



Portable Innovation Open Network for
Efficiency and Emissions Reduction Solutions

Deliverable 2.15:

PIONEERS' Best Practise Master Plan and Handbook

Disclaimer

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1 Innovations

1.1 Introduction

In the Multi-Level Perspective, innovations encompass new ideas, technologies, and collaborations. These innovations can manifest in various forms, such as pilot projects, demonstration sites, or experimental collaborations centered around novel technologies, business models, or governance approaches. While not all innovations achieve success, those that do have the potential to grow and eventually challenge the existing regime m– just like the PIONEERS demo-showcases.

In general, Innovations are affecting the port system in two ways:

1. Innovations introduce new ways for ports to operate more cost-efficient. In this way, Innovations are pressuring port systems to change and adopt in order to remain competitive.
2. Innovations can serve as solutions to cope with the dynamically evolving landscape pressures around the port.

In the context of a Greenport Masterplan (GPMP), Innovations shall be approached in a pragmatic way. Technology capabilities are a key consideration, while the right fit for the port's strategic role, operational reality, institutional setting, and decarbonisation trajectory need to be considered as well. In this sense, Innovations are the process step to move from vision to prioritisation by treating innovations as decision domains like energy, logistics, infrastructure, digital operations, governance, and organisational change.

There are a wide range of innovations dynamically evolving around port systems , including shore power, electrification, renewable energy integration, alternative fuels, digital optimisation, automation, data-sharing platforms, and new collaborative business models. An important process step of the GPMP is to identify and assess relevant innovations, which are addressing an identified challenge, a meaningful contribution to the GPMP objectives and high upscale potential.

1.2 Innovation scouting and innovation radar

What it is

Innovation scouting and the innovation radar developed in PIONEERS Work Package 1 provides a broad and evolving overview of relevant innovations and niche developments in ports and beyond. The innovation selection with the help of an innovation radar creates a more systematic basis for identifying suitable solutions and comparing them against defined criteria. This strengthens the GPMP process by connecting strategic priorities with expert-driven innovation selection, instead of relying only on trends, assumptions, or isolated project ideas.

The PIONEERS Innovation Radar, developed in Work Package 1, is a practical screening tool designed to help ports identifying and prioritising innovations that are most relevant for their green transition pathway. It was created as a structured screening approach for more than 350 innovations scouted within WP 1.

How to use it

Ports are supported with a method for identifying which innovations are most suitable for their own operational context, transition priorities, and implementation capability rather than a list of interesting technologies. In practical terms, a structured way of selection process makes the radar highly relevant for master planning. The Innovation Radar is designed as both a visual mapping tool and a structured pre-selection instrument for port innovation. It enables users to choose innovations according to their relevance for the four PIONEERS transition pillars, clean energy production and supply, sustainable port design, modal shift and flow optimisation, and digital transformation. The innovation radar also indicating how close an innovation is to practical deployment through its Innovation Readiness Level. Within this structure, each innovation is positioned according to its Innovation Readiness Level, calculated as the average of Technology Readiness Level, Market Readiness Level, and Social Readiness Level. This provides an immediate sense of maturity while also recognising that readiness is not purely technical but also depends on market readiness and social acceptance. In this sense the radar is a visual overview and an analytical filter.

To make the radar more useful for decision-making in real port contexts, WP1 extended the radar through a Multi-Criteria Decision Analysis approach. Five criteria were defined:

1. Impact
2. Feasibility
3. Scalability
4. innovation readiness,
5. Stakeholder support

These criteria were intentionally kept generic so that ports can adapt them to their own context. The weighting of criteria is supported through the Analytic Hierarchy Process, which allows decision-makers to reflect differences in port type, size, geography, and strategic priorities when assessing innovation suitability. The Figure 1 below gives the pictorial representation of our PIONEERS innovation radar:

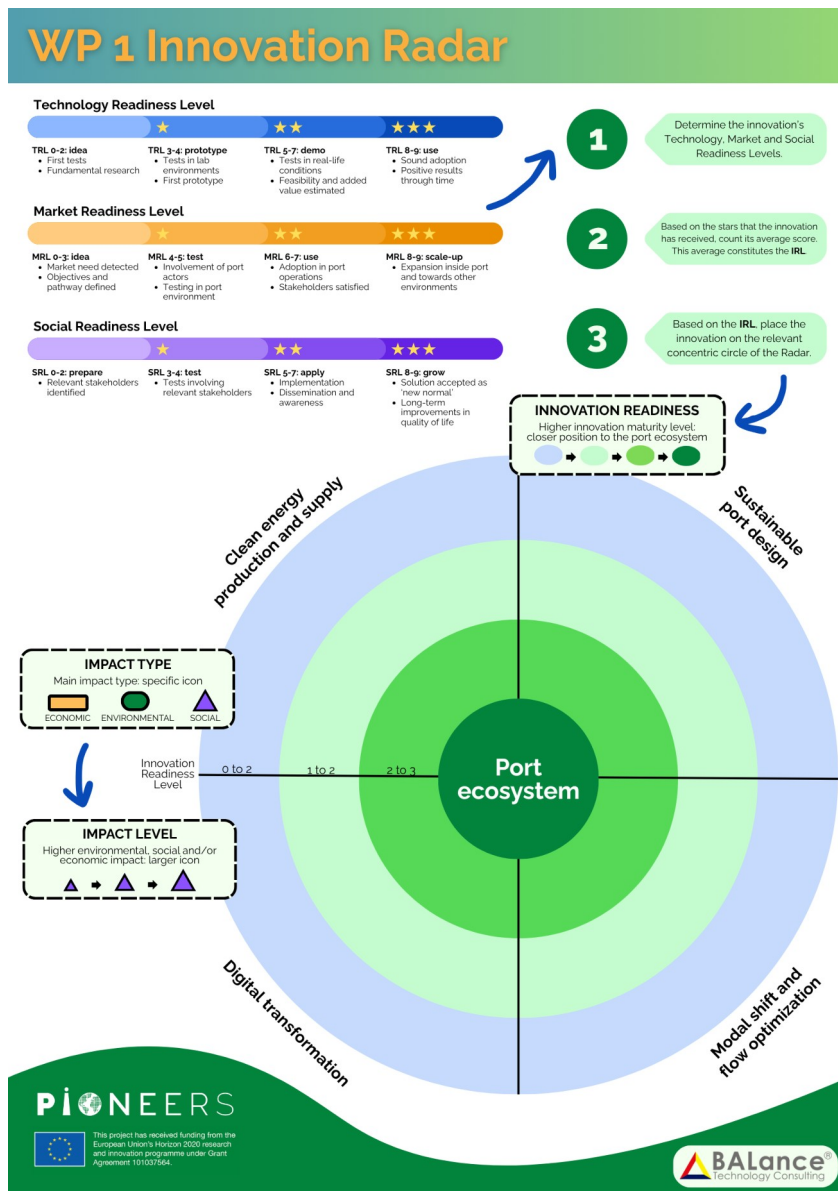


Figure 1: Innovation Radar from D1.4 innovation assessment year 4

The assessment mechanism in the radar supports to move beyond a static overview of innovations and function as a practical filtering mechanism, helping ports identify which solutions are not only promising in principle, but also credible, adaptable, and strategically relevant for inclusion in the Green Port Master Plan. The PIONEERS innovation radar for maritime can therefore be framed as an early-stage filter within the broader Green Port Master Plan process.

Lesson's learned

The innovation assessment at the WP1 generated several important lessons for master planning. One of the main takeaways is that technical maturity alone is not enough to decide whether an innovation is worth pursuing. Many technical solutions look promising, but still be difficult to integrate to existing operations, poorly supported by stakeholders, or limited in its potential to scale. Another important lesson is the importance of criteria changes depending on the port context. Large cargo seaports may place greater weight on impact, scalability, and stakeholder support, while inland or more peripheral ports may prioritise feasibility and readiness. Third, stakeholder feedback is essential to make the radar credible and usable. The radar works best when it supports structured discussion among port actors rather than replacing judgement with a purely

mechanical score. Overall, the innovation radar act as a bridge between innovation scouting and master planning. It helps in turning a large and diverse innovation pool into a more focused and actionable portfolio for further assessment and deployment. In that sense, the radar is not only a tool for innovation assessment, but also a practical instrument for improving the quality, consistency, and strategic relevance of innovation choices in port master planning.

1.3 PAM assessment

What is it?

One of the tools developed within PIONEERS was the **PIONEERS Assessment Model (PAM)**. Impact monitoring is essential to evaluate technologies in a fair and consistent way and to provide valuable insights for stakeholders. During the development of PAM, several challenges had to be addressed to ensure the model was accurate, robust, and flexible.

The first challenge was the diversity of technologies tested in PIONEERS. The project included a wide range of innovations, from digital solutions that improve efficiency and productivity to physical technologies that supply electricity to terminal vehicles or hydrogen to heating systems. As a result, a single set of indicators could not be applied to all demonstrations. The second challenge concerned stakeholder needs. Policymakers, industry partners, knowledge institutions, and port authorities require different information to evaluate success. Consequently, the relevant key performance indicators (KPIs) vary depending on the stakeholders; perspective and requirements. The third challenge was ensuring robustness. While highly detailed impact monitoring is theoretically possible, in practice data availability is limited due to collection constraints during the demonstration, GDPR regulations, and commercial sensitivities. PAM therefore relies on reliable data that can be collected relatively easily without requiring confidential information.

How to use it

To address these challenges, PAM was designed with three levels of aggregation. At the operational level, KPIs measure the direct impact of individual demonstrations. These indicators feed into tactical indicators, which assess groups of similar technologies, often aligned with the four PIONEERS demonstration pillars. At the highest level, strategic indicators evaluate the overall success of the project. In addition, PAM distinguishes between social indicators, which capture external costs and benefits, and business-economic indicators, which assess economic feasibility and operational performance. Figure 2 and Error: Reference source not found visualize the three levels of aggregation and the socio-, and business-economic indicators.

This framework was applied across all 19 demonstrations, providing detailed assessments at the demo level while also generating insights at the tactical and strategic levels. PAM can support ports both before and after implementation. Before implementation, it can estimate the expected impact of a technology using assumptions and expert input. After implementation, it can measure actual performance using operational data and, in some cases, assess the potential effects of scaling up the technology, although such projections should be interpreted with caution due to increasing implementation complexity.

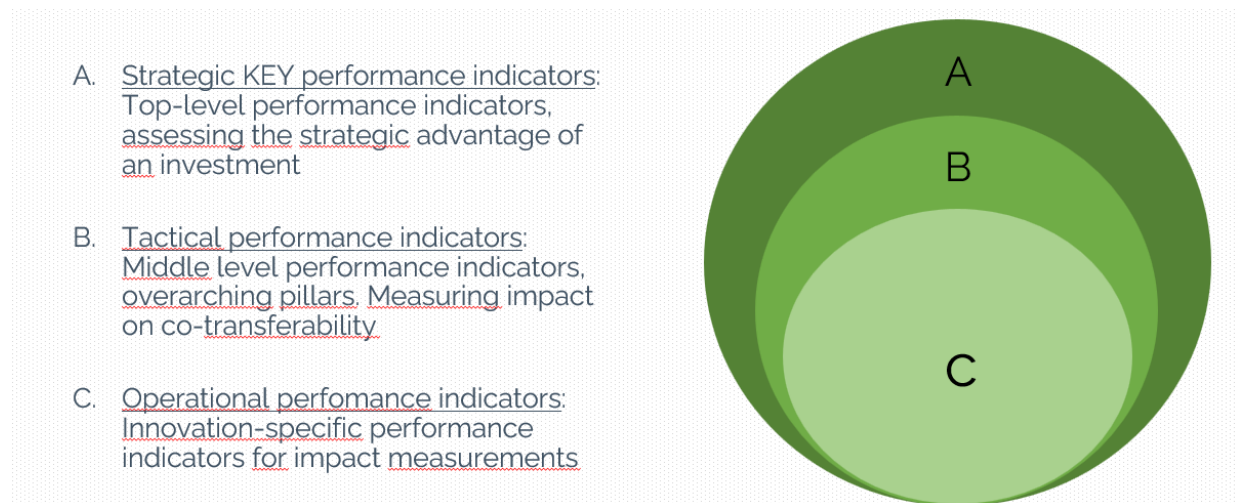


Figure 2: operational, tactical, and strategic KPIs for PAM

<u>Business Economic</u>	<u>Socio-Economic</u>
Strategic BE key performance indicators	Strategic SE key performance indicators
Tactical BE performance indicators	Tactical SE performance indicators
Operational BE indicators	Operational SE indicators