ability to generate coherent insights across regions, scales, and disciplines.

Several initiatives have sought to improve coordination and integration. Global programs such as the Global Ocean Observing System (GOOS) and its Biology and Ecosystems Panel of Experts, the Global Climate Observing System (GCOS) and the Marine Biodiversity Observation Network (MBON), along with large data integrators such as the Ocean Biodiversity Information System (OBIS) and the European Marine Observation and Data Network (EMODnet) Biology, have begun to establish shared priorities and standards for biology and ecosystems observations through the framework of Essential Variables (EVs). These developments represent important steps towards aligning observing efforts and advancing data interoperability. However, challenges persist in many areas — from harmonising methods of data collection and ensuring sustained, consistent monitoring, to improving data management, interoperability and accessibility, developing relevant data products, and ensuring that observations are effectively applied in decision-making and societal contexts (Miloslavich m.fl., 2024; Muller-Karger m.fl., 2024).

At the same time, the ocean observing community faces growing expectations to demonstrate how observations translate into societal benefits. For instance, supporting biodiversity conservation, enabling ecosystem-based management, contributing to marine spatial planning, and informing national and international policy frameworks such as the Kunming-Montreal Global Biodiversity Framework adopted under the Convention on Biological Diversity (CBD), the Sustainable Development Goals (SDGs), the Marine Strategy Framework Directive (MSFD) and the Habitats Directive. This calls for better integration not only across scientific disciplines and observation programmes, but also across the whole ocean observing system: from reviewing existing knowledge and co-designing observation strategies, through data collection, management, and analysis, to communicating results, developing usable products, applying findings in society, and evaluating effectiveness.

To support this transition towards more integrated, interoperable, and responsive biological and ecosystem ocean observing, we are developing the Blueprint for Integrated Ocean Science (BIOS) - a structured, question-based support tool designed to foster collaboration and co-creation across all components of the ocean observing system. The Blueprint for Integrated Ocean Science (hereafter referred to as the *Blueprint*) aims to spark ideas, identify opportunities, and guide joint action among a diverse range of stakeholders, including scientists, data managers, policymakers, industry actors, and civil society.

This deliverable (D2.2) presents the initial conceptual design of the Blueprint. It builds on several foundational activities led by BioEcoOcean that underpin its development. These include a comprehensive survey of the biological and ecosystem ocean observing landscape to map existing efforts, identify gaps, and understand community needs. A series of workshops has brought together experts and stakeholders to co-develop the Blueprint and refine its structure and focus. Iterative design work has shaped the evolution of the Blueprint itself, ensuring that it reflects both the complexity of the observing landscape and the practical needs of its users. Together, these efforts lay the groundwork for a tool that can enhance integration, strengthen collaboration, and improve the societal relevance and impact of biology and ecosystem ocean observing.

2. The Blueprint for Integrated Ocean Science

Our approach to the development of the Blueprint for Integrated Ocean Science is distinctly multi-, inter-, and transdisciplinary, with co-creation embedded at its core. From the outset, we have embraced a collaborative, co-creative methodology that emphasises creative problem-solving among diverse stakeholders at all stages of the project (Fig. 1). This spans from the co-design of the Blueprint’s conceptual foundation to the co-production of its concrete outputs and resources. A co-creative approach is useful in identifying and realising challenges in the workflow and creating new, more effective solutions and pathways.

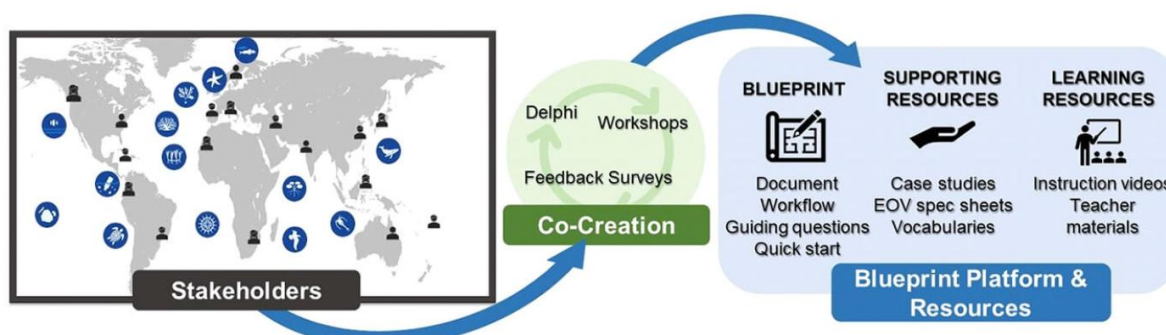


Figure 1. Illustration of the co-creative processes involving diverse stakeholders in the co-creation and of the Blueprint platform and its resources. One of the foundations in the project is the biology and ecosystem Essential Ocean Variables. Stakeholders from around the world are invited to the co-creative process. The Blueprint will be launched on an online platform, which will also include supporting resources and learning resources.

2.1 What is the Blueprint?

“A support tool to advance ocean observing”

- Question-based support tool
- To support out-of-the-box thinking, not a prescription on what to do
- To spark and encourage collaboration, and support communication across sectors
- Enable future visions with more integrated approaches and collaborations

The idea behind the Blueprint is to transform the ocean observing community from a scattered network operating largely in silos (like a disorganised container of Lego blocks, where each piece is valuable, but disconnected) into a system of interconnected and interacting processes (Fig. 2). Using guidance makes it much easier to build the Lego, and it also makes it easier to build together. Similarly, by using the Blueprint as a guiding framework, the community can better see and strengthen links between and within the ocean observing system. Together, we can build a more cohesive and integrated ocean observing community,

much like assembling an intricate Lego castle as a team. This approach will create an observing system and a community that is greater than the sum of its parts.

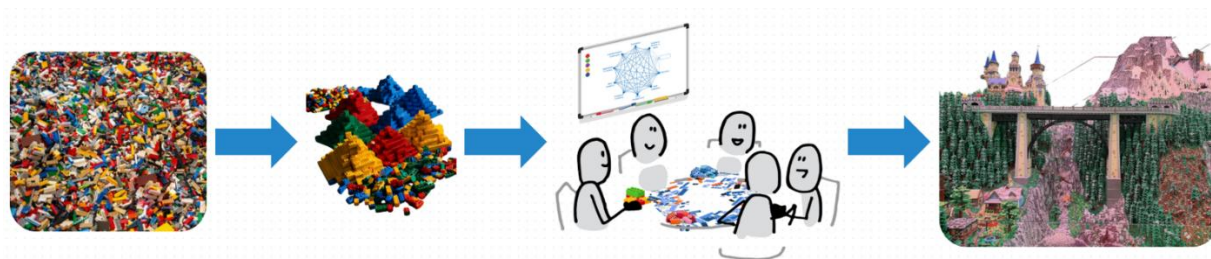


Figure 2. A visual metaphor of the co-creation process in building an integrated fit-for-purpose ocean observing system: The LEGO pieces represent the different silos within the ocean observing system; the people symbolise the stakeholders collaborating to co-create an integrated ocean observing system; and the manual used represents the Blueprint.

The Blueprint itself has already undergone several significant evolutions (please see Section 3 for the step-by-step description of the evolution). In its initial conceptualisation within the project proposal, the Blueprint was represented as a linear sequence of steps. However, through successive rounds of stakeholder engagement and collaborative design, it has evolved into a more dynamic structure, now visualised as a “spiderweb” of interconnected components (Fig. 3). This new representation underscores that there is no single, prescriptive starting point. Rather, all components are interlinked, and users may enter the Blueprint at different stages depending on their context and needs. It also better emphasises the iterative nature of the co-creative process behind building a well-functioning ocean observing system. The Blueprint encourages the interested parties to revisit and re-evaluate how well they are connected as often as needed, in a seemingly continuous process.

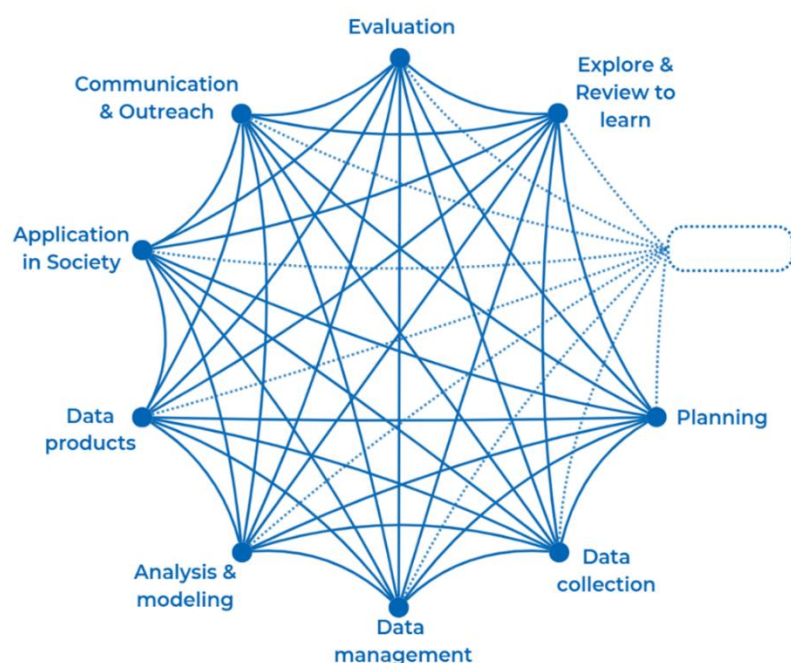


Figure 3. The current dynamic Blueprint structure is depicted as a ‘spiderweb’ of interconnected components, enabling stakeholder engagement at any point of the ocean observing process.

The Blueprint poses questions that are meant to be addressed collaboratively, often with people from different areas of expertise. The idea is not to answer every question, but to address those that are relevant to your ocean observing system, including both familiar aspects and new considerations that emerge from using the Blueprint. The key point is to encourage the involvement of relevant people (for example, a modeler, a communicator, and a strategist) to work together.

“We don’t ask about things we are not aware of”

Each component has a set of guiding questions to support users in exploring the component. Furthermore, it uses questions to connect all components to each other. Questions are a good starting point because they do not dictate what one should do, but make one aware of something that could be considered. For example; How do we connect data collection with outreach? What data products does the society need, and what data are required for those products? Are there more people doing data collection in the same area as we are? How does a modeler get hold of the data needed? How is and how should our ocean observing system be evaluated? How should we manage the data so that it is relevant for global assessments? Depending on your entry point, your context, and the aim of your work, you choose which questions should be addressed.

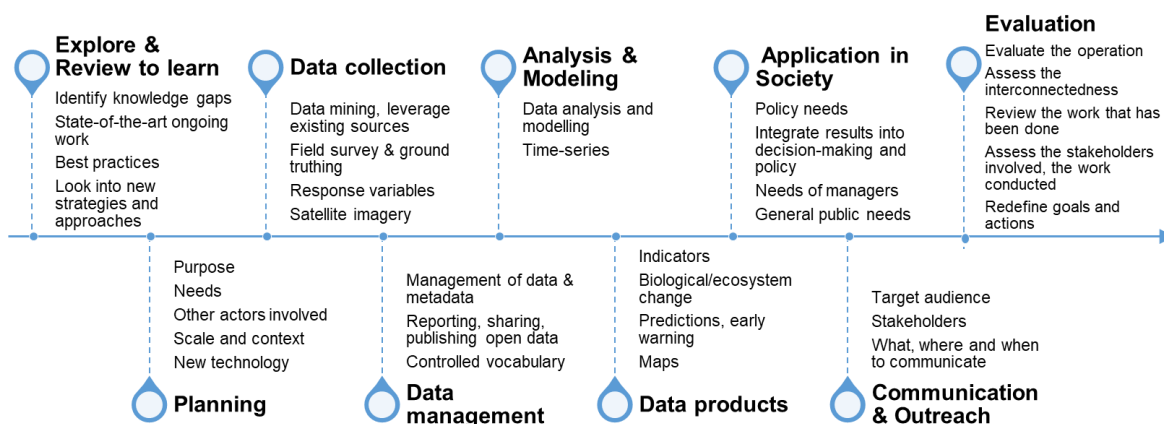


Figure 4. The nine components of the Blueprint and what they represent in our extended ocean observing system, as shaped and refined through the co-creative process.

In its current form, the Blueprint contains the following nine components (Fig. 4):

Explore & Review to Learn: This component urges you to explore beyond your normal field, and review what is out there to for example investigate state-of-the-art technologies, strategies, protocols or methodologies, with the intention to learn how they could apply to, or improve, current work, e.g., by identifying current knowledge gaps that could be addressed.

Planning: Encourages users to think about the purpose, scale, and context of the work, what is needed for successful implementation, and what parties may already be involved in similar work to establish potential collaboration opportunities. It is about planning for all components in the Ocean observing system.

Data Collection: This component is about gathering data, and what to think about how to do it. Data can be collected in many ways, such as by remote sensing, from open data, long-term monitoring programs, in the field etc.

Data Management: How data will be managed after collection, where can it be published to be openly accessible, which controlled vocabularies can be used, what steps may be needed to make data FAIR (Findable, Accessible, Interoperable, and Reusable).

Analysis & Modelling: What models or analysis techniques are most appropriate for the data, what kind of data would improve models (e.g., time series).

Data Products: Not only what kinds of products could be produced and in response to whose needs (e.g., indicators of change, predictions, maps), but what kind of data is needed to produce them.

Application in Society: How can results be integrated into decision-making, what kind of information is needed to inform policies, managers, researchers and the public to generate data-supported action. What information does society want and need, and what can be developed.

Communication & Outreach: Defining target audiences, what kind of information needs to be communicated, to whom, and at what time to make sure results are shared and then evaluated appropriately.

Evaluation: Assessment of the current work, how well others are involved, how well the work is meeting its goals (including reporting failures!), and to redefine any goals or actions accordingly. Evaluating the observing system in question.

The final Blueprint will be launched on a digital platform and will be interactive. It will have downloadable resources for its practical implementation, along with training materials on how to use it. The launch of the Blueprint is planned for late 2027.

3. The Evolution of the Blueprint

The Blueprint has undergone significant development since the start of the project, shaped throughout an ongoing co-creative process (Fig. 5). The following subsections describe this evolution in greater detail.

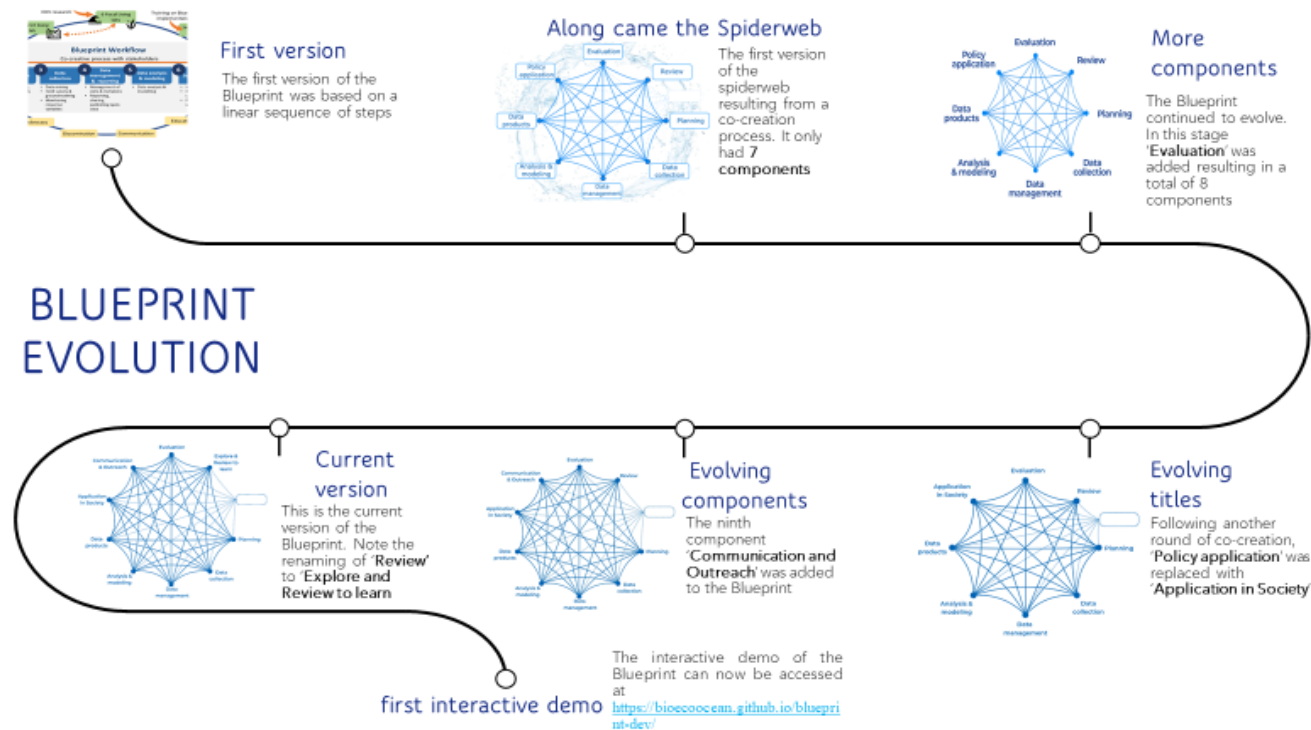


Figure 5. Blueprint evolution from a linear sequence of steps to an interactive spiderweb where all components interlink.

3.1 Initial Development of the Blueprint

From the beginning, the Blueprint was envisioned to be a support tool to enhance collaboration across the ocean observation community. Its goal was to promote a more integrated approach for collecting, managing, and applying biological and ecosystem observations. Rather than prescribing a fixed sequence of actions, it was conceived to be a flexible, question-based framework, designed to stimulate critical thinking and foster a shared understanding among actors working with different components of the ocean observing system. While the original representation of the Blueprint has developed, its goal and purpose remain unchanged.

The Blueprint's original design at the onset of the project was grounded in established best practices, including frameworks for EOVS, emerging innovations in data management, and insights from the latest scientific and technological advances (Fig. 6). It aimed to guide users across the full ocean observing value

chain and beyond, from reviewing existing knowledge and planning observations to managing data, producing outputs, supporting societal applications, and evaluating outcomes.

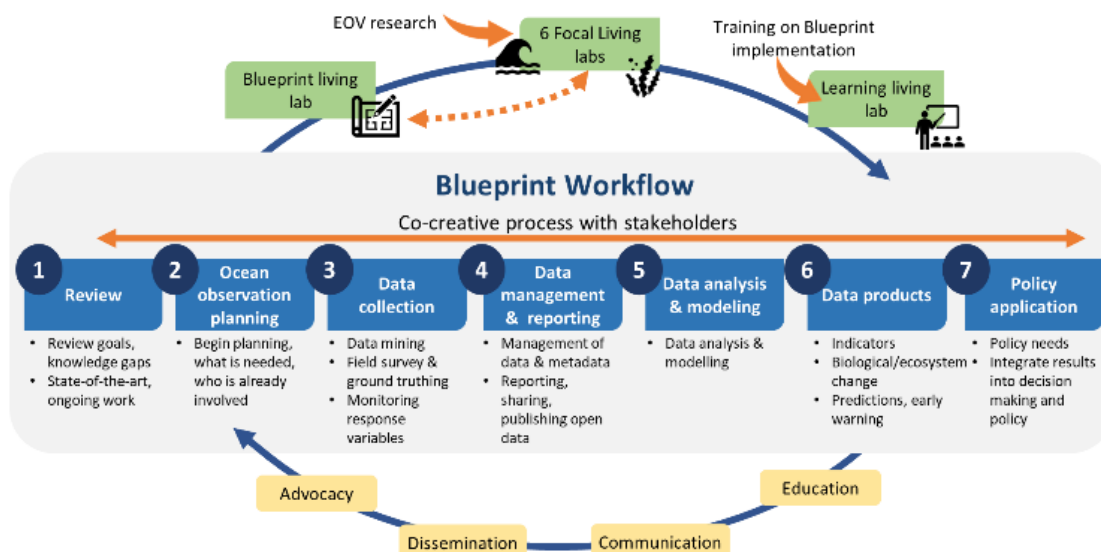


Figure 6. The structure of the initial Blueprint, depicted as a linear sequence of steps.

Early in its development, it became clear that co-creation would be essential to ensure the Blueprint's relevance and usability. Engaging a broad and diverse range of stakeholders allowed us to identify bottlenecks, expose gaps in current workflows, and co-develop innovative, practical solutions. A participatory design process was adopted to ensure that the Blueprint would reflect real-world needs and support integration across disciplines, sectors, and contexts.

To guide this co-creative process, we employ a mix of methodologies, including possibility mapping, scenario thinking, and literature reviews, to identify current challenges in the biology and ecosystems (BioEco) ocean observing system. Workshops, webinars, presentations, surveys, and feedback forms are used to gather iterative input from a wide global stakeholder base. Particular attention is given to achieving balance in gender, geography, sectoral representation, and expertise - from policy, industry, civil society, and the scientific community alike.

The Blueprint is taking a clearer shape, based on the engagements and mixed approaches, towards a communications support tool to promote systems thinking, enhance communication across communities, and support alignment with FAIR data principles. In this way, the Blueprint is positioned both as a hands-on resource to support implementation and as a strategic framework for building and scaling sustainable ocean observing systems.

In order to develop and test the Blueprint for real-life situations, the BioEcoOcean project established both physical and virtual collaborative workspaces (referred to as Living Labs) that facilitate iterative dialogue and mutual learning. These spaces bring together perspectives from policy, industry, civil society, and the scientific community. Among them, the Blueprint Living Lab serves as the dedicated environment for the Blueprint development, while the Focal Living Labs act as demonstration sites where the Blueprint is tested

and developed iteratively. This approach ensures that the Blueprint reflects real-world needs and can serve as a valuable support tool across sectors and contexts.

3.2 Literature review

During the first months of the BioEcoOcean project (Feb-May 2024), we conducted an extensive literature review and analysis of existing frameworks relevant to biology and ecosystem ocean observing. This foundational effort strongly shaped the development of the Blueprint. A particularly valuable contribution came from a master's thesis by K. Müller (Müller, 2024) supervised by L.M. Nordlund at Uppsala University, which provided a comprehensive overview of the current BioEco ocean observing landscape.

The review identified key strengths and exposed persistent challenges; particularly around coordination, integration, and usability across existing systems. It highlighted how many current efforts remain fragmented or difficult to scale and align with broader policy or management objectives. These findings helped define where and how the Blueprint could provide added value.

Informed by both the literature and follow-up expert consultations, several priority needs were identified: fostering horizontal and vertical integration across sectors and scales; offering flexible, modular guidance rather than one-size-fits-all approaches; supporting co-creation throughout the ocean observing system (including with non-academic stakeholders); and emphasising interoperability, openness, and standardisation. Crucially, the review also underscored the need to connect technical workflows with societal demands and global policy goals.

These insights continue to underpin the Blueprint's central purpose: to serve as a strategic and practical tool for strengthening and advancing biology and ecosystem ocean observing in a coordinated, inclusive, and policy-relevant manner. Further details from this literature review can be found in the report online at <https://doi.org/10.5281/zenodo.15658184>.

3.3 Consortium workshops

A series of internal Blueprint workshops were held during BioEcoOcean consortium meetings to make use of the project's broad in-house expertise and collaboratively shape the development of the Blueprint. The first of these sessions took place at the project's online Kick-off meeting in March 2024, where participants engaged in initial discussions on the Blueprint's components and structure on an interactive workspace (Fig. 7). This work was further advanced during the first in-person consortium Blueprint workshop in May 2024, which focused on identifying key challenges, proposing solutions, and drafting guiding questions for each component.

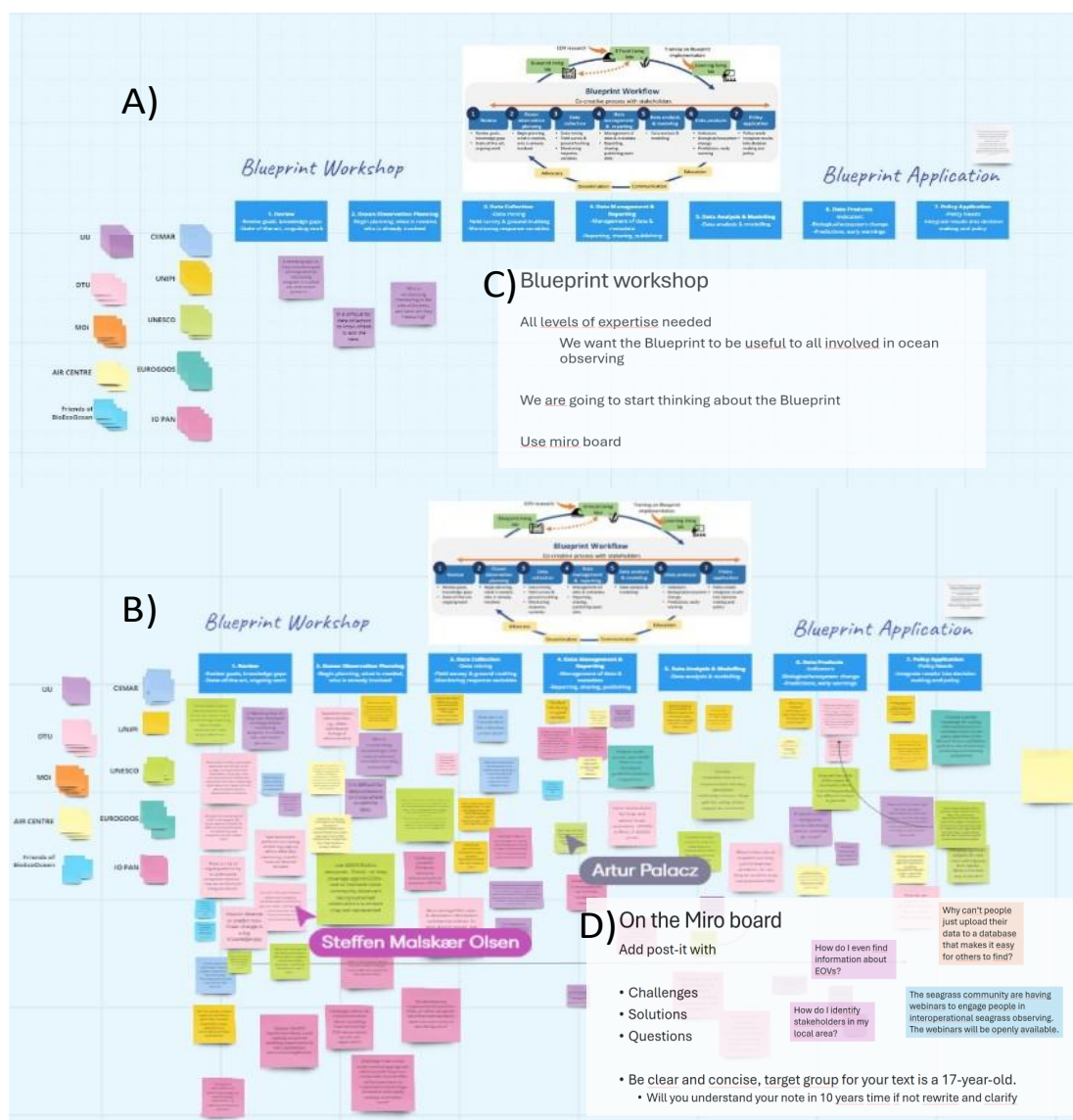


Figure 7. Screenshot of the brainstorming process using Miro Board for each of the components of the Blueprint. The upper part (A) was taken just before the brainstorming session, the lower part (B) shows the board during the brainstorming process, (C) and (D) were the overarching instructions for the participants.

3.4 Spiderweb development

Early in this Blueprint development process, it became clear that a linear design would not adequately capture the complexity of the ocean observing system and the need for interconnectedness. As a result, the Blueprint evolved into a “spiderweb” configuration, reflecting the interconnected, non-sequential and iterative nature of its components (Fig. 8). This visual redesign helps convey the importance of flexibility and integration across all parts of the observation value chain.

The first version of the spiderweb model was presented at the UN Ocean Decade Conference in Barcelona in April 2024, where it also served as the launch pad for a global stakeholder survey (Fig. 8). This marked the beginning of broader external engagement and further informed the iterative refinement of the Blueprint.

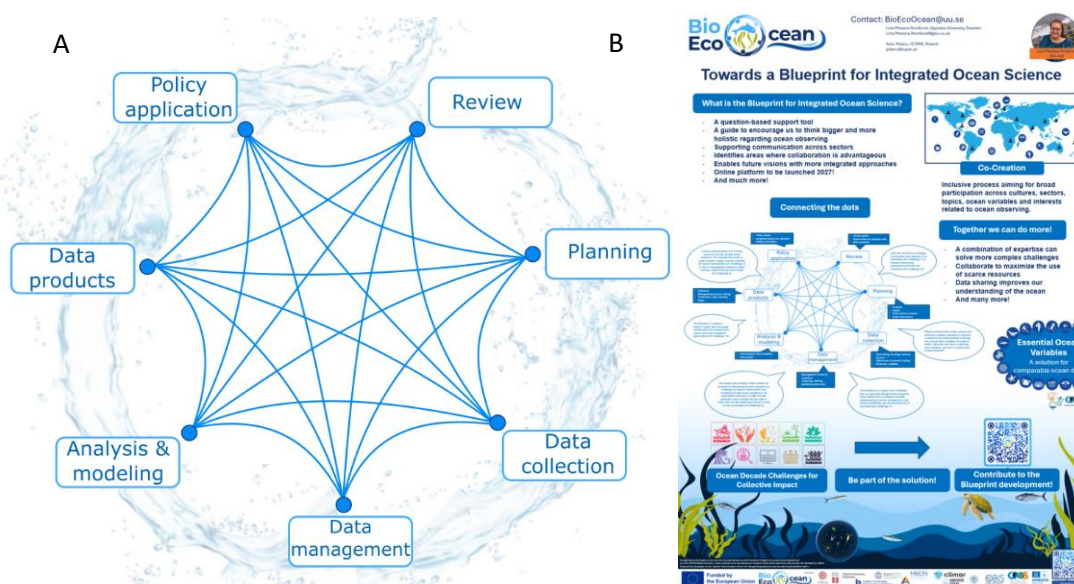


Figure 8. A) The first version of the spiderwebbed Blueprint with only seven components. The spiderweb shows how all the components connect to each other, moving away from a linear stepwise structure to interconnectedness. B) Poster presented in Barcelona at the UN Ocean Decade Conference in April 2024 (DOI: [10.5281/zenodo.10927051](https://doi.org/10.5281/zenodo.10927051)).

3.5 International Blueprint workshop

A key milestone in the early evolution of the Blueprint was the first external co-creative workshop, held in October 2024 as a Focus Group during the 7th International Marine Conservation Congress (IMCC7) in Cape Town, South Africa. This event marked the Blueprint’s first formal in-person engagement with stakeholders beyond the BioEcoOcean consortium, gathering marine conservation professionals from Africa, Asia, North America, and Europe.

Participants brought valuable insights from across the ocean observing system from a marine conservation perspective, with particular emphasis on the components related to planning, review, societal application, and evaluation. Their contributions helped refine both the Blueprint's structure and its guiding questions as well as highlighted several priority areas: the need for interoperable data management systems; recognition of non-academic and community-based contributions; integration of historical and industry-generated data; more effective communication of uncertainty; and inclusive approaches that incorporate Indigenous knowledge and environmental stewardship.

These external perspectives were highly complementary to consortium inputs and played a pivotal role in shaping the Blueprint into a more inclusive, globally relevant, and systems-aware tool. Notably, this workshop led directly to the addition of the new *Evaluation* component (Fig. 9A), and it also planted the seed for a future *Communication and Outreach* component. Further details about this event can be found in the report from the Focus Group activity online at [10.5281/zenodo.15656906](https://doi.org/10.5281/zenodo.15656906).

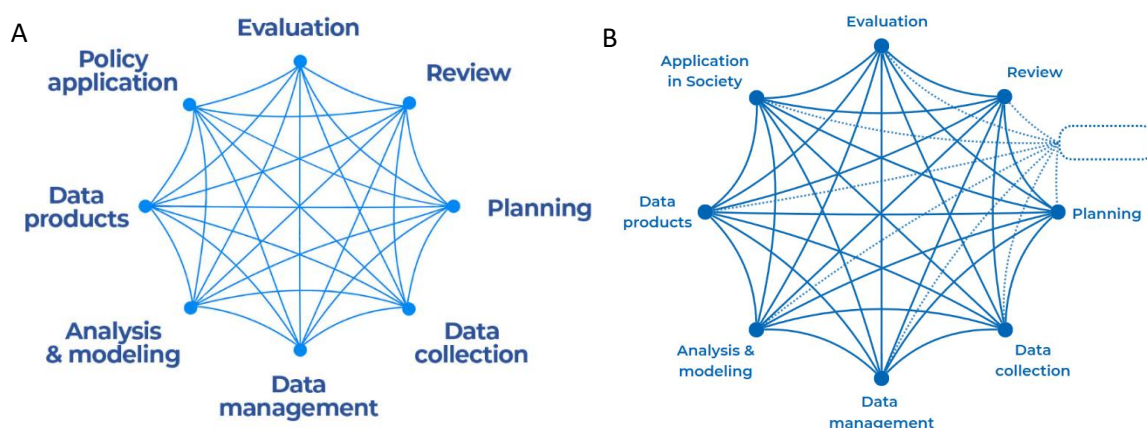


Figure 9. A, to the left: The second version of the spiderwebbed Blueprint, where an additional component, 'Evaluation', was added. This development came soon after the first spiderweb version and was based on feedback during an international workshop in South Africa. B, to the right: The third version of the spiderwebbed Blueprint, where we realised the need for an empty component, ensuring concepts are not limited to the existing components. This version also saw 'Application in Society', replacing the 'Policy application' component.

3.6 Further development

As the Blueprint continued to evolve (Fig. 9B), another consortium workshop was held in November 2024 to further refine its structure and application. During this session, each of the BioEcoOcean Focal Living Labs explored how the Blueprint applied within their specific contexts (Fig. 10). The workshop focused on stakeholder mapping and examined the overall flow of the Blueprint to better understand the interconnectedness and significance of its various components.

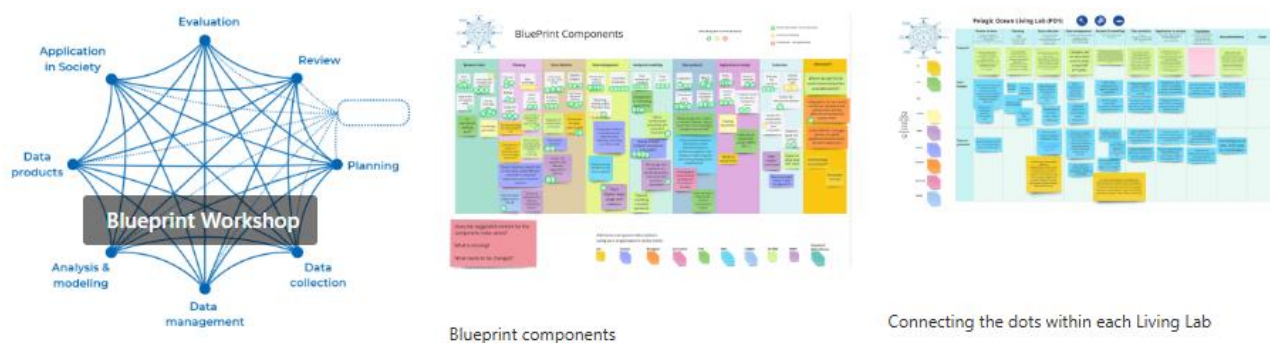


Figure 10. Screenshots from the online consortium workshop in November 2024, where participants discussed and applied each Blueprint component to their respective living labs within the project.

Particular attention was given to the *Data management* component - specifically how data flows across the Blueprint and how different components depend on effective data integration. Another key topic discussed was whether to include a *Communication and Outreach* component in the Blueprint, as participants recognized the importance of communicating ocean observations effectively to diverse audiences (Fig. 11).

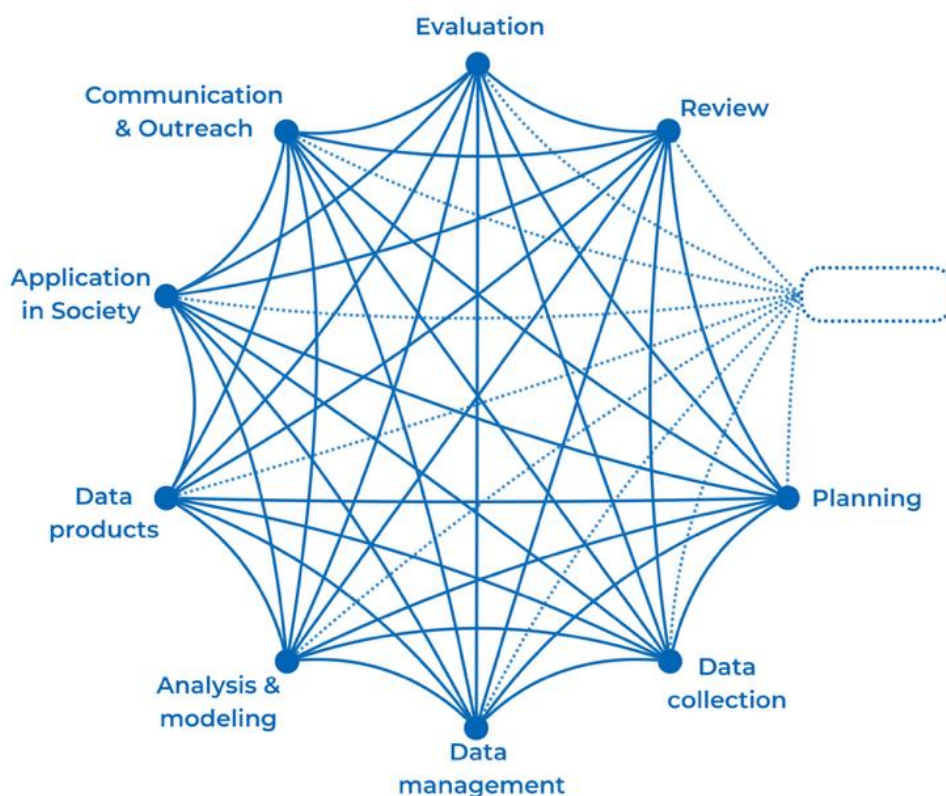


Figure 11. The fourth version of the spiderwebbed Blueprint, where the co-creation process resulted in adding the 'Communication and Outreach' component to the Blueprint.

3.7 A global survey

As part of the co-creative development process for the Blueprint, a survey targeting the global community was conducted between April 2024 and January 2025 to capture insights from a wide and diverse range of ocean stakeholders. This inclusive approach aimed to ensure that the Blueprint accurately reflects the varied needs, perspectives, and experiences of those involved in generating, managing, using, or otherwise impacted by biological and ecosystem ocean observations. The full survey design and questionnaire are openly accessible via Zenodo (DOI: [10.5281/zenodo.15528520](https://doi.org/10.5281/zenodo.15528520)). The survey results highlighted several critical priorities for enhancing the impact and usability of ocean observing systems. These include:

- Improving data accessibility and interoperability by promoting FAIR data principles, standardizing metadata, and investing in user-friendly platforms;
- Fostering co-design and inclusivity by actively engaging diverse stakeholders early in the observation process, including citizen scientists and holders of Indigenous knowledge;
- Strengthening education and capacity-building efforts focused on data sharing, model validation, and communication of uncertainties;
- Simplifying and harmonizing access to ocean services to encourage broader adoption across user communities.

These broad stakeholder insights represent key findings that are integrated into the Blueprint development. Further details on this extensive global survey can be found at [10.5281/zenodo.15662449](https://doi.org/10.5281/zenodo.15662449).

3.8 Developing an interactive workshop design

In early 2025, a dedicated workshop design was developed to actively engage participants in structured co-creation, aimed at advancing the Blueprint. The design creates spaces for cross-interactions, open discussion and also encourages thinking outside the box. This workshop design will inform the structure of future Blueprint workshops, with adaptations and improvements made as needed. More details about the workshop design can be found in the report online at [10.5281/zenodo.15657594](https://doi.org/10.5281/zenodo.15657594).

3.9 Workshop with the GOOS BioEco Panel

The joint meeting with the Global Ocean Observing System (GOOS) Biology and Ecosystems (BioEco) Panel, held in Sopot in February 2025, marked a pivotal step forward in the development of the Blueprint. The workshop brought together global experts in ocean observing - spanning key organism groups such as marine mammals, macroalgae, and fish - and enabled in-depth reflection on each component of the Blueprint, their interconnections, and how they align with BioEco EOVS.

During this workshop, we used the interactive Blueprint workshop design for the first time. The highly interactive workshop format successfully promoted cross-component engagement and fostered dialogue between GOOS BioEco Panel experts and BioEcoOcean partners. Discussions during the workshop reinforced the need for the Blueprint to remain both practical and visionary - a dynamic, co-created resource grounded in inclusivity and aimed at delivering tangible societal benefits.

Several key priorities emerged: importance of alignment with global policy frameworks (e.g., the Kunming-Montreal Global Biodiversity Framework and the UN Ocean Decade), the promotion of multilevel and cross-sectoral governance, integration of diverse data streams including emerging technologies, adherence to FAIR data principles, and capacity-building (particularly in under-resourced regions). Special emphasis was placed on ensuring interoperability across the Blueprint's components, including observation, data, governance, and capacity development while allowing flexibility to accommodate regional contexts and policy needs.

The insights gained from this workshop directly informed refinements to the Blueprint's structure and content and helped define the agenda for continued stakeholder engagement, real-world testing through possible case studies reaching beyond the BioEcoOcean Focal Living Labs, and long-term coordination mechanisms to ensure the Blueprint's lasting value and impact. The full report is available at: [10.5281/zenodo.15666414](https://doi.org/10.5281/zenodo.15666414).

3.10 Workshop to refine the Blueprint

The second in-person BioEcoOcean consortium Blueprint workshop, held in Sopot, Poland in March 2025, marked another key step in the Blueprint's co-creation. The focus was on examining the interconnections between the Blueprint's components and fostering a more integrated understanding of the ocean observing system. Participants emphasized the need to break down disciplinary and operational silos by strengthening links between components such as *Explore and Review to Learn*, *Analysis and Modeling*, *Data Products*, *Application in Society*, *Communication and Outreach*, and *Evaluation*.

The workshop reinforced the importance of iterative learning, user-driven design, and early stakeholder involvement in shaping societally relevant observations. Challenges related to interdisciplinary collaboration, communication support, and stakeholder engagement in modelling were openly discussed. Recommendations included the use of Artificial Intelligence (AI) tools, applying design thinking principles, involving professional communicators in projects, and developing structured evaluation frameworks. Feedback loops and continuous adaptation were recognised as essential features to keep the Blueprint dynamic and responsive to changing contexts.

Concrete outcomes of the workshop included renaming the *Review to Learn* component to *Explore and Review to Learn* to better reflect its iterative and exploratory nature (Fig. 12). The session also contributed

to refining the guiding questions for each component and helped chart the next phase of stakeholder engagement. Notably, this is also where the development of the interactive version of the Blueprint began. See the full report here: [10.5281/zenodo.15660047](https://doi.org/10.5281/zenodo.15660047).

3.11 Webinar

In April 2025, the project was featured in a global webinar hosted by the Marine Biodiversity Networking Fridays, titled *"Advancing Ocean Observations of Marine Life."* One part of the session focused on the Blueprint, while another highlighted BioEcoOcean's broader efforts to improve marine life data management for the global community. The event attracted 276 registered participants from 68 countries, 174 total viewers and 186 YouTube views (13/06/2025). Following the presentations, a moderated discussion gathered valuable input for the next iteration of the Blueprint. A recording of the webinar is publicly available on YouTube: <https://www.youtube.com/watch?v=DF1ggK068mY>.

3.12 Supporting resources for the Blueprint

Alongside the development of the Blueprint itself, efforts are underway to compile a suite of supporting resources that will enhance its practical value. These include updated specification sheets for BioEco EOVs (Deliverable D2.3), illustrative case studies of successful applications, and harmonised vocabularies to ensure consistency in terminology and interpretation. In addition, examples of real-world solutions implemented in diverse settings will be gathered to inspire users and demonstrate the Blueprint's flexibility and applicability. Collecting and curating these resources is a key focus of the upcoming stages of Blueprint development.

3.13 Feedback and Evaluation to advance Blueprint development

From the beginning, the project has recognised the importance of evaluating the Blueprint's relevance, usability, and overall effectiveness. A multi-method evaluation framework has been established to guide this process. It includes stakeholder interviews, structured questionnaires, comparative analysis of different user pathways, and a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis. This approach is designed to assess how well the Blueprint supports holistic thinking, collaboration, and integration across the ocean observation value chain.

A public feedback form is available on the BioEcoOcean website (as of February 2025), allowing ongoing input from the global community (<https://bioecoocean.org/get-involved/>). A feedback survey form will remain open throughout the next phases of development, ensuring continuous improvement. Additional

evaluation activities will be rolled out in the coming months to capture diverse user experiences and integrate feedback into future iterations of the Blueprint.

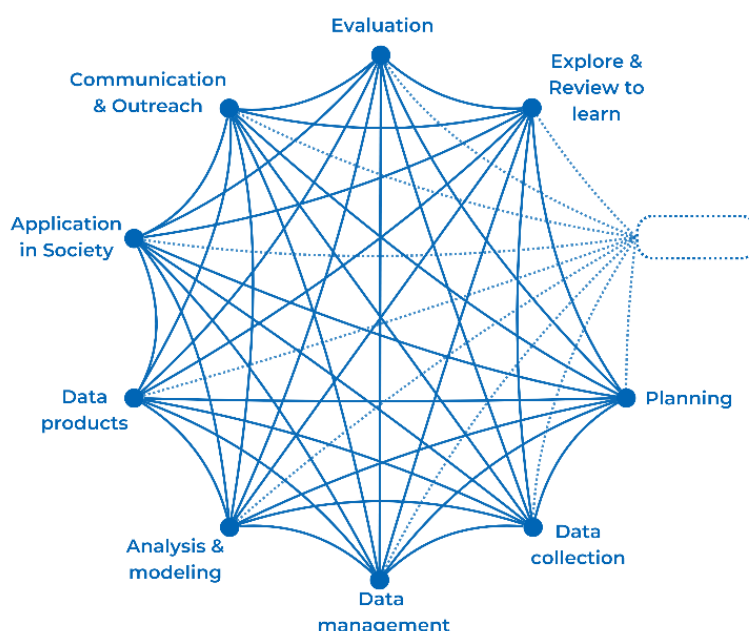


Figure 12. The current version of the spiderwebbed Blueprint. The component previously titled ‘Review to learn’ evolved into ‘Explore and Review to learn’.

3.14 Adding components in the Blueprint

As the Blueprint has evolved, its scope has expanded from the initial seven components to a total of nine. This expansion reflects both the input from diverse stakeholders and the growing ambition of the tool (see Figs. 6-12). Three new components were added to ensure the Blueprint addresses societal relevance, public engagement, and ongoing learning alongside scientific and technical considerations. These components are *Application in Society* (which builds upon the earlier *Policy Application*), *Communication & Outreach*, and *Evaluation*. Additionally, the component originally titled *Review* was renamed *Explore and Review to Learn*, to better reflect its dual role in both exploring existing knowledge and identifying actionable insights that can inform future efforts.

3.15 An interactive Blueprint

From the beginning, the Blueprint was envisioned to become an interactive digital resource. The goal was to provide users with an intuitive, accessible platform offering downloadable tools, illustrative examples, and training materials tailored to different contexts and stakeholder needs. This interactive draft version

of the Blueprint (Fig. 13) is now under active development and can be accessed at: <https://bioecocean.github.io/blueprint-dev>.

The corresponding GitHub repository is available here: <https://bioecocean.github.io/blueprint-dev/>.

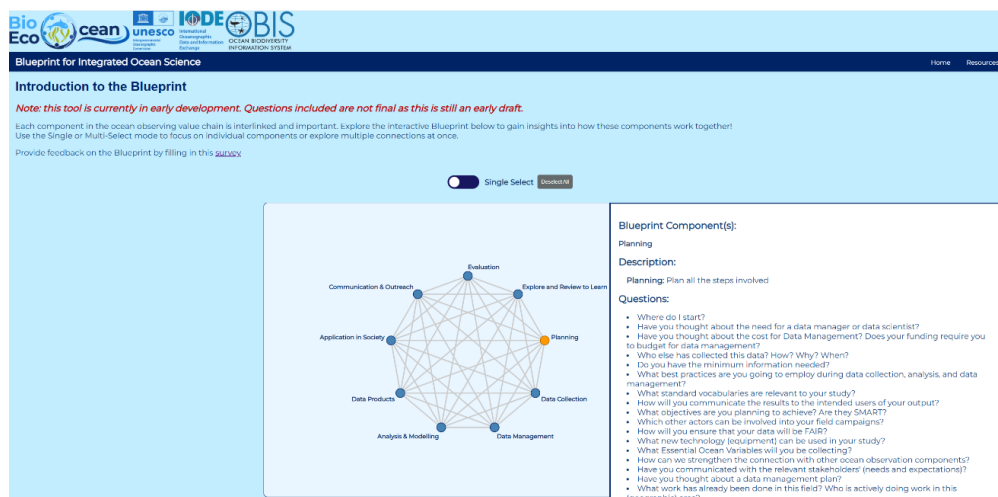


Figure 13. Image from the first draft of the interactive Blueprint showing the questions (on the right) that aim to spark interdisciplinary thoughts for the user.

The online tool enables users to explore the Blueprint’s components through an interactive spiderweb interface. Users can click on individual components (“nodes”) to view descriptions and a curated set of thought-provoking questions derived from the co-creation process. The platform supports both single- and multi-select modes, allowing users to explore how different components connect and influence one another.

Questions such as “What data do you need to conduct your analysis or modeling?” or “Did we achieve what we set out to do?” are designed to spark interdisciplinary thinking and highlight critical issues across the ocean observing system. A dedicated Resources section supports users in addressing these questions with practical tools and examples. The interface is still under development and will be refined and expanded over the course of the project based on user feedback and testing. Figures 13 and 14 illustrate how the tool visualizes connections between components, highlighting coordination across the system. These features are intended to help users better understand and navigate the interdependencies within ocean observing and promote a systems-based approach to collaborative planning and implementation.

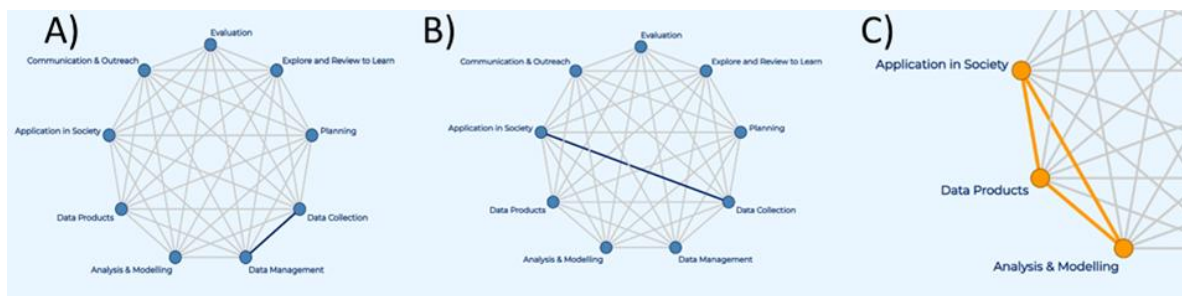


Figure 14. Various plates illustrate the coordination between selected components, indicated by dark blue lines in (A) and (B), while (C) shows interactions among three components. These links are intended to guide prospective Blueprint users in initiating connections between components at any particular point of the ocean observation process.

3.16 The co-creative process – every little helps

As outlined throughout this section, the evolution of the Blueprint has been deeply shaped by a variety of co-creative approaches (Fig. 15). These methods have included interactive workshops, stakeholder surveys, interviews, collaborative design sessions, webinars, and iterative feedback loops. Each engagement, whether large or small, has contributed valuable insights to help refine the Blueprint's structure, expand its scope, and enhance its relevance across different contexts and user communities.

By combining structured facilitation with open-ended dialogue, the co-creation process has enabled the Blueprint to grow as a genuinely participatory, inclusive, and adaptive tool. This iterative approach will continue to guide its development, ensuring that the Blueprint reflects the evolving needs of the ocean observing community and supports collective action across disciplines, sectors, and scales.

It should be noted that the ongoing co-creative development of the Blueprint has already contributed to its marked promotion and first signs of adoption among the marine life observing community. Although still in its testing phase, it has already shown to be effective in serving its ultimate goal to provoke more integrated and pro-active thinking when designing and implementing the ocean observing value chains from local to global scales.

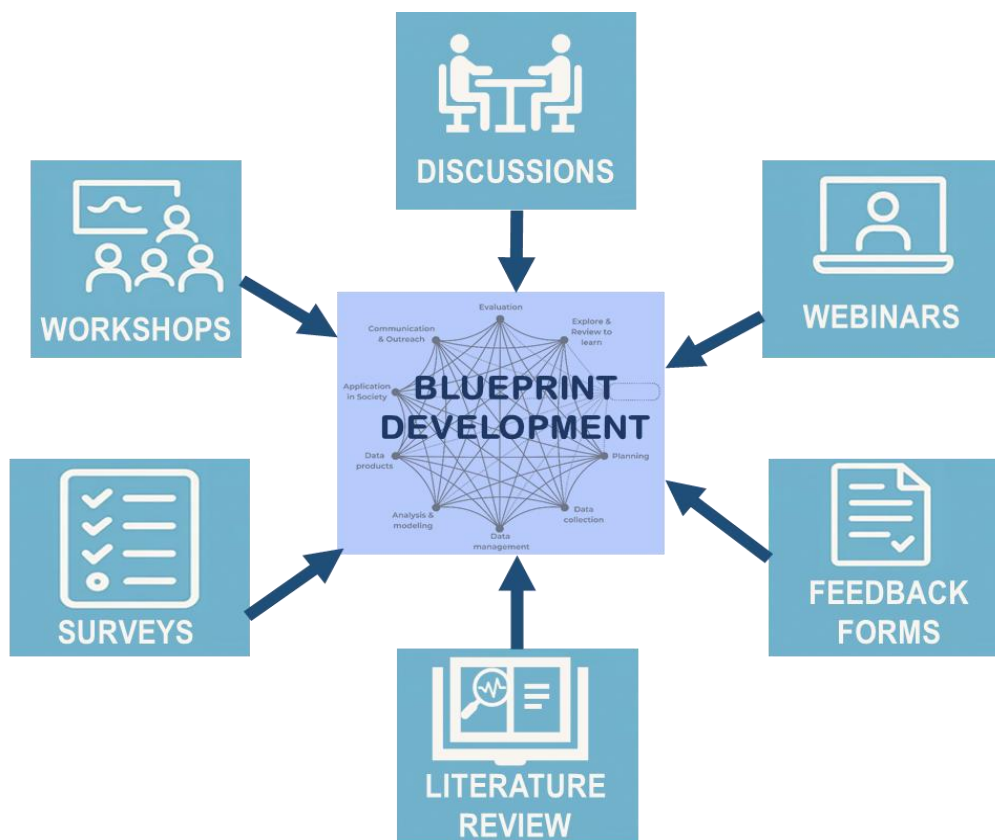


Figure 15. Key co-creation techniques used to support the development of the Blueprint to date.

4. The way forward

These early conceptual and methodological foundations have guided the Blueprint's ongoing evolution, ensuring it remains stakeholder-driven, forward-looking, and practically useful for advancing biological and ecosystem ocean observations. So, where do we go from here?

4.1 Developing training materials to use the Blueprint

To support effective uptake, we will develop accessible training materials aligned with Deliverables D5.1 and D5.2. These will include:

- A Quick Start Guide, offering a concise overview and actionable steps for using the Blueprint.
- A comprehensive training course, covering practical and strategic aspects of implementation.

Training will follow a “train-the-trainers” model, enabling facilitators to disseminate the Blueprint within their networks. The Ocean Teacher Global Academy (OTGA) will host these training resources, allowing for certification and tracking of post-project uptake.

The interactive Blueprint platform will be enhanced with downloadable materials in relevant components for ease of use. We also aim to develop user-friendly ways to connect Blueprint questions with specific support resources.

4.2 Use cases

In addition to the six focal living labs in BioEcoOcean that are supporting the Blueprint development, we also have use cases. This is to ensure that the Blueprint is grounded in real-world contexts and serves the needs of diverse users. We will initiate a series of pilot tests across selected test sites, by inviting interested institutions or regional initiatives to become early adopters and contributors to the Blueprint’s co-development. Each pilot setting represents a different geographic, ecological, and institutional context. Together, they will provide opportunities to explore how the Blueprint functions in practice, identify challenges, and gather detailed feedback from users engaging with it for specific purposes.

Each use case will use the Blueprint for its context. This will allow us to:

- Test how well the Blueprint supports thinking across different components.
- Assess the clarity and relevance of guiding questions and available resources.
- Understand the level of support needed for effective uptake (e.g., training, facilitation, documentation).

Insights from these pilots will inform iterative improvements and may be shared as documented case studies to inspire broader adoption.

4.3 Upcoming co-creation for Blueprint development

We will continue to expand and diversify stakeholder engagement through a range of upcoming co-creative activities. Everyone involved in or impacted by the ocean observing system is encouraged to join the process. The [BioEcoOcean website](#) serves as the central hub for:

- The most up-to-date Blueprint version,
- Feedback forms and surveys,
- Announcements of workshops and webinars,

- Opportunities to become a Blueprint tester.

We invite the global community to contribute actively - whether through trying out the Blueprint, sharing case studies, or providing feedback. This collective effort ensures the Blueprint remains inclusive, responsive, and fit for purpose.

And who knows? The Blueprint for Integrated Ocean Science might eventually evolve into something even more ambitious: a Blueprint for an Integrated Ocean Observing System (BIOOS). That's the beauty of co-creation: We don't yet know where it will take us, but we are building the path together.

References

Miloslavich, P., Bax, N. J., Simmons, S. E., Klein, E., Appeltans, W., Aburto-Oropeza, O., Andersen Garcia, M., Batten, S. D., Benedetti-Cecchi, L., Checkley, D. M., Chiba, S., Duffy, J. E., Dunn, D. C., Fischer, A., Gunn, J., Kudela, R., Marsac, F., Muller-Karger, F. E., Obura, D., & Shin, Y.-J. 2018. Essential ocean variables for global sustained observations of biodiversity and ecosystem changes. *Global Change Biology*. <https://doi.org/10.1111/gcb.14108>

Miloslavich, P., O'Callaghan, J., & al, et. 2024. Ocean Decade Vision 2030 White Papers – Challenge 7: Sustainably Expand the Global Ocean Observing System. UNESCO-IOC. <https://doi.org/10.25607/BRXB-KR45>

Muller-Karger, F. E., Hwai, A. T. S., & et al. 2024. Ocean Decade Vision 2030 White Papers – Challenge 2: Protect and Restore Ecosystems and Biodiversity. UNESCO-IOC. <https://doi.org/10.25607/Y60M-4329>

Müller, K. 2024. Challenges for Global Ocean Observation of Life in the Sea. <https://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-528857>

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Partners

