Capacity with a pOsitive enviRonmEntal and societAL footprInt: portS in the future era

COREALIS
THE PORT OF THE FUTURE

D.7.7: Conclusion report of COREALIS scientific contributions

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List of Acronyms

Abbreviation / acronym	Description
AP	Average Precision
AR/VR	Augmented/virtual reality
BASE/X	Business Agility through Service Engineering in a Cross-Organizational Setting
CFO	Cargo Flow Optimizer
CT	Container Terminal
D1.1	Deliverable number 1 belonging to WP 1
DAMVI	Diversity-Aware weighted Majority Vote over previously learned base classifiers for Imbalanced datasets
EC	European Commission
IOIS	Inter-organizational information systems
IoT	Internet of Things
JIT	Just-In-Time
KPIs	Key Performance Indicators
M2M	Machine to machine
PCT	Piraeus Container Terminal
PI	Physical Internet
PoFSG	Port of the Future Serious Game
PORTMOD	Simulation tool that aims to facilitate Container Terminal (CT) operation improvements
ROI	Return on Investment
RTPORT	5G-based Model-Driven Real Time Module
SCM	Supply chain management
SDBM/R	Service-dominant business model radar
SOA	Service-oriented architectures
SSCM	Sustainable supply chain management
TAM	Technology Acceptance Model
TAS	Truck Appointment System
WP	Work Package

Executive Summary

This deliverable summarizes COREALIS project in academic point of view and describes the project's contribution to academic community. In addition of presenting all the scientific achievements of the project, i.e., journal articles, and conference papers and posters, this deliverable also presents what kind of empirical material the project has produced, and how it would be possible to write academic papers based on that material and which kind of theoretical contribution the paper may contain.

As this deliverable works as summarizing document, there are at least three different approaches to read this deliverable. First, for researchers working with maritime and port logistics topics, sustainable supply chain management issues or questions related to implementation of new digital technologies, this deliverable presents an overview of available material and works as a handbook to find the material. Second, for COREALIS partners, this deliverable helps to develop project documents further as academic papers. Third, this deliverable also summarizes the scientific contribution of COREALIS project for those, who are interested in that perspective.

Until M35 (March 2021), as the most concrete scientific output, the project has published or have acceptance for publication for 12 conference papers, one conference poster, one technical report and 6 scientific journal articles. In addition, 3 scientific journal articles are under review. Moreover, the project members participated actively in scientific conferences and other events to have an overall presentation of COREALIS project.

1. Introduction

COREALIS EU project (5/2018-4/2021) aims to develop further digital technology solutions to support cargo ports to handle upcoming and future capacity, traffic, efficiency and environmental challenges. Figure 1 presents an overview of innovations developed and tested in COREALIS project.

Figure 1 Innovations developed and tested during COREALIS EU project.

Developed COREALIS innovations were tested in five different living labs: Antwerp (Belgium), HaminaKotka (Finland), Livorno (Italy), Piraeus (Greece) and Valencia (Spain). Figure 2 presents living labs on map of Europe.

Figure 2 Living labs where COREALIS innovations were tested

1.1 Scope of the deliverable

This deliverable was intended to summarize COREALIS project in academic point of view, and to describe what kind of contribution the project has offered to academic community. However, global COVID-19 pandemic posed challenges for the second half of the project. Usually, that period is used to summarize project results and writing academic papers based on those results. However, for COREALIS project, COVID-19 delayed the tests and forced researchers to work remotely. All these challenges forced project partners to prioritize their work, and unfortunately organizing innovation development, tests, and promised workshops in new circumstances are more important than scientific writing for project execution perspective. Therefore, the scientific partners of COREALIS project had plans to write more scientific papers to disseminate project results than actually were published.

As the publication plans of COREALIS project changed, another purpose of this deliverable was found. That other purpose is to ensure that all the scientifically relevant results of COREALIS project can be found. As COREALIS project produced a lot of important results that could combine practice with science in scientific publications, this deliverable can be used as a handbook to find those results.

1.2 Structure of the deliverable

The deliverable is organized as follows. After this introduction, the theoretical background for COREALIS project is presented in section 2. The section 3 presents how COREALIS project has supported writing scientific papers, and what kind of scientific dissemination the partners have made during COREALIS project. Then, scientific contributions of published COREALIS results are presented in publication level in section 4. Section 5 summarizes the main scientific contribution of COREALIS project and its publications under three different topics and proposes two topics for high quality scientific articles that could be written by combining empirical material of COREALIS project. Section 6 presents how COREALIS have participated in Open Research Data Pilot and where it is possible to find COREALIS publications and all material produced in the project. Finally, Conclusion section concludes the deliverable.

1.3 Intended readership

This deliverable has three types of readers:

1. COREALIS project partners who has willingness to write scientific papers after the project.
2. Everyone who is interested to research topics of COREALIS project.
3. Those who evaluate the COREALIS project results in general.

For the first reader group, the purpose of this deliverable is to inspire to write scientific papers by helping to find suitable theoretical contribution and tell how the paper could use the work of other partners.

For the second reader group, this deliverable works as a handbook for COREALIS project results. As described in section 6 of this deliverable, the purpose of COREALIS project is to ensure open access of project results. However, the enormous data of COREALIS project is scattered around different deliverables and conference papers. By reading this deliverable, it is easier to see what kind of results the project has produced, and where it can be found.

Usually, EU project partners write these kinds of summarizing deliverables to tell project evaluators what they have produced in the project, and whether the project funding is correctly used. Even if this deliverable also has that purpose and reader group, the authors of this deliverable have higher aims and hope that this deliverable will have more readers than just the evaluators.

2. Theoretical background for COREALIS project

Funded under the European Union's Horizon2020 Framework Programme, COREALIS develops a strategic, innovative framework, supported by disruptive technologies, including Internet of Things (IoT), data analytics, next generation traffic management and emerging 5G networks, in order to support cargo ports to handle upcoming and future capacity, traffic, efficiency and environmental challenges. Within this framework, the proposed beyond-state-of-the-art innovations target to increase efficiency and optimize land use, while being financially viable, respecting circular economy principles and being of service to the urban environment.

These port-driven technological and societal innovations are tailored to realize COREALIS high-level objectives, which are focused on:

- Embracing circular economy models in its port strategy and operations.
- Reducing the port's total environmental footprint associated with intermodal connections and the surrounding urban environment for three major transport modes, road/truck, rail and inland waterways.
- Improving operational efficiency, optimizing yard capacity, and streamlining cargo flows without additional infrastructural investments.
- Enabling the port to take informed medium-term and long-term strategic decisions and become an innovation hub of the local urban space.

The ultimate ambition of COREALIS is to achieve a significant step forward for future ports, maximizing their capacity and efficiency with minimum infrastructure upgrades, while at the same time ameliorating the port-city relation. To this end, COREALIS innovations are expected to have a multi-dimensional impact.

From the operational side, COREALIS palette of ICT components is focused on meeting the capacity and efficiency targets. The proposed framework aims to improve the terminal operations efficiency, maximize the use of the infrastructure and equipment and decrease operational costs as well as external costs such as congestion, waiting and idle times. For this purpose, the Predictor innovation aims to the significant extension of the total lifecycle of the port spare parts, while the PORTMOD innovations deals with the optimization of stacking and availability of container handling equipment and cranes. In parallel, through the RTPORT innovation, the leveraging real-time data availability is achieved, along with the increased reliability of the port operations process models. Also, the optimum number of self-owned yard vehicles is provided by the Brokerage platform. Furthermore, one of the project's objectives is to improve the logistics efficiency in general and this is achieved through the Cargo Flow Optimizer (CFO) that supports the provision of higher cargo throughputs due to enhanced hinterland connections and shorter end-to-end deliveries. Also, increased operational efficiency can be enabled through the Just-In-Time (JIT) Rail Shuttle Service by using removing some of the seaport operations to dry port.

Considering the societal aspect, COREALIS targets in the citizens and stakeholders' satisfaction through the betterment of life quality. It establishes efficient connections with hinterland transport network and promotes the use of the most energy-efficient transport modes (e.g., railway and inland waterways). It will foster the smart urban development of port-cities, enabling port managers to take informed decisions towards sustainable policies with city stakeholders. Through the Port of the Future Serious Game (PoFSG), the understanding on common challenges from port operators and city decision makers is improved, while the transforming of the port from a vast energy consumer to a green energy 'prosumer' can be achieved through the Green Cookbook. Also, the Innovation Incubator aims to redefine the port's role and engage the local pioneering industries.

Regarding the environmental impact, the COREALIS innovations aim to achieve a lower environmental impact of port operations in general. Through the Truck Appointment System (TAS) innovation, the primary goal is to increase visibility of transport flows from and to terminal, but the ultimate goal is to reduce the traffic congestion in and around ports and thus, to reduce the CO_2 port emissions and noise. In parallel, through the PoFSG, real-time sustainable complex scenarios of logistics flows, port design and planning can be incorporated, while the interventions' impact to the climate change adaptation of the port-city can be evaluated.

From the beginning of the project, COREALIS partners were fully dedicated not only to creating breakthrough innovations that decisively contribute to the creation of the future ports of Europe and beyond, but also to widely disseminate its valuable results and outcomes, ensuring that COREALIS project acquires high visibility, outreach and influence on all interested parties.

3. Scientific dissemination during COREALIS project

3.1 Methods to support the common writing of papers in COREALIS

This subsection summarizes, what has been done in COREALIS project to promote scientific publications.

3.1.1 Developed guide for writing papers

VTT presented the guide for writing papers during plenary meeting in Athens in June 2019. The purpose of that presentation was to motivate COREALIS partners to write scientific publications about the project outcomes and give general guidelines for the writing. The presentation had the following topics:

- About scientific dissemination in general
- Different levels of scientific publications
- Topics for scientific papers in COREALIS project
- Possible viewpoints for presenting the work of COREALIS project
- How to increase scientific value of the paper?
- Propositions for writing papers that summarize the outcomes of COREALIS project

Hereafter the content of the above topics is presented shortly.

About scientific dissemination in general

The first part of the presentation is concentrated on explaining what scientific publication is by explaining its purpose. The purpose of scientific publication is to advance science by publishing original empirical and theoretical work. Therefore, other publications, e.g., vocational magazines articles, are usually not considered as scientific publications. However, those publications are also recommended and needed in COREALIS project.

Different levels of scientific publications

Scientific publications have different levels depending on their scientific value. In this deliverable, the paper classification is explained in an order that follows the typical development of paper of especially inexperienced author. In that type of paper writing, the author first writes report and then advances it further by improving its scientific value step by step. The purpose of highlighting this order was also to motivate especially for inexperienced authors to start by the first step and publish something.

In this project, the first step was named as Technical papers for large multipurpose conferences like ITS World Congress or TRA. Even if technical papers are not always considered as scientific publication, the purpose of raising these as the first step was to encourage especially industrial partners to publish something that does not require previous publishing experience. Typically, technical papers reports e.g. certain innovation, tests, or certain results.

The second step was named as Scientific conference papers. Comparing with technical papers, the content in these papers is explained in wider context. Therefore, these papers have more literature references as the results are compared with other similar studies and the work relates to the existing literature.

The third step is Journal papers. The journal paper explains the work in wider theoretical context and pinpoints the originality of the paper by positioning the work in existing literature. There was also discussion about different level of journals and the conclusion was that the better the paper is written and the bigger scientific contribution it has, the more appreciated journal may publish the paper.

Topics for scientific papers in COREALIS project

Then different topics for scientific papers were presented.

First conceptual papers were mentioned. Paper of Nikolopoulou et al. presented in IPIC2019 conference was named as an example of this kind of paper.

Then, literature reviews were mentioned as good topics for papers. The purpose was to encourage to publish the results of many deliverables that contain extensive literature review. Especially, in the early phase of the project there were many of these kinds of deliverables. Paper under work based on part of D3.1 was mentioned as an example.

Then different topics for presenting the empirical work of COREALIS project was mentioned. At first, it is possible to present developed COREALIS innovation (e.g., RTPORT, PORTMOD, TAS, etc.). The other alternative is to present tests and results of certain Living Lab. Then, the use of other empirical material (e.g., online questionnaire) could be used as the basis for paper. Finally, the ideas of papers summarizing the work of COREALIS project by using the material for several Living Labs and COREALIS innovations were introduced.

Possible viewpoints for presenting the work of COREALIS project

After presenting possible topics for the papers, the possible viewpoints were presented. These viewpoints concentrate on topics related to presentation of empirical work of COREALIS project.

If the paper's topic is to develop a COREALIS innovation, two alternative viewpoints are proposed. First, the viewpoint can be technology based and the research question could be something like: "What is the novelty of the developed solution?" Second, the viewpoint can be solution based, and then the research question could be something like: "How the innovation contributes for certain (e.g., logistics) problem?"

If the paper's topic is to present tests and results of certain Living Lab, two alternative viewpoints are proposed. First, the viewpoint can be operational and the research question could be something like: "How the adoption of COREALIS innovations could improve the operations in Living Lab?" Second, the viewpoint can be to look for the joint effect of the adopted innovations and then the research question could be

something like: “How the COREALIS innovations (of one Living Lab) complete each other?”

Techniques to increase scientific value of the paper

The following part of the presentation focused on the techniques to improve scientific value of the paper. The general idea of the presentation of these techniques was to motivate authors to elaborate further their conference papers as journal articles.

First, the paper should be positioned with existing literature e.g., many COREALIS innovations are not novel and, therefore, the review of similar innovations should be included as a part of the paper. In addition, adding theoretical contribution for the paper increases its value e.g., innovation adoption theories or sustainable supply chain management could be used as these kinds of theories.

Second, the authors should concentrate on Methodology section by explain rigorously what has been done and why.

Third, the conclusion section needs emphasis e.g., it is important to explain what kind of conclusions can be made from the results of the paper and justify these conclusions. In addition, generalization of the results should be included.

Propositions for writing papers that summarizing the outcomes of COREALIS project

The presentation ended by propositions for writing papers that summarize the outcomes of COREALIS project. As these propositions were made already in the early phase of the project and this deliverable has a dedicated section for suggestions of future paper topics, the propositions of that time were presented very shortly.

The idea was to use all the material of COREALIS project and write together with interested partners a common paper. The suggested topic was adoption of digital technologies in ports and suggested research methodology design science.

3.1.2 Collection of lists of preferable conferences and journals

A list of potential scientific journals has been created in order to advance scientific publications in COREALIS and encourage partners in contributing to the scientific dissemination. The indicative list of the proposed journals is available in Annex 1.

In addition, an online calendar of the most prominent and related to COREALIS project events has been created as an action to support and encourage the event participation. It is being regularly updated by all partners, accommodating also the emerging needs raised from COVID-19 outbreak that strived for virtual and remote attendance. An indicative list of upcoming events is available in Annex 2.

3.1.3 Participation in conferences

From the scientific point of view, published papers and reports are the permanent scientific results of conferences. However, there were also other conference activities that promoted scientific work of COREALIS:

- Presentations in Conferences and Events
- Posters and Reports
- Special interested sessions (Training seminars, Dissemination workshops)
- Mass media publications
- Project events (COREALIS LLs Training seminars & Webinars)
- Booth presentations and stands

COREALIS performed activities are summarized in Table 1. For each activity a detailed description of the event, the partners involved, the achieved result and the presented material is available at the COREALIS website: https://www.corealis.eu.

Table 1 COREALIS performed activities.

Conferences/ Events
• **Jean Monnet Symposium**, Chios, Greece, 28-29/06/2018, **DYNNIQ**, https://www.corealis.eu/wp-content/uploads/2018/07/COREALIS-JeanMonnetSymposium-180628.pdf
• **DocksTheFuture: Workshops with Experts**, Porto, Portugal, 29-30/10/2018, **SEAB,** https://www.corealis.eu/wp-content/uploads/2019/05/COREALIS-Overview.v.2.pdf
• **4th ITS Hellas Conference & Exhibition**, Athens, Greece, 18-19/12/2018, **ICCS,** https://www.corealis.eu/wp-content/uploads/2019/01/PortsFuture_Multimodal_System_Tsertou_ICCS.pdf
• **DocksTheFuture MidTerm Conference**, Trieste, Italy, 04/04/2019, **ICCS,** https://www.corealis.eu/wp-content/uploads/2019/05/Port-of-the-Future-COREALIS-presentation.pdf
• **European Maritime Days 2019**, Lisbon, Portugal, 16-17/05/2019, **VPF, POA,** https://www.corealis.eu/index.php/event/european-maritime-day-2019-in-lisbon-portugal/
• **Baltic Ports Conference 2019**, Stockholm, Sweden, 04-06/09/2019, **ERTICO,** https://www.corealis.eu/wp-content/uploads/2019/09/Baltic-Ports-Conference_COREALIS-presentation.pdf
• **Seminario sulla Carbon footprint nel sistema portuale dell'Alto Tirreno,** Livorno, Italy, 12/09/2019, **CNIT,** https://www.corealis.eu/wp-content/uploads/2019/10/alexandr_tardo_CNIT_carbonfootprint_Livorno.pdf
• **1st International Conference on Maritime Transport,** Rome, Italy, 10-12/09/2020, **VPF,** https://www.corealis.eu/index.php/event/1st-international-conference-on-maritime-transport-2019/
• **UN SDSN Global Solutions Forum**, New York, USA, 25/09/2019, **ADSP MTS, ERICSSON & CNIT,** https://www.corealis.eu/wp-content/uploads/2019/09/GSF_LC-005_final.pdf
• **BiLOG conference**, La spezia, Italy, 16-17/10/2019, **CNIT,** https://www.corealis.eu/wp-content/uploads/2019/07/COREALIS_Bilog_fin.pdf
• **ESA at the New Space Economy European Expoforum**, Rome, Italy, 10-12/12/2019, **CNIT,** https://www.corealis.eu/wp-content/uploads/2020/01/space_economy_rome_CNIT_Alexandr_Tardo.pdf
• **TRA2020**, Virtual event, 23/06/2020, **DELTARES,** https://www.corealis.eu/wp-content/uploads/2020/06/TRA2020-Webinar_DELTARES.pdf
• **OR62**, Virtual events, 15/09/2020, **MOSAIC,** https://www.corealis.eu/wp-content/uploads/2020/09/CARGOFLOWOPTIMISER.pdf
• **4th Smart Blue City Conference**, Athens, Grecce, 09-10/10/2020, **ICCS,** https://www.corealis.eu/wp-content/uploads/2020/10/COREALIS_4thSmartBlueCity_ICCS_v2.pdf

- **ICIL (Institute for Careers and Innovation in Logistics & Supply Chain**, Virtual event, 04/11/2020, **MOSAIC,** https://www.corealis.eu/wp-content/uploads/2020/11/ICIL_CFO_20201104v02.pdf
- **ITS Virtual Congress**, Virtual event, 09-10/11/2020, **ICCS, MOSAIC,** https://www.corealis.eu/wp-content/uploads/2020/11/CFO_20201103v01.pdf, https://www.corealis.eu/wp-content/uploads/2020/11/ITS-Virtual-Congress-2020_COREALIS_ICCS.pdf
- **3rd Annual Baltic Sea Region 5G ecosystem forum**, Virtual event, 11-12/11/2020, **ICCS,** https://www.youtube.com/watch?v=EywG6BFGYcE&feature=youtu.be
- **DocksTheFuture Conference "Defining the concept of the Port of the Future 2030"**, virtual, 24/11/2020, **ICCS** https://www.corealis.eu/wp-content/uploads/2020/11/DtF_COREALIS_ICCS.pdf
- **5G for Italy 3rd edition**, virtual event, 02/12/2020, **CNIT** https://www.corealis.eu/wp-content/uploads/2020/12/5G_for_Italy_2020_Pagano_Tardo_final.pdf
- **EU&U**, Athens, Greece, 18/01/2021, **ICCS** https://www.corealis.eu/wp-content/uploads/2021/01/COREALIS_EUandU_18012021_updated.pdf
- **2021 IEEE International Forum on Smart Grids for Smart Cities,** virtual, 19/03/2021, **DYNNIQ,** https://www.corealis.eu/index.php/event/2021-ieee-international-forum-on-smart-grids-for-smart-cities/

Technical Papers/Posters/Reports

- **ITS European Congress 2019**, *Port Multimodal Inland mode of transportation predictor & prescriptor*, 03-06/06/2019, **MOSAIC,** https://www.corealis.eu/wp-content/uploads/2019/10/ITSEurope_CFO_Mosaic_Factor_compressed.pdf
- **IPIC 2019**, *Sustainable port development: towards the Physical Internet concept, 09-11/07/2019*, **ICCS, SEAB, DYNNNIQ, CNIT, VPF, PCT, VTT, Deltares**, https://www.corealis.eu/wp-content/uploads/2019/10/IPIC2019-Sustainable-port-development_towards-the-Physical-Internet-concept-1.pdf
- **IPIC 2019**, *RTPORT: the 5G-based Model-Driven real Time Module for General Cargo Management*, 09-11/07/2019, **CNIT, ERICSSON, ERICSSON research** , https://www.corealis.eu/wp-content/uploads/2020/03/IPIC2019_Full_Paper_CNIT_ERICSSON_v1.0_20_06_2019_updated.pdf
- **IPIC 2019**, *Poster: Big Data and Data Analytics for Ports of the Future, COREALIS, 09-11/07/2019*, **ICCS, NEC, MOSAIC,** https://www.corealis.eu/wp-content/uploads/2019/07/IPIC2019-Poster-COREALIS_V4.pdf
- **Minisymposium: Mathematics of Logistics: emerging trends in Optimization and Simulation Modelling**, *Port Multimodal Inland mode of transportation predictor & prescriptor*, 22-24/07/2019, **MOSAIC,** hhttps://www.corealis.eu/wp-content/uploads/2019/10/CTMI2019_Mosaic_Factor_20190328v01.pdf
- **1st International Conference on Maritime Transport 2019, Rome, Italy,** *Just-In-Time rail shuttle service feasibility study at the port of Valencia*, 09/2019, **VPF,** https://www.corealis.eu/wp-content/uploads/2019/07/JIT-Rail-Shuttle-edited-Aug-2019-vf.pdf
- **The International Joint Conference on Neural Networks (IJCNN)**, *Diversity-Aware Weighted Majority Vote Classifier for Imbalanced Data*, 19-24/04/2020, **NEC Laboratories,** https://www.corealis.eu/wp-content/uploads/2020/07/Diversity-Aware_Weighted_Majority_Vote_Classifier_.pdf
- **TRA2020**, *Sustainability of port operations: The European ports' attempts to reduce negative environmental impacts*, 27-30 April, **VTT,** https://www.corealis.eu/wp-content/uploads/2020/07/TRA2020_30102019_Hinkka.pdf
- **TRA2020**, *PORTMOD – A Simulation tool to improve container terminal operation*, 27-30 April, **VTT,** https://www.corealis.eu/wp-content/uploads/2020/07/TRA2020_16042019_ToniLastusilta.pdf

- **TRA2020**, *The Cyber threat preparedness in the maritime logistics industry*, 27-30 April, **VTT,** https://www.corealis.eu/wp-content/uploads/2020/05/TRA2020_Cybersecurity_article_Pyykko_et_al..pdf
- **Report**, *Port of the future: Addressing efficiency and sustainability at the Port of Livorno with 5G*, 06/2020, **ERICSSON, in collaboration with AdSPMTS, CNIT, FEEM,** https://www.corealis.eu/wp-content/uploads/2020/06/ericsson-port-of-the.pdf
- **27th ITS World Congress**, *Energy Assessment for the Port of the Future: towards Sustainable Logistics*, 10/2020, **DYNNIQ** (not yet published, as part of the conference proceedings)
- **2021 World of Shipping Portugal,** *Efforts by European ports to improve the sustainability of their operations*, 2021, **VTT,** (the improved version of the paper is under review in Case Studies on Transport Policy)
- **2021 IEEE 93rd Vehicular Technology Conference – VTC2021-Spring**, **3rd International Workshop on Dependable Wireless Communications – DEWCOM,** *Secure Multi-access Edge Computing Assisted Maneuver Control for Autonomous Vehicles*, **CNIT, University of Pisa, University of Aveiro** *(accepted for publication)*

Peer reviewed journal publications

- *Angelos Amditis (ICCS), Athanasia Tsertou (ICCS), Amalia I. Nikolopoulou (ICCS) , Konstantinos Gkiotsalitis (NEC), Meng Lu (DYNNIQ), Evangelia Latsa (SEAB), Elena Krikigianni (SEAB), Ioannis Kanellopoulos (PCT), Salvador F. Pruñonosa (VPF), Ville Hinkka (VTT), Allister Slingenberg (DELTARES)*: **"Port of the Future: A Framework for Sustainable Port Development"**, Sustainability Journal,, (under review process)
- *Paolo Pagano (CNIT), Alexandr Tardo (CNIT), Domenico Lattuca (CNIT), Anna Sessler (ERICSSON), Rossella Cardone (ERICSSON), Luca Stroppolo (ERICSSON research), Marzio Puleri (ERICSSON research), Teresa Pepe (ERICSSON research):* **RTPORT: the 5G-based Model-Driven real Time Module for General Cargo Management,** Journal of Business and Economics, ISSN 2155-7950, USA June 2020, Volume 11, No. 6, pp. 631-646, available at: https://www.corealis.eu/wp-content/uploads/2021/03/RTPORT-5G-based.pdf
- *Pérez-Cervera, C (VPF).; Lu, M. (DYNNIQ); Sánchez-Pérez, A. (VPF); Sáez-Carramolino, L. (VPF); Furió-Pruñonosa, S. (VPF),* **Collaborative Service-Dominant Business -Model Design for a Just-in-Time Rail Shuttle Service at the Port of Valencia,** International Journal of Transport Development and Integration, (under publication process).
- *Sáez-Carramolino, L. (VPF); Sánchez-Pérez, A. (VPF), Meng Lu, A. (Dynniq); Pérez-Cervera, C. (VPF) & Furió-Pruñonosa, S (VPF)* **Just-in-time Rail Shuttle Service Feasibility Study at the Port of Valencia**, International Journal of Transport Development and Integration, (under publication process).
- *Ville Hinkka (VTT),* **Design science-based approach for implementation of supply chain-wide tracking,** Operations Management Research journal, (under review process)
- *Ville Hinkka (VTT), Reetta Mäkinen (VTT), Jenni Eckhardt (VTT), Toni Lastusilta (VTT),* **Alternative Approach for Improvement Sustainable Supply Chain Management in the Large European Container Ports**, Forthcoming in HighTech and Innovation Journal, Vol 2. No 2, June 2021.
- *Ville Hinkka (VTT), Saara Hänninen (VTT), Lassi Similä (VTT), Tiina Koljonen (VTT), Reetta Mäkinen (VTT),* **Seaports Leading a Way towards Sustainable Maritime Industry: Port of Helsinki's Action Plan to Become Carbon Neutral by 2035,** Case Studies on Transport Policy, (under review process).
- *Andrea Tesei (CNIT), Marco Luise (University of Pisa), Paolo Pagano (CNIT) & Joaquim Ferreira (Campus Universitario de Santiago),* **Secure Multi-access Edge Computing Assisted Maneuver Control for Autonomous Vehicles**. Accepted in IEEE Open Journal on Vehicular Technology.
- *Andrea Tesei (CNIT), Domenico Lattuca (CNIT), Alexandr Tardo (CNIT), Luca Di Mauro (CNIT), Paolo Pagano (CNIT), Marco Luise (University of Pisa), Paulo C. Bartolomeu (University of Aveiro), Joaquim Ferreira (Campus Universitario de Santiago),* **Securing**

Seaport Logistics Vehicles Using a Distributed Ledger-based Credential Management System, IEEE Open Journal of Vehicular Technology, (under publication process)

Special Interested Sessions

- **ITS World Congress 2018**, *Special Interested Session SIS 70: Port of the future towards automation*, Copenhagen-Demark, 20/09/2018, **ICCS, ERTICO, CNIT,** https://www.corealis.eu/index.php/event/its-world-congress/
- **Collaborative Innovation Days: "New Global Routes: One Belt One Road Initiative & TEN-T"**, *Moderated session: Disruptive technologies and their impact on the OBOR Initiative*, Athens, Greece, 06/11/2018, **ICCS,** https://www.corealis.eu/index.php/event/collaborative-innovation-day-new-global-routes-one-belt-one-road-initiative-ten-t/
- **International Conference on Maritime Transport 2019**, *Moderated session: 'Ports of the Future: Sustainable intelligent ports for smart and autonomous ships and logistics'*, Rome Italy, 10-12/09/2019, **VPF,** https://www.corealis.eu/wp-content/uploads/2019/09/MT19_Presentación_final_compressed.pdf
- **ITS World Congress 2019**, *Special Interested Session SIS48: 'Towards a Sustainable Technology Driven Port City Development Management"*, Singapore, 21-25/10/2019, **ICCS, ERTICO, CNIT, DYNNIQ,** https://www.corealis.eu/index.php/event/26th-its-world-congress/
- **Port of the Future Serious Game (PoFSG) workshop**, *Dissemination workshop*, Delft, 05/02/2020, **DELTARES,** https://www.corealis.eu/wp-content/uploads/2020/06/20200205-COREALIS-PoFSG-test-session.pdf
- **Training seminar**, *Digital Transformation towards fourth generation ports "Smart Ports"*, Valencia, 24-28/02/2020, **VPF,** https://www.corealis.eu/index.php/event/digital-transformation-towards-fourth-generation-ports-smart-ports-2/

Mass Media Publications

- **English Kick-off Press Release**, 15/05/2018, **All partners,** https://www.corealis.eu/index.php/event/corealis-kick-off-meeting/
- **Greek Kick-off Press Release**, 15/05/2018, **SEAB, ICCS, PCT,** https://www.docksthefuture.eu/corealis-project-started-in-athens-with-the-aim-of-defining-the-challenges-of-the-ports-of-the-future/, https://i-sense.iccs.gr/images/corealis_press_release.fin.pdf, http://seability.eu/2018/05/07/corealis-kick-off-meeting-in-athens/, https://www.portseurope.com/corealis-project-starts-in-athens-with-the-aim-of-defining-the-challenges-of-the-ports-of-the-future/
- **Italian Press Release on 5G technology**, 27/09/2018, **ERICSSON, CNIT,** https://www.corrierecomunicazioni.it/digital-economy/livorno-diventa-porto-4-0-5g-e-iot-tecnologie-chiave/
- **COREALIS Italian radio interview**, 25/10/2018, **CNIT,** https://www.radio24.ilsole24ore.com/programmi/smart-city/puntata/trasmissione-ottobre-2018-210427-gSLA3UJFsC?refresh_ce=1
- **Article in Levante El mercantil Valenciano,** 17/11/2018, **VPF,** https://www.levante-emv.com/distrito-portuario/2018/11/17/valenciaport-duplica-trafico-mercancias-traves/1796349.html
- **Article in Satama Steveco's customer magazine**, 10/12/2018, **VTT, STEVECO,** https://issuu.com/steveco-lehti/docs/satama_2_2018
- **Article in ERICSSON's Blog**, 25/09/2019, **ERICSSON,** https://www.ericsson.com/en/blog/2019/9/whats-a-smart-port-environment, https://www.telecomitalia.com/tit/en/archivio/media/comunicati-stampa/telecom-italia/corporate/istituzionale/2019/PR-Italy-brings-to-NewYork-the-project-Logistics-of-the-future-in-Sustainable-Smart-Ports.html

- **Article in Greenreport.it**, 25/09/2019, **ERICSSON, AdSP-MTS, CNIT,** http://www.greenreport.it/news/mobilita/livorno-protagonista-a-new-york-con-il-progetto-logistics-of-the-future-in-sustainable-smart-ports/
- **Article in quifinanza.it & eleborsa.it & ilmessaggero & lastampa & repubblica**, 25/09/2019, **ERICSSON, AdSP-MTS, CNIT,** https://quifinanza.it/finanza/italia-protagonista-a-new-york-per-la-sostenibilita-dei-porti/312390/, https://www.teleborsa.it/News/2019/09/25/italia-protagonista-a-new-york-per-la-sostenibilita-dei-porti-147.html#.Xj1RIn8zbct, https://www.ilmessaggero.it/economia/news/italia_protagonista_a_new_york_per_la_sostenibilita_dei_porti-4757224.html, https://finanza.lastampa.it/News/2019/09/25/italia-protagonista-a-new-york-per-la-sostenibilita-dei-porti/MTQ3XzIwMTktMDktMjVfVExC, https://finanza.repubblica.it/News/2019/09/25/italia_protagonista_a_new_york_per_la_sostenibilita_dei_porti-147/?refresh_ce
- **Article in ERICSSONs annual report**, 09/2019, **ERICSSON**, https://www.ericsson.com/4a82a6/assets/local/about-ericsson/sustainability-and-corporate-responsibility/documents/2019/technology-for-good-impact-report-2019.pdf
- **Article in DigitalVoice.it**, 26/09/2019, **ERICSSON,** https://www.digitalvoice.it/italia-a-new-york-con-il-progetto-logistics-of-the-future-in-sustainable-smart-ports/
- **Article in La Repubblica newspaper**, 11/11/2019, **ERICSSON,** https://www.repubblica.it/economia/rapporti/mondo5g/industry-quattropuntozero/2019/11/11/news/da_livorno_al_pireo_i_porti_europei_si_aprono_alla_rivoluzione_5g-237809547/
- **Article in corrierecomunicazioni.it**, 23/04/2020, **ERICSSON,** https://www.corrierecomunicazioni.it/telco/5g/il-5g-oro-per-i-porti-italiani-e-non-solo-ma-civitavecchia-blocca-tutto/
- **Article in internet4things.it**, 25/06/2020, **ERICSSON,** https://www.internet4things.it/industry-4-0/machine-type-communications-negli-scenari-industriali-connessioni-critical-type-e-massive-type/
- **Online & booklet article in businessfinland.fi**, 01/07/2020. **VTT,** https://www.businessfinland.fi/49e5f7/globalassets/ict-digi-maritime/bf_smartportsfromfinland_lores_010720.pdf
- **Article in valenciaplaza.com,** 30/11/2020, **VPF,** https://valenciaplaza.com/el-proyecto-book-a-slot-se-alza-con-el-primer-premio-del-valenciaport-hackathon

Project events

- **Kick-off meeting**, Athens-Greece, 07-08/05/2018, https://www.corealis.eu/index.php/event/corealis-kick-off-meeting/
- **Livorno Focus Group**, Livorno-Italy, 17/07/2018, https://www.corealis.eu/index.php/event/corealis-focus-groups/
- **Haminakotka Focus Group**, Kotka- Finland, 30/08/2018, https://www.corealis.eu/index.php/event/corealis-focus-groups/
- **Piraeus Focus Group**, Piraeus- Greece, 04/09/2018, https://www.corealis.eu/index.php/event/corealis-focus-groups/
- **Antwerp Focus Group**, Antwerp-Belgium, 05/09/2018, https://www.corealis.eu/index.php/event/corealis-focus-groups/
- **Valencia Focus Group**, Valencia-Spain, 25/09/2018, https://www.corealis.eu/index.php/event/corealis-focus-groups/
- **COREALIS 1st plenary meeting**, Antwerp-Belgium, 03-04/10/2018, https://www.corealis.eu/index.php/event/corealis-1st-plenary-meeting/
- **COREALIS 2nd plenary meeting**, Kotka, Finland, 12-13/02/2019, https://www.corealis.eu/index.php/event/corealis-2nd-plenary-meeting/
- **COREALIS 1st webinar**: COREALIS Webinar: Living Labs as a stepping stone to the Port of the Future, 7/3/2019, https://www.corealis.eu/index.php/event/corealis-webinar-living-labs-as-a-stepping-stone-to-the-port-of-the-future/

- **COREALIS 2nd webinar**: Intra-Terminal Operations State-of-the-Art, 14/6/2019, https://www.corealis.eu/index.php/event/corealis-2nd-webinar/
- **COREALIS 3rd plenary meeting**, Athens, Greece, 26-27/06/2019, https://www.corealis.eu/index.php/event/corealis-3rd-plenary-meeting-in-athens-greece/
- **COREALIS 4th plenary meeting & 1st exploitation workshop**, Valencia, Spain, 16-18/10/2019, https://www.corealis.eu/index.php/event/corealis-4th-plenary-meeting-in-valencia-spain
- **COREALIS 5th plenary meeting**, Brussels, Belgium, 07-08/01/2020, https://www.corealis.eu/index.php/event/corealis-5th-plenary-meeting-in-brussels-belgi
- **COREALIS 1st review meeting**, Brussels, Belgium, 09/01/2020, https://www.corealis.eu/index.php/event/corealis-1st-review-meeting-in-brussels-belgiu
- **COREALIS Piraeus Demo & Training seminar**, Webinar, 04/06/2020, https://www.corealis.eu/index.php/event/piraeus-living-lab-training-seminar/
- **COREALIS 6th plenary meeting**, Virtually, 09/06/2020, https://www.corealis.eu/index.php/event/corealis-6th-plenary-meeting-virtual
- **COREALIS Livorno Demo & Training seminar**, Webinar, 19/06/2020, https://www.corealis.eu/index.php/event/livorno-living-lab-training-seminar/
- **COREALIS HaminaKotka Demo & Training seminar**, Webinar, 21/10/2020, https://www.corealis.eu/index.php/event/corealis-webinar-series-haminakotka-
- **COREALIS Valencia Demo & Training seminar**, Webinar, 27/10/2020, https://www.corealis.eu/index.php/event/corealis-webinar-series-valencia-port-empowering-the-port-city-sustainability/
- **COREALIS Antwerp Demo & Training seminar**, Webinar, 10/11/2020, https://www.corealis.eu/index.php/event/corealis-webinar-series-valencia-port-empowering-the-port-city-sustainability/
- **Valencia Hackathon,** Online, 20-27/11/2020, https://www.corealis.eu/index.php/event/valenciaport-hackathon/ and https://www.corealis.eu/index.php/event/valenciaport-hackathon-winners-final-ceremony/
- **COREALIS 7th plenary meeting**, Virtually, 25/11/2020, https://www.corealis.eu/index.php/event/corealis-7th-plenary-meeting-virtual/

Other activities

- **Presentation of COREALIS project to Lemesos Port**, Lemesos, Cyprus, 28-29/03/2019, **ICCS, SEAB** (Joined CAB)
- **Presentation of COREALIS project to INTERMODEL Final General Assembly,** Brussels, Belgium, 10/10/2019, **VTT,** https://www.corealis.eu/index.php/event/corealis-at-intermodel-final-general-assembly-in-brussels/
- **Booth presentation of COREALIS project to ITS Hellas**, Athens, Greece, 17-18/12/2019, **SEAB,** https://www.corealis.eu/index.php/event/its-hellas-2019-in-athens/
- **Booth presentation of COREALIS project to Navigate Maritime Trade Fair,** Turku, Finland, 22-23/01/2020, **VTT,** https://www.corealis.eu/index.php/event/navigate-maritime-trade-fair-2020-in-turku-finland/
- **Booth presentation of COREALIS project to LOGY Conference**, Helsinki, Finland, 06-07/02/2020, **VTT, STEVECO Oy,** https://www.corealis.eu/index.php/event/logy-conference-in-helsinki-finland/
- **ITS Virtual Congress**, *Virtual stand showcasing COREALIS project*, virtual, 09-10/11/2020, **ERTICO,** https://www.corealis.eu/index.php/event/its-european-congress-virtual/

EU media presence

- **The EU blue economy report 2020,** https://blueindicators.ec.europa.eu/sites/default/files/2020_06_BlueEconomy-2020-LD_FINAL-corrected-web-acrobat-pro.pdf
- **INEA for HORIZON 2020,** https://ec.europa.eu/inea/en/horizon-2020/projects/h2020-transport/infrastructure/corealis

- **CORDIS on EU results,** https://cordis.europa.eu/project/id/768994
- **Waterborne transport in Europe: The role of research and innovation in decarbonisation: an analysis of waterborne transport, based on the Transport Research and Innovation Monitoring and Information System (TRIMIS),** https://op.europa.eu/en/publication-detail/-/publication/bbb33009-8d1e-11eb-b85c-01aa75ed71a1
- **COMMISSION STAFF WORKING DOCUMENT: Sustainable and Smart Mobility Strategy – putting European transport on track for the future,** https://op.europa.eu/en/publication-detail/-/publication/6ea435f8-3b06-11eb-b27b-01aa75ed71a1/language-en/format-PDF/source-196823517

Thesis

- **Sotiriadou Alexia** (2019), **DELTARES**, *Sustainability assessment of Mediterranean container terminals: Piraeus and Livorno case studies: Recommendations for the extension of the Port of the Future Serious Game, available at:* https://repository.tudelft.nl/islandora/object/uuid:35fc0e18-bba3-4478-9f1b-9e915a2b9c4f?collection=education

3.2 Overview of papers written during COREALIS project

In this subsection the COREALIS papers that were published or accepted for publication before submitting this deliverable are presented shortly. The papers are divided in five different categories named:

- Paper presenting overview of COREALIS innovations
- Papers concentrating to present one COREALIS innovation
- Papers presenting technology and method to be used in some of COREALIS innovations
- Papers related to sustainable port operations in general
- Papers about other COREALIS related topics

Total number of papers is 21, being 13 of them focused on presenting one single COREALIS innovation or technological research topics behind innovations. These papers present altogether six different innovations. Sustainable port operations in general, is a topic for four papers. Two papers present COREALIS project approach as a whole, one paper presents implementation of digital technologies and one paper focuses on cyber security threats of port. The summary of the papers is presented in Table 2.

Table 2. Summary of paper topics published in COREALIS project

Paper	Contribution to COREALIS project	Main scientific contribution	Conference (C), Journal (J)
Nikolopoulou et al. (2019)	Overall presentation	Physical internet	C
Amditis et al.	Overall presentation	Concept paper	J (review)
Sáez-Carramolino et al. (2019)	JIT rail shuttle service	Dry port concept	C & J
Pérez-Cervera et al. (2019)	JIT rail shuttle service	Multimodal transportation	J

Persi and Morillo (2019)	Cargo Flow Optimizer	Inland waterborne cargo	C (2 times)
Pagano et al. (2019)	RTPORT	5G	C & J
Lu and De Breucker (2021)	Green Cookbook	Renewable energy	C
Lastusilta et al. (2020)	PORTMOD	CT layout and operations	C
Goyal and Khiari (2020)	Predictor (technology)	Imbalanced data	C
Tesei et al. (2021a)	RTPORT (technology)	Communication of autonomous vehicles	C & J (accepted)
Tesei et al. (2021b)	RTPORT (technology)	Distributed Ledger Technology	J (accepted)
Hinkka et al. (2020)	Sustainability in ports	SSCM	C & J (accepted)
Hinkka et al. (2021)	Sustainability in ports	Limiting CO_2 emissions	C & J (review)
Hinkka	Implementation of digital technologies	Design science	J (review)
Pyykkö et al. (2020)	Security in ports	Maritime cyber security	C

3.2.1 Paper presenting overview of COREALIS innovations

- *Nikolopoulou, Amalia; Amditis, Angelos; Tsimiklis, Georgios; Tsertou, Athanasia; Latsa, Evangelia; Krikigianni, Elena; Lu, Meng; Tardo, Alexandr; Pérez Cervera, Carles; Kanellopoulos, Ioannis; Hinkka, Ville and Slingenberg, Allister: "Sustainable port development: towards the Physical Internet concept", 6th International Physical Internet Conference (IPIC 2019). London, The United Kingdom, July 9-11, 2019. Published in conference proceedings pp. 34-43.*

In the above paper, the authors presented the innovative framework of COREALIS project supported by disruptive technologies for cargo ports to handle upcoming and future capacity, traffic, efficiency and environmental challenges. The COREALIS innovations that have been developed are presented, targeting to contribute to the Port of the Future objectives regarding reduction of port's total environmental footprint associated with intermodal connections; the improvement of operational efficiency and increase of data sharing and information visibility; and the promotion on the innovation in the port-urban context. Through the provided solutions, the contribution to the digitization and smart objects creation, the movement of containers and their interconnectivity, as well as to multimodality is described. Overall, this paper presents the COREALIS project's goal to develop models and tools which can support ports to improve their efficiency and gradually participate in a Physical Internet network.

3.2.2 Papers concentrating to present one COREALIS innovation

Just-In-Time rail shuttle service

- *Sáez-Carramolino, L.; Sánchez-Pérez, A.; Pérez-Cervera, C. & Furió-Pruñonosa, S: Just-in-time Rail Shuttle Service Feasibility Study at the Port of*

Valencia. 1st International Conference on Maritime Transport 2019, Rome, Italy.

The above paper contributes to the development of the strategy of the Port of Valencia in order to increase the rail modal share for import/export cargo through the definition and feasibility analysis of an innovative Just-In-Time Rail Shuttle service for a key port-hinterland corridor in Spain connecting Valencia with Zaragoza. The proposed solution aims to directly unload the containers from the ship and load them onto trains, in order to minimize the movement of containers at the terminal and to operate as an "air bridge" at the airports, so that the shuttle makes round trips within one day and the containers are loaded on the first available JIT rail service. In order to minimize the cost per unit transported the feasibility study includes designing the operational solution (service characteristics, the requirements of the information system and the definition of the business models needed for its implementation.

- *Sáez-Carramolino, L.; Sánchez-Pérez, Meng Lu, A.; Pérez-Cervera, C. & Furió-Pruñonosa, S: Just-in-time Rail Shuttle Service Feasibility Study at the Port of Valencia, International Journal of Transport Development and Integration*

The above journal article is an enhanced and improved version of previous conference paper.

- *Pérez-Cervera, C.; Lu, M.; Sánchez-Pérez, A.; Sáez-Carramolino, L.; Furió-Pruñonosa, S., 2019. Collaborative Service-Dominant Business -Model Design for a Just-in-Time Rail Shuttle Service at the Port of Valencia. Accepted in: International Journal of Transport Development and Integration.*

The paper above contributes to the development of an innovative Just-In-Time (JIT) Rail Shuttle service for a key port-hinterland corridor in the port of Valencia (Valencia-Zaragoza) and its service-dominant business logic, which emphasizes the interaction between different transport agents as they co-create value through collaborative processes. The service-dominant business model radar (SDBM/R) has been developed in close collaboration with industry experts and evaluated through an extensive series of hands-on workshops with industry professionals from the port and logistics sector. This paper focuses on the application and evaluation of this methodology in the inland container transport domain, addressing the design of new business models for digital innovation of collaborative JIT Rail Shuttle service. In summary, it contributes a novel business design approach that has an academic background and relevant practical embedding.

Cargo Flow Optimizer

- *Stefano Persi and Carlos Morillo: Port Multimodal Inland mode of transportation predictor & prescriptor. 2019. 13th ITS European Congress, Eindhoven, The Netherlands.*

The paper above presents the Cargo Flow Optimizer (CFO) tool that uses the data available from the key port stakeholders (Port Authority, Terminal Operators, inland transportation operators, etc.) to create a predictive and prescriptive model in order to improve multimodality. The proposed tool aims to improve the port operations while at the same time it reduces the current negative impacts in the surrounding area.

The above paper has been also presented during Minisymposium: Mathematics of Logistics: emerging trends in Optimization and Simulation.

- *Stefano Persi and Carlos Morillo: Port Multimodal Inland mode of transportation predictor & prescriptor. 2019. Minisymposium: Mathematics of Logistics: emerging trends in Optimization and Simulation.*

RTPORT

- *Paolo Pagano, Alexandr Tardo, Domenico Lattuca, Anna Sessler, Rossella Cardone, Luca Stroppolo, Marzio Puleri, Teresa Pepe: RTPORT: the 5G-based Model-Driven real Time Module for General Cargo Management. 6th International Physical Internet Conference (IPIC 2019). London, The United Kingdom, July 9-11, 2019.*

The above paper presents how RTPORT, the 5G-based Model-Driven Real Time Module, will allow a better management of general cargo resulting in faster throughput compared to traditional human-driven communications. It describes how a full reorganized mobile network (5G), connecting smart sensors with cloud resources will be used in order to decrease environmental impacts by optimizing forklifts movements in the port area as well as improving workers' safety and enhance their skills with digital tools. The paper also gives technological viewpoints by explaining RTPORT's development as means to drive the implementation of more efficient processes and the reorganization of technologies at the terminals: connected platforms, cloud-based services, service-oriented architectures (SOA), sensors and other IoT technologies (M2M), augmented/virtual reality (AR/VR), autonomous transportation, next generation mobile networks (5G) and blockchain-based technology.

An enhanced version of this conference paper has been also published in Journal of Business and Economics, USA.

- *Paolo Pagano, Alexandr Tardo, Domenico Lattuca, Anna Sessler, Rossella Cardone, Luca Stroppolo, Marzio Puleri, Teresa Pepe: RTPORT: the 5G-based Model-Driven real Time Module for General Cargo Management. Journal of Business and Economics, ISSN 2155-7950, USA, June 2020, Volume 11, No. 6, pp. 631-646.*

Green Cookbook – Energy Assessment Framework

- *Meng Lu and Sven De Breucker: "Energy Assessment for the Port of the Future: towards Sustainable Logistics." Presented in 27th ITS World Congress 2020 (online), will be published in 2021.*

The paper above presents a novel simulation tool for analyzing and modelling energy consumption and efficiency of ports. It aims to enable (large-scale) use of renewable energy for the ports of the future by understanding the costs, benefits, technical challenges and solutions. It also proposes a specific approach of grids optimization for supporting sustainable growth of the port, from economic, environmental and social aspects, and increasing the competitiveness of European ports.

PORTMOD

- *Toni Lastusilta, Hannu Rummukainen, Ville Hinkka: "PORTMOD - a Simulation Tool to Improve Container Terminal Operation." Transport Research Arena Conference (TRA2020), Helsinki, Finland, April 27-30, 2020 (Conference cancelled).*

The paper above presents PORTMOD, which is a new simulation tool that aims to facilitate Container Terminal (CT) operation improvements. The idea of PORTMOD is that currently no Terminal Operating System provider provides what-if analyses. PORTMOD aims to fill this gap by simulating CT operation, which can be used to improve CT efficiency by adjusting CT operation or analyzing investment decisions. Furthermore, PORTMOD enables analyzation of container flows in order to identify improvements as well as potential bottlenecks. PORTMOD is built on open source DESMO-J framework, where the acronym stands for Discrete-Event Simulation and Modeling in Java. PORTMOD differs from many other CT simulators by retaining the programming language possibility to build up customized simulations. Therefore, it is well suited for CT simulations with customizations; expansion of new simulation modules; and research purposes.

3.2.3 Papers presenting technology and method to be used in some of COREALIS innovations

Paper about machine learning algorithms

- *Anil Goyal & Jihed Khiari: "Diversity-Aware Weighted Majority Vote Classifier for Imbalanced Data." 2020. The International Joint Conference on Neural Networks (IJCNN), Glasgow, UK.*

In the above paper, the authors propose a diversity-aware ensemble learning based algorithm, referred to as DAMVI, to deal with imbalanced binary classification tasks. Specifically, after learning base classifiers, the algorithm i) increases the weights of positive examples (minority class) which are "hard" to classify with uniformly weighted base classifiers; and ii) then learns weights over base classifiers by optimizing the PAC-Bayesian C-Bound that takes into account the accuracy and diversity between the classifiers. They show the efficiency of the proposed approach with respect to state-

of-the-art models on predictive maintenance task, credit card fraud detection, webpage classification and medical applications.

Paper about communication architectures of autonomous vehicles

- *Andrea Tesei, Marco Luise, Paolo Pagano & Joaquim Ferreira: "Secure Multi-access Edge Computing Assisted Maneuver Control for Autonomous Vehicles." 2021. Accepted in 3rd International workshop on Dependable Wireless Communications (DEWCOM), Helsinki, Finland (Virtual event) and to be published in IEEE Open Journal on Vehicular Technology.*

In the paper above, the authors propose a novel secure architecture that leverages the Vehicular Edge Computing (VEC) cloud paradigm to enable the deployment at the edge of the network of real-time and mission-critical autonomous driving applications. Starting from authors' previous work on IOTA-VPKI, they decomposed its architecture in different MEC-deployable applications to deploy IOTA-VPKI' Trusted Authorities (TAs) at the edge of the network. To complement their proposal, the authors described the Cooperative Autonomous Driving Maneuver Control use case related to cooperative change lane.

Paper about Distributed Ledger Technology for port operations

- *Andrea Tesei, Domenico Lattuca, Alexandr Tardo, Luca Di Mauro, Paolo Pagano, Marco Luise, Paulo C. Bartolomeu, Joaquim Ferreira*: "*Securing Seaport Logistics Vehicles Using a Distributed Ledger-based Credential Management System*." 2021 *Accepted in IEEE Open Journal of Vehicular Technology.*

In the paper above, the authors present how Distributed Ledger-based Credential Management System exploiting a Distributed Ledger Technology (DLT) can offer transparent and real-time tracking of logistic vehicles and cargos within a terminal. Based on a customization of Vehicular Ad-Hoc Network (VANET) security standards, the authors proposes scheme that provides authentication, authorization, and revocation capabilities to promptly exclude misbehaving logistic vehicles from the system, while maintaining an immutable record of all the logistic vehicles' activity.

3.2.4 Papers related to sustainable port operations in general

- *Hinkka, Ville; Mäkinen Reetta; Eckhardt, Jenni and Lastusilta, Toni: "Sustainability of port operations: The European ports' attempts to reduce negative environmental impacts". Transport Research Arena Conference (TRA2020), Helsinki, Finland, April 27-30, 2020 (Conference cancelled).*

The paper above aims to discover how the largest European container ports communicate about their efforts to improve the sustainability of their operations to find out how the ports themselves see their position as a part of transition towards more

sustainable supply chain operations. Based on the paper, different large European container ports consider environmental issues variously and therefore there is a risk that some ports may get competitive advantages by slipping in the environmental questions. Alternatively, if the port does not take sustainability questions seriously and it gets a bad reputation, the risk is that the customers and consumers do not accept the behavior of the port and shipping companies start to avoid that port.

- *Hinkka, Ville; Mäkinen Reetta; Eckhardt, Jenni and Lastusilta, Toni: "Towards more sustainable port operations: Alternative Approach for Improvement Sustainable Supply Chain Management in the Large European Container Ports". Accepted in HighTech and Innovation Journal. Vol. 2 No. 2. June 2021.*

The paper above is improved version of the previous paper.

- *Hinkka, Ville; Hänninen, Saara; Similä, Lassi; Koljonen, Tiina and Mäkinen Reetta: "Efforts by European ports to improve the sustainability of their operations". Accepted in 2021 World of Shipping Portugal. An International Research Conference on Maritime Affairs. Virtual Conference, Parede, Portugal, 28-29 January 2021.*

The paper above examines how European seaports aim to improve the sustainability of their operations. The aim is approached with a literature search on the sustainability targets of ports especially in Europe, and by reviewing the webpages of the ten largest European container ports. Based on the literature search and webpage review, limiting CO_2 and other greenhouse gas emissions seems to be a high priority in these ports. Limitation of CO_2 emissions is further investigated in the light of the Port of Helsinki's aim to become carbon neutral by 2035 in this paper. Based on paper's analysis ports have a major role to play in the maritime transport sector's efforts to improve sustainability. However, this will require clear targets as the timeframe is long. Otherwise, efforts risk being focused on actions that merely push the problem around, like moving CO_2 emissions elsewhere or increasing other pollutants when CO_2 is cut. In addition to concentrating on a port's own organization and the operations within it, balancing subsidies for cleaner vessels with extra charges for more polluting ones could help motivate shipping companies to purchase new, cleaner vessels or acquire technological solutions to mitigate the harmful effects of existing ones.

3.2.5 Papers about other COREALIS related topics

Short description of paper related to cyber security challenges of ports:

- *Pyykkö, Harri, Kuusijärvi, Jarkko; Silverajan, Bilhanan and Hinkka, Ville: "The Cyber Threat Preparedness in the Maritime Logistics Industry". Transport Research Arena Conference (TRA2020), Helsinki, Finland, April 27-30, 2020 (Conference cancelled).*

The paper above reflects the importance of preparedness regarding cybersecurity and cyber threat related factors in maritime and port logistics industry in present era when

the digitalization combined with new emerging technologies i.e. Artificial Intelligence, Internet of Things, Blockchain and so forth are being utilized with accelerating speed in the maritime logistics among others. Based on the paper, the future trend in the maritime logistics indicates that all the resources relate to each other in order to form integrated autonomous operating systems based on IT-platforms. Therefore, there is a need also in the maritime logistics industry to attach cybersecurity related matters and cyber threat prevention more systematically to the existing procedures in every level of the organization and consider these aspects when new technologies are being implemented. According to paper, training the personnel from the non-technical to the technical experts in realistic exercises helps to prepare and handle the cyber incidents and raise the overall level of cybersecurity preparedness.

3.3 Overview of papers in process (currently under review)

The paper below is under construction and is going to be published in the Sustainability Journal, an international, cross-disciplinary, scholarly, peer-reviewed and open access journal of environmental, cultural, economic, and social sustainability of human beings.

- *Angelos Amditis (ICCS), Athanasia Tsertou (ICCS), Amalia I. Nikolopoulou (ICCS), Konstantinos Gkiotsalitis (NEC), Meng Lu (DYNNIQ), Evangelia Latsa (SEAB), Elena Krikigianni (SEAB), Ioannis Kanellopoulos (PCT), Salvador F. Pruñonosa (VPF), Ville Hinkka (VTT), Allister Slingenberg (DELTARES) "Port of the Future: A Framework for Sustainable Port Development".*

The following paper has been under review in Operations Management Research journal since May 4th, 2020. The paper handles implementation of tracking solutions of multiple organizations.

- *Ville Hinkka (VTT): "Design science-based approach for implementation of supply chain-wide tracking".*

The following paper is a revised version of same authors' paper presented in 2021 World of Shipping Portugal conference. This paper has been under review in Case Studies on Transport Policy since February 21st 2021.

- *Hinkka, Ville; Hänninen, Saara; Similä, Lassi; Koljonen, Tiina and Mäkinen Reetta (VTT): "Seaports Leading a Way towards Sustainable Maritime Industry: Port of Helsinki's Action Plan to Become Carbon Neutral by 2035".*

3.4 Other scientific dissemination

In 9th-11th of July 2019, colleagues from I-SENSE GROUP of ICCS, SEABillity Ltd, CNIT and MOSAICFACTOR that were representing COREALIS project, attended the 6th International Physical Internet Conference 2019 (IPIC), held in Church House, Westminster, London, UK.

COREALIS has been successfully disseminated in IPIC2019 through the presentation of two papers and one poster in Figure 3 below. Papers were related to “Sustainable port development: towards the Physical Internet concept” and “RTPORT: the 5G-based Model-Driven real Time Module for General Cargo Management” respectively, while the poster was targeted to “Big Data and Data Analytics for the Ports of the Future”.

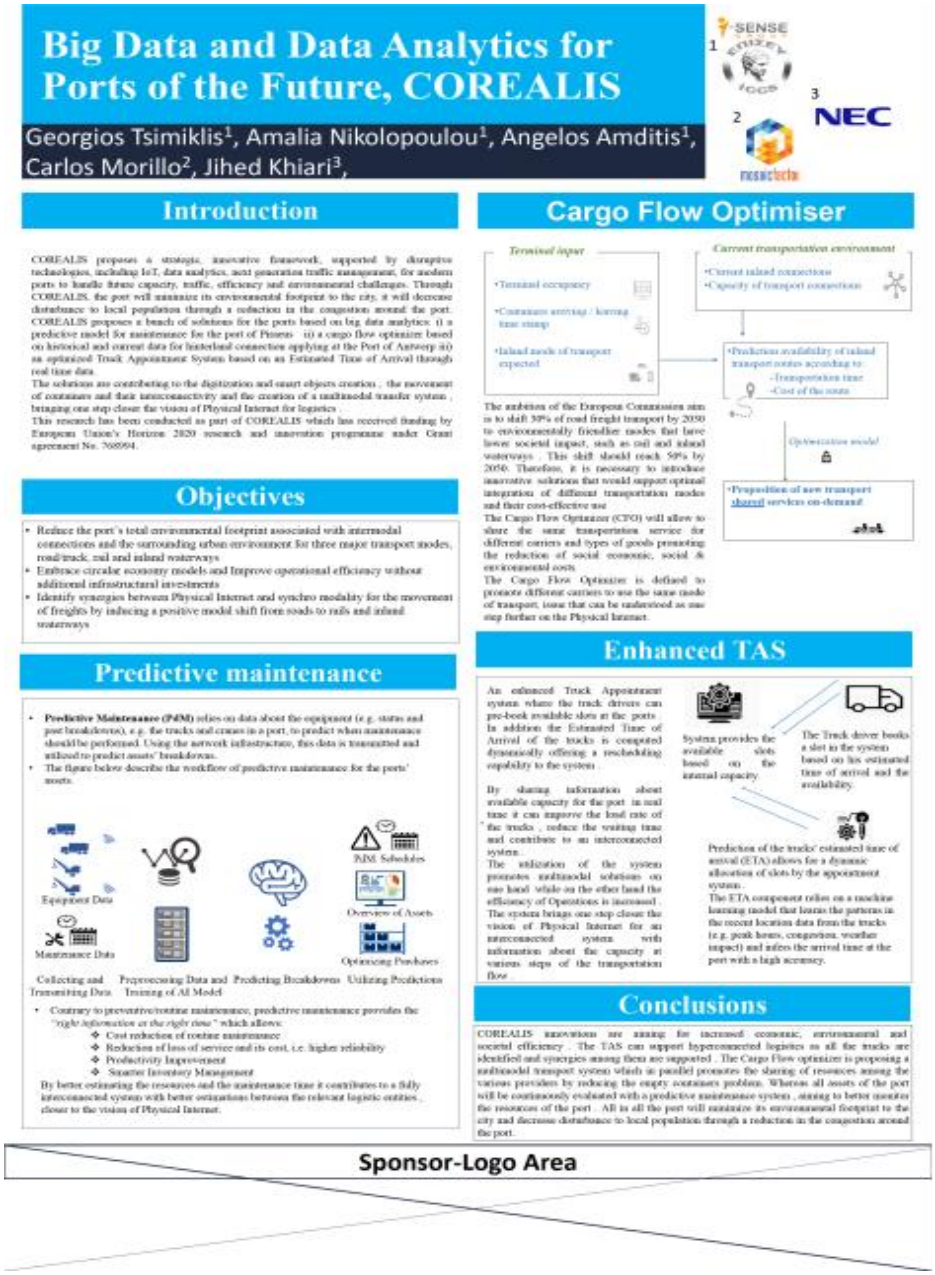

Figure 3 COREALIS Poster, displayed and presented in IPIC 2019.

Also, ERICSSON in collaboration with AdSPMTS, CNIT, FEEM developed a report entitled ‘Port of the Future: addressing efficiency and sustainability at the Port of Livorno with 5G’ (Figure 4), where they examined how technology innovation can optimize port operations and what assessment models can be used to measure economic, social and financial benefits.

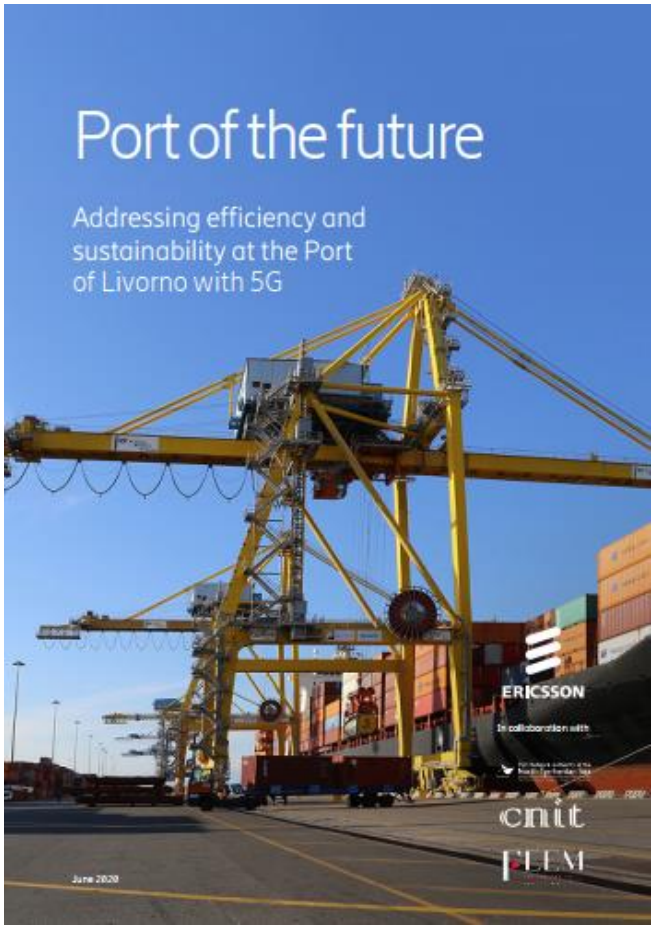

Figure 4 Port of the Future: addressing efficiency and sustainability at the Port of Livorno with 5G cover page.

Additionally, one Master thesis has been also conducted in the context of COREALIS project, entitled as '*Sustainability assessment of Mediterranean container terminals: Piraeus and Livorno case studies: Recommendations for the extension of the Port of the Future Serious Game'* by Sotiriadou Alexia, in Delft University of Technology, on 17/01/2019. The Master thesis is available here: https://repository.tudelft.nl/islandora/object/uuid:35fc0e18-bba3-4478-9f1b-9e915a2b9c4f?collection=education . The research was carried out in cooperation with the independent institute for applied research in the field of water and subsurface, DELTARES.

Among other aspects, the aforementioned master thesis addressed the need to extend the Port of the Future Serious Game (PoFSG) in order to include, in a realistic way, port-city future developments and their potential impacts on the environment and the society, as well as to facilitate stakeholder engagement. Based on the results of a sustainability assessment, several weaknesses of the PoFSG were identified and tools were developed, for extending the PoFSG. The focus was mostly drawn upon two specific aspects: the scoring system of the measures' performance on "People, Planet and Profit" and the inclusion of relevant sustainability measures. Additionally, more general recommendations were also made for the other aspects of the PoFSG.

4. Scientific contribution of published COREALIS project results

4.1 Scientific contribution of published papers

Sustainable port development: towards the Physical Internet concept

Conference paper Nikolopoulou et al., (2019) have an overall presentation of framework that COREALIS project creates for improving sustainability of port operations by adopting new digital technology solutions. Therefore, this paper is the first scientific publication that presents the objectives and approaches of COREALIS project. Another scientific contribution relates to Physical Internet (PI) concept [1], and how the aims of COREALIS project supports the idea of PI.

Just-in-time Rail Shuttle Service Feasibility Study at the Port of Valencia

Conference paper (and journal paper with same authors and topic) Sáez-Carramolino et al., (2019) deals with the same COREALIS innovation as the previous paper. While the previous paper concentrates on business model design, this paper have more practical approach and it takes a closer look for most suitable operational models for multimodal shift to rail cargo. The paper concluded that the optimal solution would be the one that minimizes the cost per unit transported. To calculate the costs for different scenarios, the authors performed sensitivity analysis on the cost per TEU transported (€/TEU) and applied stochastic simulation to see which are the most relevant parameters that affect it.

In addition, the paper analyzed the importance of cooperation between different actors. Particular focus for the implementation of the shuttle service was the information exchange involved between the actors (shipping agents, port-rail-inland terminals/container terminals, freight forwarders, railway operators and other railway undertakers). The paper listed those required changes in information flows that implementation of the new JIT Rail Shuttle Service requires.

Like the next paper, this paper contributes for the wider topic related to the theory of dry port concept [2] [3]. JIT Rail Shuttle Service between Port of Valencia and Zaragoza works as a case study [4] of the dry port concept and the issues related to implementation of this service in this case show the challenges and requirement needs that the adoption of the concept faces. Both of these papers summarizes the results of COREALIS D2.2.

Collaborative Service-Dominant Business - Model Design for a Just-in-Time Rail Shuttle Service at the Port of Valencia

Journal article Pérez-Cervera et al. (2019) presents the development of Just-In-Time (JIT) Rail Shuttle service for a key port-hinterland corridor between port of Valencia and Zaragoza. The paper deals with sustainability issues related to port operations,

especially for research related to multimodal transportation and aims for increasing the share of rail cargo according to the aims of European Commission [5].

In addition, the paper introduces a method, based on Service Dominant Business Model Radar (SDBM/R), which overcomes the drawbacks of the traditional Business Model Canvas methodology, and which is appropriate for the development of business models in the logistics sector with multiple actors in a collaborative environment, such as the JIT Rail Shuttle Service. The method is based on the framework of BASE/X (Business Agility through Service Engineering in a Cross-Organizational Setting) developed by Grefen [6].

Port Multimodal Inland mode of transportation predictor & prescriptor

Conference paper Persi and Morillo (2019) presents the opportunities of COREALIS innovation Cargo Flow Optimizer (CFO) in Port of Antwerp. The paper deals with sustainability issues related to port operations, especially for research related to multimodal transportation and aims for increasing the share of inland waterways cargo according to the aims of European Commission [5].

The essential enabler of using CFO is information sharing between partners and ability to analyze the data in order to predict future cargo flows and finding alternative transport possibilities.

RTPORT: the 5G-based Model-Driven real Time Module for General Cargo Management

Conference paper Pagano et al. (2019) presents an overview of COREALIS innovation RTPORT, which is designed to improve port operations by IoT and 5G technologies. The paper concentrates on presenting hardware and software technologies behind RTPORT, and how the features of RTPORT like localization and tracking could be used to improve port operations related to general cargo management. The main technology enabling the work of RTPORT is 5G-based mobile network that enables low-latency communications for data exchange.

This paper contributes for the progress towards Industry 4.0, where 5G technology works as an important enabler [7]. In general, this paper works as a case study where 5G technology have an application in logistics and in port operations. The paper also evaluates why this application could not be performed by using 4G technology. In addition, the paper also contributes to the Physical Internet (PI) concept.

Energy Assessment for the Port of the Future: towards Sustainable Logistics

Conference paper Lu and De Breucker (2021) presents an overview of COREALIS innovation Green Cookbook - Energy Assessment Framework. This energy assessment framework has been created for ports in general and the Piraeus Container Terminal (PCT) in particular. A model allows to investigate and analyses the impact of renewable energy sources and battery storage on the transition from fossil-fueled to a more sustainable and local electricity generation. The model aims to maximize the self-consumption of the renewable generation by the local load and maximizes the ability

of the local generation to cover the load demand. Simultaneously the model takes the constraints of the grid connection into account, aims to divert the peaks in the RES-generation towards the battery, while the load peaks are covered by discharging the battery. If is this not attainable, the RES-production can be curtailed, and the load can be shed to operate the grid within its limitations. All these different objectives can be determined in function of the energy content of the battery and power of the grid connection.

The simulation also determines the cost of the installation comprising the renewable generation, its inverters, the battery and the battery inverters. This allows to calculate the price per kWh of renewable energy (including storage). The power level of the grid connection can be chosen based on the existing connection or the constraints posed by the port on the allowable degrees of RES-curtailment and load-shedding. Once these factors are known, the framework allows easy determination of the attainable levels of self-consumption and self-sufficiency with the chosen battery, as well as RES-curtailment, total cost of the installation and CO_2 reduction potential.

PORTMOD - a Simulation Tool to Improve Container Terminal Operation

Conference paper Lastusilta et al., (2020) presents an overview of COREALIS innovation PORTMOD. The idea of PORTMOD is to simulate container terminal operations which allows testing different ways to operate and make justified changes e.g., for terminal layout.

The paper contributes for the literature related to development of container terminal layout [8]. Container terminals needs to consider more for the operational development, as the competition between ports are tightening all the time. Changing business environment poses new requirements for container ports, and in order to cope with those requirements, ports have development needs [9]. Usually, layout planning and simulation of terminal operations are separate tasks [10], but the paper of Lastusilta et al. (2020) contributes for discussion that whether there is a need for a tool integrating these two tasks.

Diversity-Aware Weighted Majority Vote Classifier for Imbalanced Data

Conference paper Goyal and Khiari (2020) contributes for the research related to imbalanced data [11] and ML model for COREALIS innovation Predictor. The paper proposes a diversity-aware ensemble learning based algorithm named Diversity-Aware weighted Majority Vote over previously learned base classifiers for Imbalanced datasets, referred to as DAMVI, to deal with imbalanced binary classification tasks. The key benefits of the paper's approach are that it does not make any prior assumption on underlying data distribution and it is independent of base learning algorithm. To show the potential of our algorithm, they empirically evaluate our approach on predictive maintenance task, credit card fraud detection, webpage classification and medical applications. From their experiments, they show that DAMVI is more "consistent" and "stable" compared to state-of-art methods [12-14] both in terms of F1-measure and Average Precision (AP), in case when they have high imbalance in class

distribution (<4 % of Imbalance Ratio). This is due to the fact that their method is able to explicitly control the trade-off between accuracy and diversity among classifiers on hard positive examples.

Secure Multi-access Edge Computing Assisted Maneuver Control for Autonomous Vehicles

Conference paper Tesei et al. (2021a) contributes for research related to safety and security of autonomous driving. More specifically, the paper contributes for communication architecture between vehicles and surroundings. COREALIS innovation RTPORT benefits of this technology. The paper proposes a secure architecture compatible with the Vehicular Edge Computing cloud paradigm that enables the deployment at the edge of the network of real-time and mission-critical applications. The proposed architecture guarantees the security of each application-specific communication exploiting IOTA-VPKI architecture [15, 16], which deploy at the edge different Trusted Authorities (TAs) that are entitled to authenticate, enroll, authorize, and eventually revoke certificates assigned to the vehicles.

Securing Seaport Logistics Vehicles Using a Distributed Ledger-based Credential Management System

Journal article Tesei et al. (2021b) contributes for research related to technologies to improve safety and security of logistics vehicles performing intra-terminal cargo operations. The proposed solution is based on IOTA-VPKI [15, 16], a Distributed Ledger based public key infrastructure compliant with US and EU standards. In the paper, IOTA-VPKI is customized to track seaport logistics vehicles and general cargo, exploiting the underlying distributed ledger technology as transparent storage of such tracking information. Furthermore, the proposed solution adopts a threat model based on ETSI TVRA report [17] to address the security requirements and the robustness of the system against different types of attacks.

Sustainability of port operations: The European ports' attempts to reduce negative environmental impacts

The conference paper Hinkka et al. (2020) presents how European ports communicate about the attempts to reduce negative environmental impacts of their operations. The empirical material is obtained by navigating the webpages of ten biggest container ports in Europe and considering all the information they have about the sustainability efforts of the port. Then these findings are compared with the EU level targets of port and maritime sustainability [18].

The paper contributes for the research related to sustainable supply chain management [19], while the specific focus is port context [20]. The paper highlights the needs for harmonizing environmental practices in European ports to avoid unfair competition between ports by compromising environmental issues. The paper also encourages to research further how single supply chain echelon, such as port, would be able to make

sustainable operations as a competitive advantage, and what kind of communication that requires.

Efforts by European ports to improve the sustainability of their operations

The conference paper Hinkka et al. (2021) examines how European seaports aim to improve the sustainability of their operations. Based on the paper, limiting CO_2 and other greenhouse gas emissions seems to have a high priority in European ports as European Union is thriving for carbon neutrality by 2050 [21]. The paper has Port of Helsinki's aim to become carbon neutral port by 2035 as a case study. By reviewing this case study, the paper is able to show the means and opportunities to reach carbon neutrality.

The paper highlights the fact that major part of the port related CO_2 emissions come from vessels. The port itself can reduce the CO_2 emissions of its operations and infrastructure significantly but influencing on emissions of vessels is much more difficult. The other problem is port-hinterland connections, if there are no other options than trucks. Port of Helsinki has found some ways to decrease emissions of vessels and to motivate shipping companies to invest in technologies that reduce CO_2 emissions of their vessels.

The Cyber Threat Preparedness in the Maritime Logistics Industry

The conference paper Pyykkö et al. (2020) is a position paper looking at the current state of cybersecurity readiness in maritime logistics and ways to improve it. The purpose of the paper is to summarize how the implementation of new digital technologies such as COREALIS innovations have affected cyber threats in maritime logistics industry and how the industry could prepare for these cyber threats.

Based on the paper, there are limited number of scientific articles about cyber threats related to maritime and port industries. In a supply chain management (SCM) viewpoint, cyber threats are considered as a part of the security threats, and the literature considered terrorism as a primary security threat. In this viewpoint, causing disorder in general is seen as the purpose of cyber-attacks [22], and therefore the consequences of cyber threats are seen as disruption of businesses [23]. This paper highlights the recent research approach, where maritime cyber threats are various [24]. In addition, the paper distinguishes the threats of physical and cyber environment [25].

4.2 Scientific contribution of other COREALIS outcomes

Until now, several deliverables have been prepared in COREALIS project that include information about the project's scientific outcomes and have been made publicly available contributing also to the project's scientific dissemination. Below, a short description of COREALIS publications follows along with an explanation of their contribution to the scientific dissemination of COREALIS project.

- **D1.1: Port of the future challenges, enablers and barriers**

Deliverable 1.1 aimed to make a comprehensive and systematic recording of current, mid-term and long-term challenges, enablers and barriers that European ports are facing in the era of digital revolution regarding operational capacity/efficiency, hinterland connectivity, environmental footprint and sustainability concerning climate change, societal acceptance and inclusion in public-private partnerships. The methodology used to identify relevant challenges, enablers and barriers for European Ports involved desk-research and an online survey and a questionnaire. The research within D1.1 contributed to COREALIS scientific outcomes, as it has become evident that hinterland connectivity and the ability to trace operational status are considered to be the most significant enablers while operational efficiency and service digitalization are the most dominant challenges as perceived by stakeholders. Also, an interesting outcome, revealed from the questionnaire's responses, is that all considered barriers are important, with social acceptance and legislation as the most hindering ones for the development of the Port of the Future.

- **D1.2: COREALIS Personas and Stakeholder classification**

The overall objective of the D1.2 was to list and classify the stakeholders that constitute the ecosystem of a smart port and its surrounding urban space, indicating their business/operational profile and the area(s) of intervention and interaction with the COREALIS framework and innovations. An extended stakeholders' list with a set of 12 personas significant for the port system has been created. The data analysis within D1.2 led to the conclusion that businesswise, the COREALIS innovations with the most impact as perceived by stakeholders, are the Truck Appointment System and the Cargo Optimization tool. The final expectation was that the insights gathered can be used to give input to a deployment roadmap of the COREALIS innovations, which can maximize the efficiency of developments and efforts and result in an early Return on Investment (ROI).

- **D2.1: State of the Art of Port Hinterland Connections**

The work carried out within D2.1 tried to depict the state-of-the-art of hinterland connections, on the basis of road, railway and inland waterways connections, of the COREALIS ports, namely the Port of Antwerp, the Port of HaminaKotka, the Port of Livorno, the Port of Piraeus and the Port of Valencia. This publication has led to several important scientific conclusions as it clearly illustrates that the modernization of ports goes hand in hand with the adoption of state-of-the-art ICT tools. Moreover, the implementation of innovative solutions, the digitalization of port processes, the adoption of collaborative schemes and new business models becomes essential to keep ports' competitiveness based on operational efficiency and sustainable growth.

- **D3.1: Intra-Terminal Operations State of the Art Review**

Within D3.1, a comprehensive and systematic recording of current, mid-term and long-term challenges that European ports are facing in the era of digital revolution regarding operational capacity/efficiency, hinterland connectivity, environmental footprint and sustainability concerning climate change, societal acceptance and inclusion in public-private partnerships is made. A deeper research has been made within this publication by reviewing the state-of-the-art of port intra-terminal operations and making a literature review of scientific works on leveraging data analytics for providing data-driven control actions to intra-terminal operations. Many important conclusions resulted from this deliverable, contributing to the scientific outcomes of COREALIS project.

- **D4.1: Green Port Policy functionalities in the Port of the Future Serious Game (User Manual)**

The Deliverable 4.1, aimed to present the updated version of the Port of the Future Serious Game (PoFSG), which is an innovative and interactive training and simulation game that is used to explore the feasibility and sustainability of port city developments. Detailed information about the PoFSG's concept, elements, development process, playing rules and background information is given within D4.1, which also serves as user's manual and is a useful tool contributing to COREALIS scientific dissemination.

- **D4.2: Alpha-version Green Cookbook**

This document is the alpha version of the Green Cookbook, aiming to provide an energy assessment framework for the Piraeus Container Terminal (PCT). Within D4.2 cost-effective solutions for the integration of renewable energy sources, the reduction of the carbon-footprint of the port in particular and the improvement of the air-quality of the port-environment in general have been investigated and analyzed. The developed simulation environment provided a framework for these investigations, that can lead to ratified conclusions, very useful for the scientific impact of COREALIS project on the sustainability of the port operations and port environment.

Due to delays in tests because of COVID-19, COREALIS project will produce the following public reports by end of April 2021:

- **D5.7 that summarizes all the tests and their results in COREALIS living labs.**
- **D6.2 that evaluates the results of these tests**

4.3 Other data collected during COREALIS project

During summer and autumn 2018, COREALIS project designed an e-survey questionnaire for port stakeholders. The survey was submitted predominantly to ERTICO's network of 1,400 GDPR compliant contacts. 107 responses (a response rate

of about 7%) was achieved, originating from a range of different stakeholders. The survey included 49 questions. The questions concerned background information about respondent, respondent's views related to sustainability and related policies, and considerations about COREALIS innovations. The responses data was completed by interviews.

The results of this survey are presented in COREALIS D1.2. However, the data collection required considerable effort for project partners, especially for ERTICO. This kind of database allows statistically relevant result analysis by using more complicated research methods. Therefore, the collected data could be employed more, and most probably there are possibilities to find results that have scientific interest.

Section 5.2.2 suggests in more detail what kind of scientific paper could be written based on this material. The challenge is that COREALIS project has promised to respondents that the response database will be deleted when the project ends. So, the article should be written by end of April 2021.

5. Opportunities for high quality publications based on COREALIS project outcomes

COREALIS project offers multiple opportunities for high impact scientific publications. The purpose in EU projects is to write publications during project period, because the writing can be more difficult due to the lack of resources after the project. As writing high quality articles requires empirical material, article writing happens usually during the second half of the project. However, the review times of journals can be quite long, especially if there are difficulties to find suitable journal. Therefore, it often happens that the articles about project results are published after the end of the project.

Soon after the mid-term review of COREALIS project, COVID-19 pandemic started. Due to the pandemic, all the COREALIS tests were delayed, and researchers were obliged to work remotely at home. These unexpected circumstances made scientific writing much more difficult. First, delay of tests made problems of getting empirical material. Second, writing articles at home with laptop without access to written material of workplace is much more difficult than writing articles in a workplace with several big screens and access to written material. Third, access to electronic material was also limited in many organizations as research institute or university libraries were not able to serve so many remote customers simultaneously. All these difficulties made writing articles considerably more difficult than estimated. Therefore, many promising articles remained unwritten. However, the material for these articles exists, and most probably there are e.g., doctoral and master's degree students among COREALIS partner organizations, who have willingness to use these materials and continue writing process after the project. In the following, some of the main scientific contributions of COREALIS project are summarized and then propositions for paper topics are presented to inspire writing journal articles.

5.1 Main scientific contribution of COREALIS project

This subsection presents three scientific contributions of COREALIS project to help the scientist working in these areas to use empirical material and publications produced in COREALIS projects.

5.1.1 Implementation of new digital technologies in supply chain management

The ports are important logistics nodes in our societies. In academic viewpoint, the role of logistics is to provide the boundary-spanning, demand and supply coordinating capabilities the firm needs to create customer value to satisfy customers [26]. Logistics is an intrinsic part of a larger concept of supply chain management (SCM), which integrates all the key business processes across the supply chain [27-29]. Supply chains

consist of several autonomous organizations participating in input-output transformational processes around a good or a service, including material and information flows, and eventually leading to the delivery of an end-product or service to a customer or other end-user [30, 31]. While the purpose of logistics management is to create customer value from the viewpoint of a single firm, the perspective in SCM is the whole supply chain. Therefore, SCM is based on the collaboration between supply chain members and the notion of competition between supply chains, not supply chain members [32-34].

The definition of the concept "supply chain management" includes integration of the key processes [35], and the theory behind integration states that increased integration leads to higher performance [36], even if some authors require more justification for this statement [37]. The literature also points out that a broad span of integration offers better performance for companies than a narrow span integration with direct upstream or downstream companies [38].

Supply chains are separated in two distinct substructures: (1) physical, which deals with the flow and storage of goods; and (2) information, which deals with information associated with those goods [39, 40]. The rapid development of ICT systems has enabled companies to develop new techniques to improve information-related supply chain integration by advancing inter-organizational information systems (IOIS) and related applications such as e-business technologies [41, 42]. Therefore, IOIS have become an essential tool to achieve supply chain integration.

The objective for use of information technology in SCM is to enhance the service level, improve operational efficiency and information quality, and enable agile supply chain operating models [43]. In practice, ICT is expected to influence the following supply chain performance measures: (1) Cost, (2) Delivery, (3) Quality, (4) Flexibility, (5) Inventory, (6) Process improvement, (7) Innovation, and (8) Sales and financial [44]. However, building IOIS systems alone does not improve the efficiency or reduce the transaction costs of the supply chain [45]. ICT integration alone cannot act as a substitute for other efforts at supply chain integration [36, 46].

Several factors affect organizations' willingness to adopt new technology and how ICT applications diffuse. Davis [47] created the well-known Technology Acceptance Model (TAM) for new technology adoption. According to two approaches of TAM, the new technology needs to be considered useful, and its adoption and use cannot be too difficult. However, some authors (e.g., [48]) argue that individual level ICT adoption and implementation models, such as TAM, are not applicable on the organizational level. Shin and Edington [49] raise seven contextual factor categories which affect IT implementation: (1) Path dependencies, which include, e.g., the form of current systems and the experiences of previous implementation of systems; (2) Project management, which includes managing expectations, dedicated resources, communications and end-user participation; (3) Organizational management structure, which includes the role of the CEO (chief executive officer), the commitment level and corporate project leader;

(4) IT competency, which includes the CIO's (chief information officer) competency, the firm's past IT experience, the business line managers' IT competencies and the project team's IT skills; (5) Techno-political culture, which includes the political environment, social order, interdepartmental cooperation and mutual understanding; (6) Complementary investments, which includes change management, business process and work flow redesign, and training; and (7) End user, which includes satisfaction, willingness to change and stakeholders [49].

Nevertheless, there are certain problems in the adoption of IOIS. The SCM literature clearly highlights that the whole supply chain should be seen as a single entity. In most cases, supply chain integration increases performance of the supply chain, and therefore, integration of information flows by using IOIS increases the competitiveness of the whole supply chain. Still, each company decides whether it will join IOIS, as diverse or dissimilar companies may see the objectives of IOIS differently. For example, Samaddar et al. [50] propose that downstream companies are more likely to engage in strategic IOIS, while upstream companies are more likely to engage in operational IOIS. A big share of the ICT literature in the field of SCM considers internal integration [36, 51], which indicates that ICT adoption raises challenges even within one organization. Companies also tend to see ICT adoption in their own perspectives, which can be different from other supply chain partners' perspectives or what is the best solution for the whole supply chain [42]. Still, those companies that first build positive relationships with other supply chain companies and show commitment to each other and then adopt new ICT technology will gain more benefits of that technology [52, 53]. However, supply chain integration by adopting IOIS may also change the dynamics of the supply chain, which may decrease some supply chain actors' intentions to implement IOIS [54, 55].

When companies are considering IOIS adoption, they compare the benefits and disadvantages of the adoption. Different authors have described different factors under consideration in this situation. TAM compares the usefulness of the technology with the ease of implementation [47]. Richey et al. [56] see this situation as a choice between internal and external drivers, such as a desire to improve, and environmental pressures with barriers such as internal planning failure and external monitoring failure. In the last resort, the question is about the price of the IOIS adoption versus expected redeemable benefits of the system.

The experiences of conducting pilots in COREALIS project offer vast amounts of empirical material related to adoption of ICT and IOIS systems in SCM. In general, all the COREALIS innovations will have positive effect on supply chain efficiency and improve sustainability of supply chain. Therefore, their adoption would be beneficial of entire supply chain point of view. However, there were numerous small and big issues that either advance or hindered pilots in each stage of the project. By analyzing these experiences, it would be possible to deepen the knowledge related to implementation of new digital technologies of SCM.

5.1.2 Sustainable supply chain management

Sustainable supply chain management (SSCM) has numerous different definitions [57]. One of the simplest is by [58]: "SSCM is an extension to the existing ideology of SCM by adding social and environmental aspects." Another more specific definition is written by [59]: "SSCM deals with the management of information, capital flows, and materials as well as cooperation between different firms along the supply chains while taking goals from all 3Ds (3-Dimensions) of sustainable development which are derived from stakeholder and consumer requirements."

SSCM has been under research in a number of scientific papers both in qualitative and quantitative fields [60, 61]. Therefore, it is obvious that sustainability concerns need to be incorporated into the core functions of the supply chain namely purchasing, manufacturing, warehousing, distributing, usage, recycling and disposal [62]. Companies are under remarkable pressure in order to be able to keep their existing supply chains due to recent trends of globalization, demand uncertainty, market changes, and other economic challenges. Focusing only on the internal efficiencies of supply chain will be insufficient to gain competitive advantage. If sustainability concepts are integrated into core functions of a business firm's supply chains, it achieves a good market position in the global context [63].

Based on the literature review of current SSCM research, Panigrahi et al. [64] observed the following gaps in the current SSCM literature, and they proposed further research in these areas:

1. the integration of social issues into the environmental and economic aspect of SSCM.

2. lifecycle analysis and the concept of closed-loop supply chains for a connected view of sustainability in supply chains.

3. addressing the issues of inventory management within sustainable supply chains (as the traditional inventory models focus on economic aspects).

4. collaborative relationships between suppliers and customers for better understanding and implementation of sustainable supply chain initiatives and practices.

5. linkage between sustainability initiatives and managerial practices for success or failure of sustainable supply chain practices.

6. guidelines, evaluation tools and techniques for SMEs and large enterprises to justify investment for sustainable supply chain practices; and

7. industry specific research on SSCM.

COREALIS project could contribute at least research topics 4-7, proposed above.

In principle, the purpose of all the COREALIS innovations is to improve sustainability of supply chains. Therefore, the experiences of implementation of all the COREALIS innovations contributes also for research topic 4 above in addition to contributing implementation of digital SCM technologies in general as described in previous subsection 5.1.1.

COREALIS D1.2 presents an overview of responses of e-survey questionnaire for port stakeholders organized in summer and autumn 2018. This deliverable shows the contradictions in responses related to organizations remarkable interests towards COREALIS innovations and their current practices and e.g., KPIs (Key Performance Indicators) used to measure operations of these organizations. Subsection 5.2.2 presents an idea of scientific paper related to this topic, which contributes for research topic number 5 above.

One of the purposes of COREALIS project is to develop further COREALIS innovations and evaluate their suitability in different types of ports. Many COREALIS innovations such as Green Cookbook are actually tools for companies to justify investments in sustainable supply chain practices. Therefore, these innovations directly contribute for research topic 6 above. The contribution of the other innovations are not that straightforward, but the analysis of the development process of these innovations contributes for that research topic.

Finally, COREALIS project works as port industry specific research on SSCM (topic 7).

5.1.3 Development of port logistics

COREALIS project has so far published many conference papers related to different COREALIS innovations. The purpose of these innovations is to develop port logistics. Therefore, these papers already give their own contribution in different aspects of port logistics. However, the end of this subchapter concentrates on presenting COREALIS project's contribution in TAS, dry port concept, and potential future technologies in port logistics.

In addition to published papers, COREALIS project contributes otherwise for port logistics. E.g., COREALIS innovation Truck Appointment System (TAS) is discussed only briefly in two conference papers, but it is possible to find more information about tests of TAS in Valencia and HaminaKotka ports from COREALIS deliverables. Based on literature, more information about empirical information of the benefits of TAS in different circumstances could be needed [65].

Dry port is an evolving port related SCM concept [66]. COREALIS innovation JIT Rail Shuttle Service between Port of Valencia and Zaragoza works as a case study for this concept. Based on extensive literature review of dry port papers, Lamii et al. [67]

conclude that there are not enough papers about financial performance of dry port concept and its environmental effects. Two articles published in COREALIS project aims to contribute this research gap by presenting the financial effects and saved CO_2 emissions of this service.

Many of COREALIS innovations were based on technologies that are not yet widely used in port industry. Especially COREALIS D3.1 concentrated to present many of these novel technologies like 5G networks [68] and machine learning [69]. Some of the applications of 5G technology in port logistics are presented in conference paper, but more information about test results can be found on COREALIS deliverables. Development of machine learning algorithm is also presented in one methodological conference paper, but COREALIS deliverables tell empirical results of using machine learning in COREALIS Predictor innovations.

Adoption of new port technologies also change the professional requirements of port workers [70]. COREALIS innovations and the experiences related to adoption offers material also for this kind of research. Especially COREALIS D6.2, which assess the impact of adoption of innovation could offer good viewpoints.

5.2 Suggestions for paper topics

Based on the previous subchapter, this subchapter presents topics for two different papers that employs and combines the data from COREALIS projects.

5.2.1 Enablers and obstacles for implementing port technologies

COREALIS project is built around several COREALIS innovations, which are developed and tested in five different living labs. During the project, the development of each innovation has been largely separate process. When one living lab tests typically tests 2-3 different innovations, there might be some cooperation between the tests and technology development, but the main overall view remain unclear. COREALIS D5.7 and D6.2 summarizes tests and evaluates their results. However, those deliverables concentrate on measurable results and the evaluation is based on those results. Still, each test is a sum of experiences, and by combining these experiences, it would be possible to get wider view on realities in implementation of port technologies.

The authors of this deliverable are proposing the following journal article.

The article contributes for implementation of new digital technologies in port related SCM. Subsection 5.1.1 presents theoretical contribution behind the topic.

The article would have the following three research questions: 1) What kind of operational port environments would benefit the implementation of new digital technology solutions and COREALIS innovations? 2) What kind of interventions would be needed to enable the adoption of digital technologies? 3) What types of mechanisms may enable or obstacle the adoption of digital technologies in ports?

The methodological approach for the article would be design science [71-73]. Design science would be a suitable research approach for the paper, because it is known as actor perspective and solution orientation [74]. According to [73], design science methodology can be divided into four phases: 1) The problem is framed and the basis for potential solutions is developed. 2) The basic solution design is subjected to empirical testing in an iterative, trial-and-error error-type process where the solution is refined by improving, implementing and evaluating design. 3) The solution is examined and evaluated from a theoretical point of view, and theoretical justification and a demonstration of theoretical utility are sought by introducing the solution in several contexts. 4) The researchers seek broader generalizations with applicability beyond the limitations of the empirical context of the study. [73]. Gregor and Jones [75] name the new theory developed by using design science methodology as *design theory*.

The idea in design science can be concluded as expressing that the researchers take an active role in designing the solution – or artifact – which is subject to empirical evaluation and theory building afterwards [73]. By using design science methodology, the researchers involved in the empirical case studies managed to decrease the gap between managerial relevance and theoretical contributions in the problem-solving process by preceding the phases of the design science.

Design science methodology relies on design propositions and when the design propositions are used for exploration, they are termed “means-ends propositions”. In exploration, means-ends propositions specify the means to reach desired ends in particular situations [73]. When the research results should be synthesized, such as a paper that aims to develop a new design theory based on empirical developed in COREALIS innovation tests, Denyer et al. [72] forms design propositions by using the term “CIMO-logic”. Denyer et al. [72] explain the constructs of CIMO-logic as follows: “In this class of problematic Context, use this Intervention type to invoke these generative Mechanism(s), to deliver these Outcome(s)”.

While design science research in information systems research emphasizes the intervention and its evaluation [76], the design science approach in operations management concentrates more on novel combinations of context, intervention and outcome than in novelty and evaluation of interventions [73].

In the proposed paper, CIMO-logic is used to synthetize all the results of the COREALIS innovation tests backing the proposed paper. The first research question, “What kind of operational port environments would benefit the implementation of new digital technology solutions and COREALIS innovations?” intends to define the context where the innovations should be designed and adopted. The second research question, “What kind of interventions would be needed to improve the operations of port?” aims to describe the type of intervention, which is in this paper COREALIS innovations implemented in a successful way, that would improve the port operations. The third research question, “What types of mechanisms may enable or obstacle the adoption of digital technologies in ports?” aims to find, of course, the mechanisms that

either prevent or promote the adoption. The initial outcome instead has been already locked in the beginning of the COREALIS project, which aimed to design and implement COREALIS innovations in port context or at least the major part of those. However, after defining the context, intervention and mechanisms, the outcome is evaluated again by locking other propositions.

The material of the paper is collected from reports from all living labs. In addition, during evaluation, the authors of D6.2 has also listed qualitative results, and they have asked experiences of living lab stakeholders about tests. By combining all the material and analyzing them by using the design science methodology, it would be possible to develop new design theory related to implementation. Responses for research questions 1 and 2 offer limited new theoretical contribution, as they could be responded by going through the deliverables that describe port environment and COREALIS innovations. However, responses for research question 3 have potential to offer significant new theoretical contribution in the field of implementation of digital technologies.

5.2.2 Differences between ports' intentions and reality in investments in sustainable practices of operations

The COREALIS project survey (D1.2) results can provide useful empirical data for further analysis in a journal article.

The combination of systematic literature review on the chosen topic, suitable conceptual framework and analysis of empirical data focused on the relevant topics which have been presented within COREALIS project will provide valuable scientific dissemination material.

The sustainability related issues in the transport sector and the need for environmentally friendly supply chains are being highlighted with increased pressure from various directions. Port's roles and functions as a part of critical infrastructure and linking the global economy make them a vital factor for promoting sustainability of transport systems. UN Environmental Program [77] is stating that "Reducing emissions from ports and other maritime sources can greatly improve air quality for billions of people, as well as significantly reduce global climate change."

Many scholars including [78] impress that in order to gain a holistic overview regarding sustainable port operations this requires research from diverse research fields including business and management, technology, social sciences and humanities. Despite it is evident that the climate change prevention related legislation, public pressure and various other drivers are pushing also the stakeholders acting within port operations domain to decrease their emissions caused by their individual operations, the decision to invest on more sustainable technology / energy will encounter many barriers. Tay et.al [79] have identified based on extensive literature review regarding barriers towards sustainable supply chain practices three main internal factors including (I) lack of management commitment, (II) strategic issues, (III) functional issues and seven main external factors including (I) regulation, (II) competitors' actions, (III) customers, (IV)

media / “Green wash”, (V) sectoral, (VI) organizational and market issues, (VII) technology. As the investment towards new, more sustainable technology is compulsory in the future of port operations it needs to be considered as a long-term decision. However, there are evidence (e.g. [80]) that still some of decisions regarding sustainability within port domain are driven by short-term economic profits rather than focusing on long term planning towards sustainability and future requirements in the port operations.

The purpose of the journal article is to analyze whether the some above presented barriers are noticeable within the received empirical data material received during the COREALIS project. Further analysis is done to comprehend the decision-making process of a stakeholder of port operations towards long-term investments towards more sustainable resources. In additional evaluation is done with different stakeholders’ capability to adopt new sustainability-driven business models.

6. Realization of Open Research Data Pilot

COREALIS project participates in Open Research Data Pilot. More specifically, COREALIS project maintains a website, see Figure 5 below, where all the produced scientific material is available, aiming to ensure the sustainability of the produced knowledge through the adoption of the 'Green Model'. In addition, an account of COREALIS project has been created in the OpenAIRE repository, as an additional effort to secure Open Access to all interested persons. All the scientific publications developed during the project are uploaded there and can be found at: https://explore.openaire.eu/search/project?projectId=corda__h2020::884bd42d4bad3bc84b607e9781087c64.

The main goal of the OpenAIRE platform is to shift scholarly communication towards openness and transparency and facilitate innovative ways to communicate and monitor research. It aims at transforming society through validated scientific knowledge and allowing a wide audience (e.g., citizens, educators, funders, civil servants and industry) find ways to make science useful for themselves, their working environments and the society.

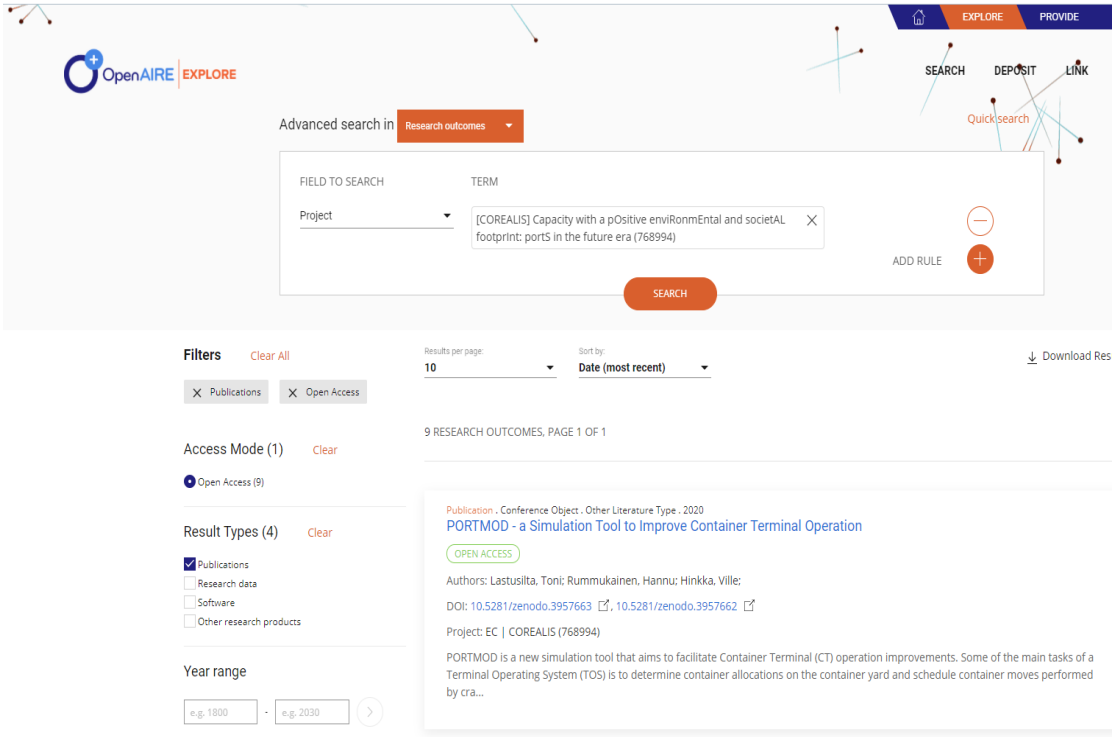

Figure 5: COREALIS publications at OpenAIRE platform.

The OpenAIRE repository of COREALIS scientific material is being constantly updated with the latest publications produced and each one reserves a unique DOI (digital object identifier). Currently eight scientific publications of COREALIS project are uploaded in the OpenAIRE repository and are all available in Open Access.

7. Conclusions

COREALIS project had high aims of publishing scientific publications. The project promoted scientific publications by collecting the lists of potential conferences and journals. In addition, guidelines for writing journal articles were presented. Even if the project has not yet met the initial targets, the results have been good in current circumstances comparing with many other EU project of similar budget. Until end of March, 2021, the project has published or have acceptance for publication for 12 conference papers, one poster and six journal articles (three more journal articles are under review). In addition, three journal articles are under review. COVID-19 pandemic caused a lot of challenging for scientific publications, as there were needs to rearrange work, tests were delayed, and remote work at home without infrastructure of university or research institute complicated writing. Besides, many conferences were cancelled, and the rest were arranged remotely, which demotivated writing conference papers.

COREALIS project produced a lot of material that could be used as scientific publications and this deliverable helps to find that material. As COREALIS project participated in Open Research Data Pilot, all publishable material of the project is open access. In addition to helping to find project material for scientific publications, this deliverable also suggests what kind of theoretical contribution could be used in those papers. Especially this deliverable concentrated to explain how COREALIS project material could be combined with theories related to sustainable supply chain management, adoption of digital innovations, and port logistics.

Last but absolutely not least, this deliverable offers concrete ideas for scientific papers. The first topic “Enablers and obstacles for implementing port technologies” could use design science as research approach. By using design science research methodology, it could be possible to make significant theoretical contribution by using practical experiences of implementation tests in COREALIS project. The second topic “Differences between ports’ intentions and reality in investments in sustainable practices of operations” contributes to sustainable supply chain management and focuses on inconsistencies between ports’ way to bring out their sustainability focus with actual operations and investment decisions of ports. There is willingness to write these two papers among COREALIS partners, and VTT has started to write a paper related to the second topic. However, as this is a public deliverable, anyone can use these ideas as a basis of his or her paper. Nevertheless, only COREALIS partners are able to use the results of e-survey questionnaire (see Section 4.3) until the end of April 2021 as an empirical material for this paper.

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Annex 1: COREALIS list of proposed scientific journals

No.	Title of journal/magazine	Website	Description
1	Industrial Engineering & Management	https://www.omicsonline.org/industrial-engineering-management.php	Industrial Engineering & Management (IEM), a broad-based journal was founded on two key tenets: To publish the most exciting researches with respect to the subjects of industrial engineering & it's management. Secondly, to provide a rapid turn-around time possible for reviewing and publishing and to disseminate the articles freely for research, teaching and reference purposes.
2	International Journal of Shipping and Transport Logistics	http://www.inderscience.com/jhome.php?jcode=ijstl	IJSTL is an international peer-reviewed journal addressing all methodological aspects in the field of shipping and transport logistics, particularly those that require empirical or mathematical analysis with managerial implications. IJSTL is dedicated to publishing original, high-quality and methodologically rigorous research papers that address significant management issues pertinent to shipping/transport logistics. IJSTL also publishes informative and critical book reviews of newly published books with scholarly and practical contributions that advance the state-of-the-art of the theory and practice of shipping/transport logistics. This journal also publishes Open Access articles
3	International Journal of Logistics Research and Applications	https://www.tandfonline.com/toc/cjol20/current	International Journal of Logistics: Research & Applications publishes original and challenging work that has a clear applicability to the business world. As a result, the journal concentrates on papers of an academic journal standard but aimed at the practitioner as much as the academic. High quality contributions are therefore welcomed from both academics and professionals working in the field of logistics and supply chain management. Papers should further our understanding of logistics and supply chain management and make a significant original contribution to knowledge. In this context the term 'logistics' is taken in its broadest context as "the management of processes, flow of materials and associated information along the entire supply chain, from raw materials through to the final user of the product". The journal covers all aspects of logistics and supply chain management.

4	Maritime economics & Logistics	https://www.palgrave.com/gp/journal/41278	Maritime Economics & Logistics (MEL) is a peer-reviewed quarterly scientific publication committed to the methodological analysis of global supply chains; that is, ocean transportation, ports, marine terminals and maritime logistics. Papers are expected to be thoroughly researched, scientifically rigorous, and at the same time, of direct applicability and usefulness to practitioners and policy makers alike. All contributions are subject to strict peer-review. Often, MEL includes a special section under the heading 'Policy Perspectives'. Papers here, often solicited ones, emphasise strategic policy implications rather than scientific rigour in a strict sense. Papers in Policy Perspectives are subject to lighter peer review; this results in speedier publication. Papers submitted to MEL are submitted for both sections at the discretion of the Editors. Authors not wishing to have their papers considered for Policy Perspectives should state this in the Cover Letter.
5	International Journal of Logistics Management	http://www.emeraldgrouppublishing.com/ijlm.htm	Researchers and practitioners are invited to submit manuscripts that advance the science and practice of logistics and supply chain management. While articles in any area of logistics or supply chain management are welcomed, the journal is especially interested in those dealing with managerial applications of theory and techniques. Articles which provide new knowledge and guidelines for framing, interpreting or implementing the logistics process in the supply chain are of particular interest. This implies that the journal is particularly interested in empirical research including a special preference for qualitative research. All articles are anonymously reviewed for publication by referees who look for original ideas that are clearly presented as a contribution to scientific knowledge.
6	Journal of Business Logistics	https://onlinelibrary.wiley.com/journal/21581592	The Journal of Business Logistics (JBL) provides a forum for the dissemination of original thoughts, research, and best practices within the logistics and supply chain arenas.
7	Sustainability	http://www.mdpi.com/journal/sustainability	Sustainability (ISSN 2071-1050; CODEN: SUSTDE) is an international, cross-disciplinary, scholarly, peer-reviewed and open access journal of environmental, cultural, economic, and social sustainability of human beings. Sustainability

			provides an advanced forum for studies related to sustainability and sustainable development, and is published monthly online by MDPI. The Society for Urban Ecology is affiliated with Sustainability and their members receive discounts of the article processing charge.
8	Maritime Policy & Management	https://www.tandfonline.com/loi/tmpm20	Maritime Policy & Management (MPM) is indexed in the Social Sciences Citation Index (SSCI). Maritime Policy & Management (MPM) is a multi-disciplinary and international refereed journal, it brings together papers on the different topics that concern the maritime industry. It provides the latest findings and analyses. Emphasis is placed on business, organizational, economic, socio-legal and management topics at port, community, shipping company and shipboard levels. MPM is aimed at researchers, policy-makers and managers in the fields of maritime business. It is read by academics, government officials, journalists and those practicing maritime business in all its aspects around the world, and is intended to have both a theoretical and practical appeal.
9	Computers in Industry	https://www.journals.elsevier.com/computers-in-industry	The aim of Computers in Industry is to publish original, high-quality, application-oriented research papers that: • Show new trends in and options for the use of Information and Communication Technology in industry; • Link or integrate different technology fields in the broad area of computer applications for industry; • Link or integrate different application areas of ICT in industry. General topics covered include the following areas: • The unique application of ICT in business processes such as design, engineering, manufacturing, purchasing, physical distribution, production management and supply chain management. This is the main thrust of the journal. It includes research in integration of business process support, such as in enterprise modelling, ERP, EDM. • The industrial use of ICT in knowledge intensive fields such as quality control, logistics, engineering data management, and product documentation will certainly be considered. • Demonstration of enabling capabilities of new or existing technologies such as hard real time

			systems, knowledge engineering, applied fuzzy logic, collaborative work systems, and intelligence agents are also welcomed. • Papers solely focusing on ICT or manufacturing processes may be considered out of scope.
10	Journal of Shipping and Trade	https://jshippingandtrade.springeropen.com/	Journal of Shipping and Trade (JST) is an open access, multi-disciplinary publication that focuses both on business & management, as well as transportation-related fields. JST aims to promote practices in shipping and to improve the management of global trade activities. Towards achieving these objectives, JST provides a vehicle to facilitate professionals, academics, researchers, and policy makers in the field to disseminate information and to learn from one another's work. As a scholarly journal emphasizing shipping and trade related studies and research, JST plays a key role in establishing communication links among global shipping and trade researchers. JST also aims to contribute to current and emerging issues in shipping and trade as raised by global and regional public bodies (such as the World Bank and OECD) and major market players. JST considers papers covering shipping economics, trade and economic development, transportation management, global port management, regional studies, environmental management in shipping and trade, business model development, as well as other related topics.
11	Journal Port Science Research	http://www.journal-port.com/	Continuous Research Online Library (Journal Port Science Research) is an open peer-review journal publishing research articles bringing modern digitalization trends to the forefront of scientific publications through feature enhanced publishing formats. Journal Port Science Research aims to accomplish ethical, reachable, and impactful research publishing that aids practitioners, scholars, and students to regularly improve their learning, practice, and vocational developments. Journal Port Science Research It is published on three forms of printed paper in the year twice under the registration ISSN: 2616-6232. It is posted on a USB card twice a year under registration ISSN: 2616-7220. It is posted online continuously under registration ISSN: 2616-7441. Journal Port Science Research operates as per the guidelines stated by well-known committees like WAME, COPE, and ICMJE. Manuscripts are published in a structured

			format immediately after the initial screening. Peer-review is monitored by our editorial board members to ensure transparent and quality review.
12	Journal of Urban Planning and Development	https://ascelibrary.org/journal/jupddm	The Journal of Urban Planning and Development covers the application of civil engineering to such aspects of urban planning as area-wide transportation, the coordination of planning and programming of public works and utilities, and the development and redevelopment of urban areas. Subjects include environmental assessment, aesthetic considerations, land use planning, underground utilities, infrastructure management, renewal legislation, transportation planning, and evaluation of the economic value of state parks.

Annex 2: COREALIS indicative list of proposed events

Date	Event	Location	Website
2019			
05-07/11/2019	Intermodal Europe 2019	Hamburg, Germany	https://www.intermodal-events.com/en/home.html
05-08/11/2019	Europort Rotterdam	Ahoy, Rotterdam, Netherlands	https://www.europort.nl/
19-21/11/2019	Smart City Expo World Congress 2019	Barcelona, Spain	http://www.smartcityexpo.com/en/home
26-28/11/2019	Hypermotion 2019	Frankfurt, Germany	https://hypermotion-frankfurt.messefrankfurt.com/frankfurt/en.html
27-28/11/2019	Polis annual conference	Brussels, Belgium	https://www.polisnetwork.eu/events2/2019conference
29/11/2019	Waterborne Conference	Brussels, Belgium	https://www.linkedin.com/company/waterbornetp/
2020			
12-16/01/2020	Transportation Research Board Meeting 2020	Washington DC, USA	http://www.trb.org/AnnualMeeting/AnnualMeeting.aspx
11-12/03/2020	Logistics CIO Forum: Europe	Amsterdam	https://events.eft.com/cioeu/
17-19/03/2020	IAPH2020: World Ports Conference	Antwerp, Belgium	https://www.worldportsconference.com/
17-20/03/2020	SITL Transport & Logistics Innovation Week	Paris, France	https://www.sitl.eu/en/home/
26-30/04/2020	TRA2020	Helsinki, Finland	https://traconference.eu/
12-14/05/2020	Baltic Ports & Shipping	Germany	http://www.transportevents.com/ForthcomingEventsdetails.aspx?EventID=EVE169
18-21/05/2020	ITS European Congress 2020	Lisbon, Portugal	https://itsineurope2020.com/
28-29/05/2020	ESPO event 2020	Oslo, Norway	http://espo-conference.com/
09-11/06/2020	TOC Europe	Ahoy Rotterdam, The Netherlands	https://www.tocevents-europe.com/en/Home.html
29-03/07/2020	Forum on Integrated and Sustainable Transportation Systems	The Netherlands	https://conferences.ieee.org/conferences_events/conferences/conferencedetails/46898
20-23/09/2020	IEEE ITSC (Intelligent Transportation Systems Conference)	Rhodes, Greece	https://www.ieee-itsc2020.org/

22-24/09/2020	8th Mediterranean Ports & Shipping	Koper, Slovenia	http://transportevents.com/EventsLinks/Koper2020CA.pdf
04-08/10/2020	ITS World Congress 2020	LA, USA	https://www.itsa.org/new-events/2020/10/4/its-world-congress-2020
15-16/09/2020	SUSTAINABLE SHIPPING AND PORTS FORUM	Athens, Greece	https://sustainable2030.com/
20-23/09/2020	IEEE ITSC (Intelligent Transportation Systems Conference)	Rhodes, Greece	https://www.ieee-itsc2020.org/
22-24/09/2020	8th Mediterranean Ports & Shipping	Koper, Slovenia	http://www.transportevents.com/ForthcomingEventsdetails.aspx?EventID=EVE167
04-08/10/2020	ITS World Congress 2020	LA, USA	https://www.itsworldcongress2020.com/
09-10/10/2020	4th 'Smart Blue City' Euro-Mediterranean Conference	Athens, Greece	https://www.smartbluecity.com/
16/10/2020	Wireless Communications in Ports	London, UK	http://www.portcomms2020.com/
03-05/11/2020	Forum on Integrated and Sustainable Transportation Systems	The Netherlands	https://forum-ists2020.org/
09-10/11/2020	ITS Europe Congress 2020	Virtual event	https://virtualitscongress.com/?utm_medium=social&utm_source=Linkedin&utm_campaign=TSE&utm_content=LIGrp
11-12/11/2020	3rd-annual Baltic Sea Region 5G ecosystem forum	Virtual event	https://www.5gtechritory.com
17-18/11/2020	Smart Ports: Piers of the Future 2020	Virtual event	https://www.smartports.tv
2021			
11-12/01/2021	International Conference on Maritime Energy Management and Research	Singapore	https://waset.org/maritime-energy-management-and-research-conference-in-january-2021-in-singapore
14-15/01/2021	International Conference on Shipping in Climate Change	Zurich, Switzerland	https://waset.org/shipping-in-climate-change-conference-in-january-2021-in-zurich
14-15/01/2021	International Conference on Trends and Challenges in Maritime Energy Management	Zurich, Switzerland	https://waset.org/trends-and-challenges-in-maritime-energy-management-conference-in-january-2021-in-zurich
25-26/01/2021	International Conference on Maritime	Paris, France	https://waset.org/maritime-environment-monitoring-

	Environment Monitoring Applications		applications-conference-in-january-2021-in-paris
28-29/01/2021	World of Shipping Portugal, An International Research Conference on Maritime Affairs	Lisbon, Portugal	https://www.worldofshipping.org/WofSP06_Conference.html
26-29/03/2021	International Conference on Computers and Industrial Engineering	Egypt Japan University Of Science & Technology, Madinet Borg Al Arab, Egypt	https://10times.com/cie-madinet-borg-al-arab
22-23/04/2021	International Conference on Maritime Transport and Ship Design	New York, United States	https://waset.org/maritime-transport-and-ship-design-conference-in-april-2021-in-new-york
16-18/06/2021	The 9th International Workshop on Maritime Technology	University of Vigo, VIGO (SPAIN)	http://www.martech-workshop.org/
16-18/06/2021	27th International Conference on Urban and Maritime Transport and the Environment	Valencia, Spain	https://www.wessex.ac.uk/conferences/2021/urban-and-maritime-transport-2021?utm_source=wit&utm_medium=email&utm_campaign=ut21rem1&utm_content=2141922
23-25/06/2021	IAPH World Ports Conference	Antwerp, Belgium	https://www.worldportsconference.com
13-17/09/2021	London International Shipping Week - LISW21	TBA	https://londoninternationalshippingweek.com/
21-23/09/2021	Baltic Ports and Shipping 2021 Exhibition and Conference	Germany	http://www.transportevents.com/ForthcomingEventsdetails.aspx?EventID=EVE169
20-22/10/2021	16th Green Port Cruise & Congress	Piraeus, Greece	https://www.greenport.com/congress