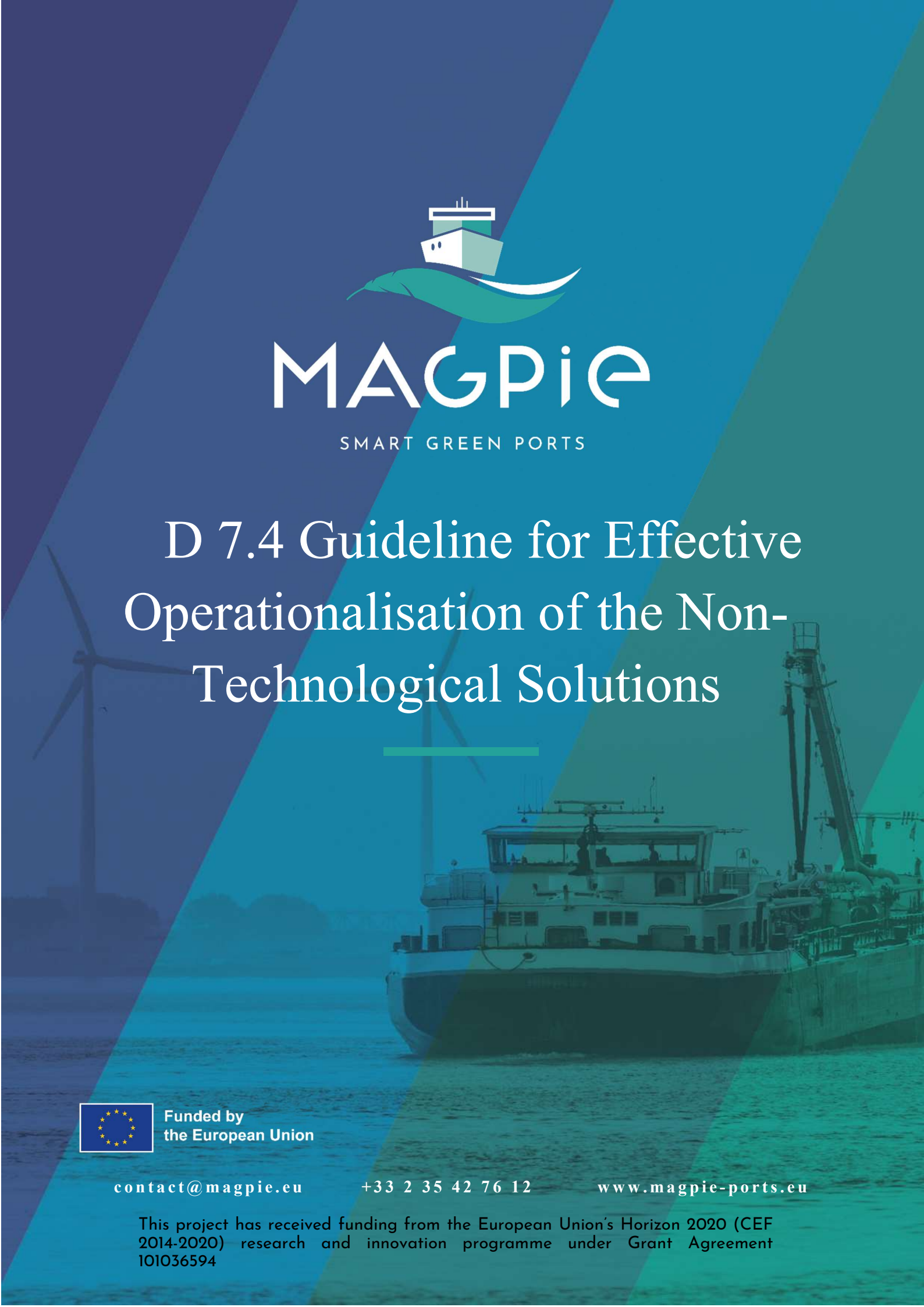
MAGPiE

SMART GREEN PORTS

D 7.4 Guideline for Effective Operationalisation of the Non-Technological Solutions



Funded by the European Union

contact@magpie.eu +33 2 35 42 76 12 www.magpie-ports.eu

This project has received funding from the European Union's Horizon 2020 (CEF 2014-2020) research and innovation programme under Grant Agreement 101036594

GUIDELINE FOR EFFECTIVE OPERATIONALISATION OF THE NON-TECHNOLOGICAL SOLUTIONS
D7.4

GRANT AGREEMENT NO.	101036594
START DATE OF PROJECT	1st October 2021
DURATION OF THE PROJECT	60 months
DELIVERABLE NUMBER	D7.4
DELIVERABLE LEADER	Delft University of Technology
DISSEMINATION LEVEL	PU
STATUS	1.0
SUBMISSION DATE	06-10-2022
AUTHORS	Jeroen Pruyn Delft University of Technology j.f.j.pruyn@tudelft.nl Kris Sooprayen Delft University of Technology k.s.sooprayen@tudelft.nl Liam van Son Erasmus UPT vanson@ese.eur.nl

Modification Control

VERSION #	DATE	AUTHOR	ORGANISATION
V0.1	23-08-2022	JFJ Pruyn, K Sooprayen, LV Son	DUT, EUR,
V0.2	05-09-2022	JFJ Pruyn, K Sooprayen, LV Son	DUT, EUR,
V0.3	08-09-2022	JFJ Pruyn, K Sooprayen, LV Son	DUT, EUR,
.....	DD-MM-YYY	Initials, last name	Partner name
	DD-MM-YYY	Initials, last name	Partner name
V1.0	29-09-2022	JFJ Pruyn, K Sooprayen, LV Son	DUT, EUR,

Release Approval

NAME	ROLE	DATE
L. van der Lugt	WP Leader	30-09-2022
M.E. Dalhuisen	Peer reviewer	23-09-2022
A.R. Rosa	Peer reviewer	23-09-2022
M.B. Flikkema	Scientific Coordinator	03-10-2022

History of Changes

SECTION, PAGE NUMBER	CHANGE MADE	DATE
		DD-MM-YYYY
		DD-MM-YYYY
		DD-MM-YYYY
		DD-MM-YYYY

Table of Contents

Executive Summary

This report aims to devise a guideline for the effective operationalisation of the non-technological solutions with respect to green innovation in the port sector. Inspiration was gained from research and discussion within the work package partners. The resulting assessment system offers both an approach to evaluating the effectiveness of the non-technological solutions with respect to green innovation in the port sector, as well as a guideline on how to design and implement these solutions. To this end, the guideline puts forth several steps and questions that should be undertaken at various stages of the design, implementation, and evaluation stages of innovation.

1. Firstly, the objectives of the non-technological solution and barriers encountered should be identified and defined. An explanation should be offered on how, where and for whom it will be implemented. These questions provide a baseline for the case being studied, hence setting the foundation for the design and execution phase.

2. Secondly, questions should be asked on what to monitor and how to bring a non-technological solution further into a well-working environment.

3. Thirdly, the intended and unintended results from the innovation should be reviewed with feedback taken from the stakeholders and the beneficiaries involved. It should be justified whether the chosen non-technological solution makes the best possible use of available resources to achieve the desired results.

3. Fourthly, it would be essential to review why the outcomes of the non-technological solutions are successful or not and to understand the underlying factors causing this effect in the short, medium and long term. This would help in determining the causal relationship and understanding the direct influence of the measure on the success or failure of the process.

4. Finally, the synthesis of the results from the previous sections should be debated.

The key questions are grouped into eight categories and further classified into five thematic groups. The thematic groups are titled 'Baseline Information', 'Design Phase & Execution Phase', 'Result Evaluation & Feedback', 'Further Insights' and 'Way Forward'. A set of methodological tools is proposed to provide an appropriate means for answering the questions and meeting the objectives of this report. It is worth mentioning that the proposed tools are tentative at this stage and may be replaced by other tools depending on the non-technological solution.

For the '**Baseline Information**', a *case study analysis* will be needed to determine the objective of the non-technological solution, the barriers being faced and where and how it is

being implemented. Moreover, a *stakeholder analysis* is proposed to identify the stakeholders involved and assess their influence and interest.

The **'Design & Execution Phase'** contrives to answer how, where, and with what means the non-technological solution will be implemented and operationalised. This phase will make use of *workshops* to involve the relevant parties in a 'living lab' design of the approach.

'Result Evaluation & Feedback' deals with the study of the results obtained from the implementation of the solution. The non-technological solution will undoubtedly produce both intended and unintended results, and a *programme theory evaluation* can be used to assess those results. Additionally, *surveys and interviews* can be conducted to obtain feedback from the stakeholders involved. It is also essential to conduct an *economic evaluation* to note whether the non-technological solution provides the best possible use of available resources to achieve the anticipated results.

'Further Insights', the *counterfactual evaluation method,* is proposed to understand why the outcomes of the non-technological solutions are successful or unsuccessful in a given context. These further insights will determine whether the right stakeholders have been involved and how the outcomes were realised.

'Way Forward', summarises all information collected and analysed from the different stages of the framework. Conclusion and recommendations will be delivered based on valuable input and lessons learnt from the case study. This section also aims at advising whether we can proceed with the studied non-technological solution for the adoption of the innovation or if we need to repeat the process with different solution(s).

1. Introduction

1.1 Background

The MAGPIE project is an international collaboration working on demonstrating technical, operational, and procedural energy supply and digital solutions in a living lab environment to stimulate green, smart and integrated multimodal transport and ensure roll-out through the European Green Port of the Future Master Plan and dissemination and exploitation activities. The consortium, coordinated by the Port of Rotterdam, consists of 3 other ports (DeltaPort, Sines and HAROPA), 9 research institutes and universities, 32 private companies, and 4 other organisations. The project is divided in 10 main work packages which include energy supply chains, digital tools, 10 demonstrators for maritime, inland water, road, and rail transport, non-technological innovations and the development of a Masterplan for European Green ports.

For the WP7 of the MAGPIE project, the specific goal is to develop and assess the necessary non-technological conditions for enabling and accelerating the implementation of low or zero-emission technological, digital, and logistical solutions in the Port Sector. WP7 is further categorised into four preparatory subtasks which will be executed during a 5-year period starting from October 2021 to September 2026, as shown in *Figure 1*.

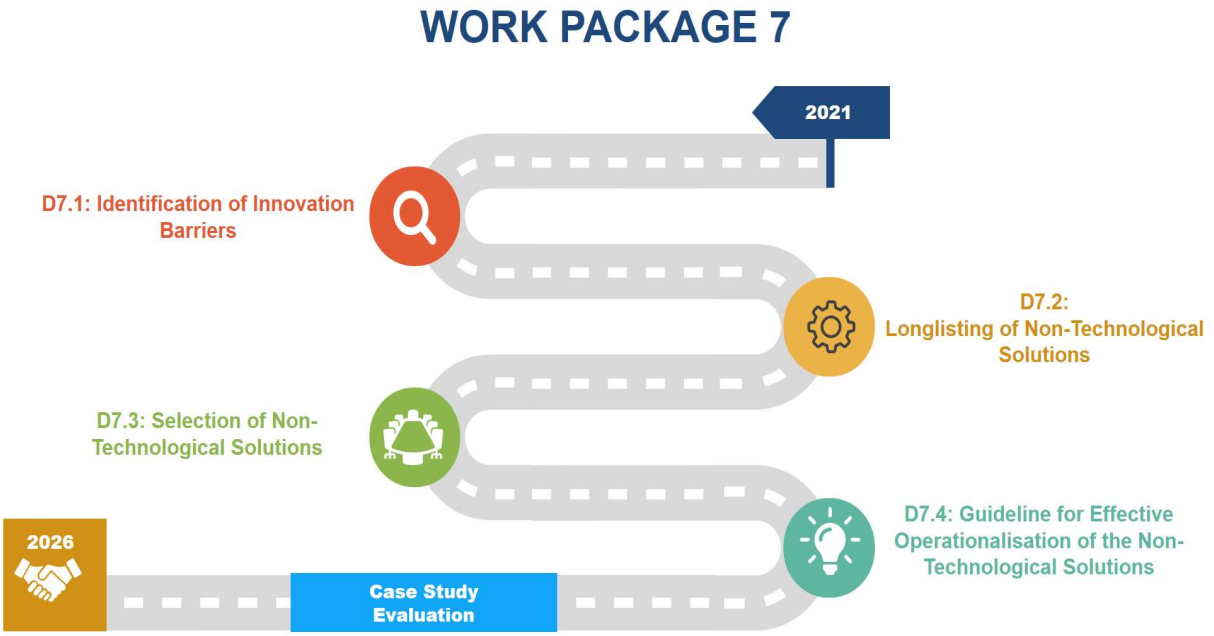


Figure 1: *Deliverables for Work Package 7*

The four preparatory subtasks are:

- D7.1: Identification of Innovation Barriers

  Seven key barriers which hinder the implementation and scaling up of green innovation in the port sector were identified and discussed in Deliverable 7.1 (T7.1.1). The seven barriers were classified as Economics, Knowledge, Standards and Regulations, Interaction, Directionality, Technology and Infrastructure.

  The identified innovation barriers were ascribed to the Mission-oriented Innovation System (MIS) functions, also known as Innovation Processes. The MIS is used to evaluate key innovation processes within the innovation regime in order to adequately design appropriate intervention strategies. It was noted that the identified barriers could be predominantly attributed to the faulty functioning of two MIS functions: Directionality and Entrepreneurship & Market formation.

- D7.2: Longlisting of Non-Technological solutions

  For Deliverable 7.2 (T7.1.2), a literature search and an expert survey were conducted to generate and review a longlist of non-technological innovations, which were further refined into a set of generic non-technological innovation concepts. The non-technological solutions were classified into three 'clusters' to provide the necessary scope to tackle the innovation barriers identified in D7.1. The three non-technological solution clusters were termed as Policy Solutions, Business Concepts and Information Provision & Quality. Please see *Section 2.2* for further elaboration.

- D7.3: Selection of Non-Technological Solutions

  The third preparatory step, Deliverable 7.3 (T7.1.2), consists of the selection of case studies from the longlist of non-technological solutions. Eight most promising non-technological solutions (case study) will be selected based on key criteria, impact and suitability in the context of the MAGPIE project. Multiple non-technological solutions could be tested in a combination or as a single case depending on the solution being studied.

- D7.4: Guideline for Effective Operationalisation of the Non-Technological Solutions

  Finally, this report is focused on the fourth deliverable of WP7 (T7.2.1), that is, to devise a guideline for the effective operationalisation of the non-technological solutions in the port context. The assessment system offers both an approach to evaluating the effectiveness of the non-technological solutions with respect to green innovation in the port sector, as well as a guideline on how to design and implement these solutions.

1.2 Problem Statement and Goal

The port sector is considered one of the most profitable and conservative sectors in the industrial world. However, with new rules and legislations being introduced with respect to socio-environmental sustainability by the regulating bodies and international organisations, the port actors have an obligation to find novel and innovative technologies to adapt to nowadays new era of sustainable change. In the same line, various green technologies and opportunities for the port sector are being promoted and encouraged worldwide. However, while the media focus is on technological innovations, it is observed that less emphasis is placed on the importance of the non-technological solutions in promoting green innovation in the port sector.

The importance of a non-technological solution is measured by the degree of success achieved from a particular action and is usually referred to as its effectiveness. In order to evaluate the effectiveness and the effective operationalisation of the non-technological solution, several steps and questions should be undertaken and answered respectively. A summarised list of key study questions and specific objectives were compiled from the literature and discussion with partners and presented in *Table 1*.

Table 1: Key Questions & Objectives

#	Key Questions	Objectives
1	What are the aim and objectives of the non-technological solution? What are the operational, ethical and regulatory complexities of the non-technological solution? What barriers do the non-technological solution face and how can they be overcome?	To obtain ground information about the non-tech
2	Who are the stakeholders involved and the intended beneficiaries? What are their interests? What is their influence?	
3	How will the non-technological solution be implemented? What resources are available, the potential risks, and what will we need for efficient operationalisation? How to operationalise the non-technological solution at different levels (if possible)? What will be evaluated? How will data be collected? What is the timeline of operationalisation? Which milestones will be set? How to plan and prepare the stakeholders involved?	To bring a non-technological solution further into a well-working environment.

4	Is the non-technological solution producing the intended results? If so, for whom, to what extent and in what circumstances? How valuable are the results for the stakeholders/beneficiaries?	To measure the effects and impacts of the non-technological solutions
5	What are the unintended results (positive and negative)? What is the feedback from the stakeholders/beneficiaries?	
6	Does the non-technological solution provide the best possible use of available resources to achieve the results?	
7	Why are the outcomes of the non-technological solutions successful or unsuccessful in the given context? How do these outcomes occur? Do we have the right stakeholders involved?	

- Firstly, ground information about the non-technological solution being studied should be collected and analysed. The objective of the non-technological should be identified, and an explanation of how, where and for whom it would be implemented should be provided.
- Secondly, questions should be asked on what to measure and how to bring a non-technological solution further into a well-working environment. There is a need to select the appropriate approach to succeed in this endeavour.
- Thirdly, the intended and unintended effects and impacts of the non-technological solutions should be reviewed with feedback taken from the stakeholders and the beneficiaries involved. It should also be seen whether the non-technological solution provides the best possible use of available resources to achieve the intended results and review whether the outcomes of the non-technological solutions would have been successful or not in a similar situation but with different solutions and understand the underlying factors of this cause.
- The synthesis of the results from the key questions and set objectives would help provide a holistic understanding of the effectiveness of the non-technological and hereafter devise a guideline for the effective operationalisation of the non-technological solutions

2. Methodology

2.1 Introduction

The objective of the methodology is to devise a guideline on how to design and implement the non-technological solutions in the port context. Firstly, a summary of the classification framework from D7.2 is presented. Secondly, the methodologies and guidelines for the evaluation of effectiveness are reviewed through both academic and non-academic literature. Finally, a consensus framework with several methodological tools is proposed to holistically evaluate the effectiveness of non-technological solutions and elucidate the questions asked in *Section 1.2.*

2.2 The Classification Framework

A list of non-technological innovative solutions in the port sector was reviewed and regrouped into a "*Classification Framework*" in *D7.2*, as summarised in *Table 2.* Please see *Annex A* and *B* for detailed examples of the non-technological innovative solutions. Three clusters were identified, namely Policy Solutions, Business Concepts and Information Provision & Quality and each cluster regroups specific innovative measures with similar characteristics. The classification framework aims to provide a comprehensive overview of the different measures and ease of understanding to the intended readers, ranging from the level of decision-makers to the general users.

Table 2: Classification Framework of Non-Technological Innovations

Cluster	Type of Measure
Policy Solution	Market Intervention
	Regulation & Norm Creation
	Green Public Procurement
	Regulation & Legislation on Safety
Business Concept	Burden/Price Sharing Mechanisms
	Platform Models
	(Green) Certification
	Market Restructuring (Consolidation)
Information Provision & Quality	Knowledge Transfer & Diffusion
	Skills & Expertise Development
	Quality Provision of Knowledge

The policy solution refers to creating a policy regime that stimulates and facilitates both the development and broad implementation of sustainable innovations in the port sector. Measures related to market intervention, regulation & norm creation, green public procurement and legislation were categorised under the policy solution cluster. These solutions comprise a long-term and consistent policy framework that advances a sustainable public good through market creation, institutional support, and financial instruments.

The business concept cluster involves solution types that favour interaction which stimulates sustainable innovations across value chains through mutual value creation between stakeholders. Mutual value creation includes activities that increase information sharing, business transactions, trust and institutionalisation. Price sharing mechanisms, platform models, green certification and market consolidation are examples falling under the business concept cluster.

The third cluster is Information Provision & Quality and comprises solution types linked to knowledge transfer & diffusion, skills development and quality provision of knowledge. These solution types have an essential role in overcoming the innovation barriers through the disruption of innovation spaces and the creation of audience awareness about the benefits of innovative technologies.

2.3 Proposed Framework – Effective Operationalisation of the Non-Technological Solutions

Academic literature on the methodologies and guidelines for the evaluation of effectiveness was extensively reviewed and summarised. It was also decided to identify additional inputs from non-academic literature sources via Google Search and interactions with knowledgeable associates. For this study, the evaluation of effectiveness was primarily correlated with the non-technological solutions identified in D7.2 and mentioned in *Section 2.2*. The list of non-technological solutions varies from the broad concept of policy solutions, business concepts and information provision & quality. Additionally, insights with regard to effectiveness in the Port Context and Innovation effectiveness are also presented as these streams provided essential guidance in determining the appropriate approach.

Several frameworks and methodologies were assessed in line with the objectives mentioned in *Table 1* and the insights obtained from the previous sections. It was observed that most frameworks started with a stone setting approach for solid foundations so as to obtain ground information and delimitations about the measure being studied, hence in agreement with the first objective of this report. The second objective of the report was to find means to bring a non-technological solution further into a well-working environment, and the work of Nesterova and Quak (2016) was proposed as a basis. Nesterova and Quak (2016) detailed a methodological approach for the design and execution of a living lab for freight transportation and here translated to the port sector by the WP7 team. A living lab tool is

characterised by a co-creation system in a real-world experimental setting, where co-creation relates to active participation between citizens and societal organisations in the research and innovation process. All participating entities of a living lab activity contribute to the research process based on their knowledge, experience and skills. Living lab research is increasingly being used to study complex societal issues that are difficult to replicate in a classic laboratory. The living lab method guarantees that the stakeholders are included considerably earlier in the innovation planning and implementation processes with constant revisits of the implementation plan to suit stakeholder needs and get maximum impact for a long time. Finally, the tools mentioned by Karousakis (2018) on how to evaluate the effectiveness of policy instruments for a specific sector were proposed to answer the questions related to the measurement of the effects and impacts of the non-technological solutions.

From the gathered literature, it was found that it would not be feasible to evaluate the effectiveness and operationalisation of the variety of non-technological solutions with a single tool. Instead, a framework was developed based on the key research questions, both practical and theoretical, and the literature review from the previous sections, see *Table 3*. The practical and theoretical research questions were classified into eight sections and further into five thematic groups. These groups were called 'Baseline Information', 'Design & Execution Phase', 'Result Evaluation & Feedback', 'Further Insights' and 'Way Forward'. A set of methodological tools was suggested to provide the answers to the fundamental questions being asked. The proposed tools can be replaced by other means if needed, depending on the complexity and requirements of the non-technological solutions. It is also worth mentioning that the methodological approach will be influenced by the non-technological solution being studied and does not require following a strict stepwise procedure from sections 3 to 6.

Table 3: Proposed Framework

#	Key Questions	Thematic Group	Tools
1	What are the aim and objectives of the non-technological solution? What are the operational, ethical and regulatory complexities of the non-technological solution? What barriers do the non-technological solution face and how can they be overcome?	*Baseline Information*	- Case Study Analysis
2	Who are the stakeholders involved and the intended beneficiaries? What are their interests? What is their influence?		- Stakeholder Analysis
3	How will the non-technological solution be implemented? What resources are available, the potential risks, and what will we need for efficient operationalisation? How to operationalise the non-technological solution at different levels (if possible)? What will be evaluated? How will data be collected? What is the timeline of operationalisation? Which milestones will be set? How to plan and prepare the stakeholders involved?	*Design & Execution Phase*	- Workshop - Living Lab
4	Is the non-technological solution producing the intended results? If so, for whom, to what extent and in what circumstances? How valuable are the results for the stakeholders/beneficiaries?	*Result Evaluation & Feedback*	- Programme Theory Evaluation - Survey/Interviews
5	What are the unintended results (positive and negative)? What is the feedback from the stakeholders/beneficiaries?		
6	Does the non-technological solution provide the best possible use of available resources to achieve the results?		- Cost Effectiveness
7	Why are the outcomes of the non-technological solutions successful or unsuccessful in the given context? How do these outcomes occur? Do we have the right stakeholders involved?	*Further Insights*	- Counter Factual Evaluation
8	What are the conclusions and main recommendations?	*Way Forward*	

- Baseline Information

  Objective: To identify the aim and objectives, barriers faced, the operational, ethical and regulatory complexities and stakeholders/intended beneficiaries of the non-technological solutions.

  Approach: For the baseline information, a case study analysis will be needed to determine the aim and objectives of the non-technological intervention and the barriers encountered. While the primary purpose of this investigation remains the potential emission reduction from the implementation of non-tech, it is essential to enquire about other objectives set by the initiator of the solution. For instance, a solution can have simultaneous goals like decarbonising the port sector and increasing employment, and the primary focus might be job creation, not decarbonisation. The operational, ethical and regulatory complexities of the non-technological solutions have to be identified. This information will check whether the non-technological can be replicated in other regions of Europe without raising ethical and legislative issues. This section will also answer questions about where and how the non-technological solution is being implemented and provide the scope. It will also state whether the activities are implemented via new technological adoption or behavioural change.

  Moreover, a stakeholder analysis is proposed to identify the stakeholders involved and assess their influence and interest. Stakeholder analysis often refers to various methods or instruments used to recognise and comprehend the requirements and expectations of significant interests inside and outside the case study environment. The stakeholder analysis helps proceed with a thorough understanding of the various actors' characteristics, interrelationships, ambitions, and drivers. The case study and stakeholder analysis will provide baseline information for the non-technological intervention. These data are prerequisites and set the foundation for the following steps of the framework

- Design & Execution Phase

  Objective: To further detail and operationalise a non-technological solution and prepare the stakeholders involved in the execution phase.

  Approach: The Design and Execution Phase contrives to answer how, where, and with what means the non-technological solution will be implemented and operationalised. This phase will make use of workshops to involve the relevant parties in a 'living lab'

design approach. A Living Lab typically consists of the following steps in its design and execution phase:

- Implementation Plan
  An implementation plan is a plan of action that details the scientific, technical, administrative, and procedural activities and duties required. For the implementation plan, it is essential to cover several topics, including but not limited to the lab's ambition, scope, risks, deliverables and milestones, timeline and planning, resources, budget, expected cost, monitoring and control tools.
- Preparation Plan
  A preparation plan is used to conduct all mandatory preparations and arrangements prior to the start of an experiment in the living lab. The steps for consideration in a preparation plan are the operational preparation of the case study, baseline measurements for results comparison, training of stakeholders, and mitigation of potential risks and undesired events.
- Execution
  During the execution phase, particular attention should be given to the progress and scope of the experiment, stakeholder and user expectations and concerns, external environment management and collection of any valuable information for further analysis.

- Result Evaluation & Feedback

  Objective: To analyse the results and feedback obtained from the implementation of the innovation

  Approach: The third thematic group, 'Result Evaluation & Feedback', deals with the analysis of comprehensive data collection and feedback from the targeted stakeholders for the implemented innovation. Data collection is collecting, measuring and analysing accurate insights for research using standard validated techniques. It is necessary to assess the information gathered during the preceding phases and look for any gaps. Intended and unintended results can be generated during the implementation of the innovation, and both results can lead to positive and negative outcomes, respectively. These results have to be studied and understood for each specific context. A programme theory evaluation can be used to assess unintended and intended results as this method tries to explain the fundamental mechanisms by which any program is expected to work and the contextual restrictions impeding its delivery, success, and impacts. Additionally, surveys and interviews can be conducted to collect feedback from the stakeholders involved. It is also essential to conduct an

economic evaluation to note whether the non-technological solution provides the best possible use of available resources to achieve the anticipated results.

- Further Insights

  Objective: To obtain answers to theoretical situations that are contrary to what actually happened or will have happened with the use of the non-technological solution

  Approach: For the penultimate thematic, 'Further Insights', the counterfactual evaluation method is proposed to understand why the outcomes of the non-technological solutions are successful or unsuccessful in a given context, have the right stakeholders been involved, and how the outcomes were realised. Counterfactual evaluation is a non-experimental approach whereby a control group does not exist, and predictive models are used to assess the behaviours of various interventions in a specific case study. In simpler terms, counterfactual analysis is a tool that aids in avoiding making mistakes made in the past or the foreseeable future. This approach also helps in determining the causal relationship and understanding the direct influence of the measure on the success or failure of the process while counteracting future or past imaginaries.

- Way Forward

  Objective: To provide conclusions and recommendations

  Approach: The last step is to summarise all data collected and analysed from the previous stages of the framework. Conclusion and recommendations will be delivered based on valuable input and lessons learnt from the case study. This section also aims at advising whether we can proceed with the studied non-technological solution for the adoption of the innovation or we need to repeat the process with different solution(s).

3. Conclusions

The objective of this report was to devise an approach for the effective operationalisation of the non-technological solutions with respect to green innovation in the port sector. To begin with, the results from previous preparatory tasks for Work Package 7 were used as a foundation to guide the research with respect to the evaluation of effectiveness. The classification framework from D7.2 provided a clear understanding of the different clusters of the non-technological solutions. The methodologies and guidelines for evaluating effectiveness were reviewed through both academic and grey literature. It was found that various researchers used several methodological tools to assess the effectiveness of a measure. However, with the variety and complexity of the non-technological solutions being considered, it was proposed to use a framework to evaluate the effectiveness of non-technological solutions and find ways how to better operationalise the non-tech. A set of tools was presented to answer specific questions related to the thematic: Baseline Information, Design & Execution Phase, Result Evaluation & Feedback, Further Insights and Way Forward. Overall, the proposed framework provides a strategic approach to evaluating the effectiveness of the non-technological solutions both at specific and systemic levels and can be used to validate its operationalisation. The use of the five thematic groups offers a clear guide of what is being researched and facilitates the review and analysis of information. Moreover, the framework allows the flexibility to add or replace the proposed evaluation tools depending on the complexity and requirement of the case study, provided the key questions are being answered.

References

Brooks, M. R., & Pallis, A. A. (2008) Assessing port governance models: process and performance components. *Maritime Policy & Management*, *35*(4), 411-432.

Brooks, M. R., Schellinck, T., & Pallis, A. A. (2011) A systematic approach for evaluating port effectiveness. *Maritime Policy & Management*, *38*(3), 315-334.

Ducruet., C. (2009) Port regions and globalisation. In T. Notteboom, P. de Langen, & C. Ducruet (Eds.), *Ports in proximity: Competition and coordination among adjacent seaports* (pp. 41–53). Aldershot: Ashgate.

Duru, O., Galvao, C.B., Mileski, J., Robles, L.T. & Gharehgozli, A. (2020) Developing a comprehensive approach to port performance assessment. *The Asian Journal of Shipping and Logistics*, *36*(4), pp.169-180.

Edwards-Schachter, M. (2018) The nature and variety of innovation. *International Journal of Innovation Studies*, *2*(2), pp.65-79.

Frobisher, P. (2021). A Strategic Model of Innovation. *International Journal of Systematic Innovation*, *6*(3), 19-29.

Ha, M. H., Yang, Z., Notteboom, T., Ng, A. K., & Heo, M. W. (2017) Revisiting port performance measurement: A hybrid multi-stakeholder framework for the modelling of port performance indicators. TransportationResearch Part E: Logistics and Transportation Review, 103, 1-16.

Karousakis, K. (2018), "Evaluating the effectiveness of policy instruments for biodiversity: Impact evaluation, cost-effectiveness analysis and other approaches", *OECD Environment Working Papers*, *No. 141*, Paris: OECD Publishing.

Khan, M.T., Khan, T.I. and Khan, S. (2020) Innovation & Its Diffusion in Business: Concept, Stages & Procedural Practices. *Sir Syed Journal of Education & Social Research*, *3*(4), pp.174-186.

Nechaev, A.S., Bovkun, A.S. & Zakharov, S.V. (2017) Innovation management characteristics of industrial enterprises. In *2017 International Conference" Quality Management, Transport and Information Security, Information Technologies"(IT&QM&IS)* (pp. 556-559). IEEE.

Nesterova, N. & Quak, H. (2016) A city logistics living lab: a methodological approach. *Transportation Research Procedia, 16,* pp.403 – 417.

Park, Y. & Dossani, R. (2020) Port infrastructure and supply chain integration under the belt and road initiative: role of Colombo port in the apparel industry in South Asia. *Transportation Research Procedia*, *48*, pp.307-326.

Zhang, Q., Zheng, S., Geerlings, H. & El Makhloufi, A. (2019) Port governance revisited: How to govern and for what purpose? *Transport Policy*, *77*, pp.46-57.

Zizlavsky, O. (2016) Innovation performance measurement: research into Czech business practice. *Economic research-Ekonomska istraživanja*, *29*(1), pp.816-838.

Annex A: Classification Framework

Cluster	Solution Type	Description
Policy solution	Market Intervention	Taxation, Subsidies, and price fixing or differentiation measures to distort the market in favour of new, sustainable technologies with positive externalities. E.g., the carbon tax or emission trading system.
	Regulation and norm creation	Implementation of (mandatory) requirements for sustainable product design, operation, and consumption. Aimed at the exclusion of undesired options, e.g., the European ship dismantling regulations.
	Green public procurement	Market creation for sustainable technologies by public procurement, whereby the government acts as customer e.g., ordering green vessels and infrastructure.
	Regulation & legislation on safety	Establishment of rules and regulations on safety ahead of the implementation of a new technology, or improving exemption procedures for new technology to support innovation. E.g., the Norwegian autonomous shipping fjord.
Business concepts	Burden/price sharing mechanisms	Financial instruments that reduce the costs borne by a given stakeholder in a value chain promoting a sustainable product or technology. In the initial stages of the transition not all partners will be equally willing or able to contribute towards green measures. The added value of these concepts is that it allows the willing and able to contribute to emission reductions. This is commonly achieved through a mass balance and the use of certificates, like the green electricity we can buy as households.
	Platform models	Facilitation of transactions, information sharing, and/or networking via a single access point (PaaS). The added value is effort reduction for customers and data aggregation at one location so that new markets can emerge, such as smart energy markets or optimised trade markets.
	(Green) Certification	Manifesting the added value of sustainable products and technologies through certification. The added value is the certainty or 'de-risking' that the certification provides to the outside world (without endangering the commercial properties). Usually this will be combined with other measures (e.g. market intervention). The certification of recycled materials and the green passport are examples of these measures.
	Market restructuring (consolidation)	Concentration of resources through horizontal (acquisitions, conglomerations) or vertical (supply chain consolidation) integration in fragmented

		sectors. The added value is that larger entities can more easily carry the costs of innovation and research. The effective bundling of forces and knowledge could be used to accelerate developments.
Information Provision & Quality	Knowledge transfer & diffusion	The active process of sharing information with those in need of it and reaching them. Information campaigns and strong marketing initiatives are examples of how this can be used to extend awareness about a given technology or issue. The goal should not be to sell, optimising the information to your strong points, but to enlighten stakeholders.
	Skills & expertise development	The allocation of resources towards education, ensuring that the necessary expertise exists, and that it can be sustained and built upon over time. Examples are sufficiently knowledgeable crew to deal with e.g., new fuels or digitisation.
	Quality provision of knowledge	The design of knowledge dissemination efforts to be factual, simple, and easy-to-find. A concern in this regard is the lack of a central, authoritative source of information on new technologies. Hence the reliability of information is always doubtful and therefore context should be rich.

Annex B: Detailed Solutions

	#	Detailed Solutions	Example
Policy Solutions	1	Taxation and tax exemptions	Price instruments: Additional or reduced taxes on transport modes, e.g. a carbon levy, or energy-content based fuel taxes instead of volume-based
	2	Flexible mechanisms	Quantity instruments: Using trading schemes to achieve policy targets, e.g., an extension of the EU Emission Trading System on the maritime sector
	3	Price differentiation	Adjustment of pricing schemes to incentivise transitional behaviour, e.g., port dues based on associated emissions/ propulsion technology
	4	Service discrimination	Adjustment of services offered to incentivise transitional behaviour, e.g., fast repair services for low-carbon vessels.
	5	Standardisation	Introduction of new norms and standards to establish energy-efficient, low-carbon, and digital technologies, e.g., Energy Efficiency Design Index of the IMO, fuelling protocols, etc.
	6	R&D support	Funding research and development in the maritime sector to accelerate the innovation of new technologies, e.g., raise of research project funding or renewal of patent regulation
	7	Subsidies	Introduction of subsidies for specific technologies, e.g., for new propulsion systems, or renewable energy generation
	8	Speed Restriction/ reduction	Order & Control instrument: Speed restriction on different transport modalities or areas/fairways/highways
	9	Regulatory Experimentation & Incentive Regulations	Allowing port parties to conduct live experiments in a controlled environment under the supervision of the regulator, e.g., EU sandbox to explore AI regulation
	10	Digital governance models for data and platform management	Regulation of digital services in the port context, e.g., regarding publication or privacy.
	11	Green Public Procurement	Green procurement of government-owned/operated vehicle/vessel fleets
Business Concepts	12	Green Shipping Corridors	Maritime routes that showcase low-emission fuels and technologies, e.g., Los Angeles-Shanghai Green Shipping Corridor
	13	Data Sharing Platforms & Partnerships	Provision of platforms to establish partnerships between data providers and users, e.g., cooperation between the port base and LOGINK, China's national platform for logistics information

	14	Investment & cost risk mitigation	Mitigating risks by sharing risk according to the partners' risk appetite, e.g., Contracts for Difference, Standardised long-term contracts for RES investments between generators and consumers.
	15	Voluntary Agreements/ Benchmarking/ Green or Carbon Neutral certification	Voluntary or governmental certification of green or carbon neutral products and support by trusted technologies, e.g., GoodFuels or certification for green hydrogen
	16	Energy Transition Management (Long-term Learning by doing)	Implementation of low-emission technologies and processes aiming for steady improvement in the long-term
	17	Split Incentive Alignment	Resolving split incentives, e.g., owners also bear the cost of energy-efficiency investments while users benefit from them
	18	Niche Development Roles	Targeting of niches to break the ice for further transitions, e.g., zero-emission passenger transport in Norway
Information Solutions	19	Consensus tooling	Tools that support finding consensus between port parties
	20	Innovation Hubs	Space for idea exchange to enable innovation
	21	Targeted Information Schemes	Publish information schemes for a specific target group, e.g., a white paper series for policymakers
	22	Decision support tools (Marginal Abatement Costs)	Tools that facilitate decisions in the maritime and energy business
	23	Port User Forums	Create a space for port users to provide feedback and ideas

Annex C: Contribution to the Knowledge Portfolio

Below information is not applicable to this deliverable

BACKGROUND – TITLE / RESPONSIBLE[1] NAME	
Owner(s)	Partner Name(s)/third party rights, if applicable
Nature	Patent, design, software, etc.
Registration/Protection	Patent number or patent application number, copyright (year, etc), version N° (for s/w), etc.
Description	Description of background
Access conditions for research in the project / Limitations	Description of the access conditions, in particular: If a request in writing is needed and if access is conditional upon a specific licence agreement If limited to a WP
Access conditions for Use / Limitations	Description of the access conditions for use including for further research, internal usage and/or commercial usage
Licensees in the project	Names of the licensees – 1st set
	Date of allocation
	Type of licence/specific access rights granted
	Signature of parties (optional)
	Names of the licensees – 2nd
	Date of allocation
	Type of licence/access rights granted
	Signature of parties (optional)
Licensees for use	Names of the licensees – 1st set
	Date of allocation
	Type of licence
	Signature of parties (optional)
	Names of the licensees – 2nd set
	Date of allocation
	Type of licence
	Signature of parties (optional)

[1] *Responsible means the organisation in charge of handling the IPR attached to the Background.*

EXPLOITABLE FOREGROUND	
Type of exploitable foreground	Please select: • General advancement of knowledge • Commercial exploitation of R&D results • Exploitation of R&D results via standards • Exploitation of results through EU policies • Exploitation of results through (social) innovation
Exploitable Foreground (description)	1. Identify the task, WP where the Knowledge has been produced 2. Description of the Foreground 3. Background required to use the Foreground
Confidential	Yes / No
Foreseen embargo date	DD-MM-YYYY
Exploitable product(s) or measure(s)	
Sector(s) of application	
Timetable for commercial use or any other use	
Patents or other IPR exploitation (licenses)	
Owner & Other Beneficiary(s) involved	

All fields must be filled

PATENTS, TRADEMARKS, REGISTERED DESIGNS, ETC.	
Type of IP rights*	Please select: Patents / Trademarks / Registered Designs / Utility Models / Others
Application reference(s) (e.g. EP123456)*	
Subject or title of application*	
Confidential*	Yes / No
Foreseen embargo date	DD-MM-YYYY
Applicant(s) as on the application*	
URL of application	(Mandatory for Patents)

**Mandatory fields*