



Original scientific paper

Technical Land-Sea Spaces: Impacts of the Port Clusterization Phenomenon on Coasts, Cities and Architectures

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ARTICLE INFO:

Article History:

Received: 2 February 2023

Revised: 11 June 2023

Accepted: 25 June 2023

Available online: 30 June 2023

Keywords:

Port Clusters;
Technical Spaces;
Land-Sea Interactions &
Management;
Coastal and Marine
Environments;
Port-City Architectures.

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ABSTRACT

Land-sea interactions, extending inland and towards the marine spaces, are affected by major management and design transformations. Globalization processes, port expansion projects and extensive energy transition requests have recently led port institutions to demand more land, engaging deeply with logistics platforms and radically restructuring forms of port governance. In this competitive context, the phenomenon of Port Clusterisation, i.e. the administrative aggregation whereby two or more ports are merged to form port clusters, is heavily impacting the institutional sphere. However, not only does this phenomenon have no control over cities, but its spatial component seems to be neglected by the disciplines of space, such as urbanism and architecture. As a result, port and city institutions lack design tools to tackle urgent challenges as coastal utilization, the need for resilient port-city infrastructures and the regeneration of the port-city architectural heritage. As part of the ongoing research project, titled PULSE and undertaken at the University of Genoa, the article aims to lay the earliest theoretical-methodological foundations for addressing the spatial products of Port Clusterisation, i.e. those technical spaces whose study contributes to developing spatial and design approach to port clusters. In terms of novelty and contribution to academia, an examination of the spatial footprint of port clusters will allow research to move beyond its state-of-the-art by targeting a phenomenon that, though pivotal, is under-researched, especially within the spatial disciplines. In terms of first findings, the article presents the PULSE Questionnaire, intended as a “data collection tool”, and the first spatial impacts, introduced by the cluster scheme, useful for the construction of an “evaluation tool”, the Indicator System, at a later stage of the research.

JOURNAL OF CONTEMPORARY URBAN AFFAIRS (2023), 7(1), 208-223.

<https://doi.org/10.25034/ijcua.2023.v7n1-14>

www.ijcua.com

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Highlights

- This paper provides first insights into the globalization processes that affect ports, ports clusters and port-related spaces.
- Ports, port clusters and port-related spaces are the subject matter and design of spacial disciplines (urban design and architecture).
- The cluster is an inclusive spatial device that can act as a priority on the conflicts of the city-port and land-sea interface.
- The cluster offers an unprecedented design filter that goes beyond the very valid concept of system.
- Academic research groups and port institutions (system authorities/port networks) can develop shared investigation and design tools.

Contribution to the field statement

This article provides a significant socio-economic contribution by examining the Port Clusterisation phenomenon and its spatial implications within the context of extended port urbanization. By introducing the concept of the cluster as an inclusive spatial device, the article offers insights into optimizing land-sea interfaces, sustainable infrastructures, and the revitalization of disused coastal spaces, ultimately fostering a more integrated and harmonious relationship between cities and ports.

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How to cite this article:

Moretti, B. (2023). Technical Land-Sea Spaces. Impacts of the Port Clusterization Phenomenon on Coasts, Cities and Architectures. *Journal of Contemporary Urban Affairs*, 7(1), 208-223. <https://doi.org/10.25034/ijcua.2023.v7n1-14>

1. Introduction

1.1. Regionalization, Clusterisation, Spatial Stretching

Land-sea interactions, extending inland and towards the marine spaces, are affected by major management and design transformations. In the specific field of networked maritime analyses related to technical spaces and operative interfaces, a consolidating approach is that according to which the poles of the land-sea system (i.e. mainly river and sea ports) are progressively acquiring at least regional influence in terms of scale and impact. It was the first maritime economics, together with geography, that theorized the so-called Port Regionalization phenomenon: through this fundamental conceptualization, Theo Notteboom and Jean-Paul Rodrigue (Notteboom & Rodrigue, 2005) have shown how ports are moving beyond their maritime structures and traditional operative perimeters by increasing the transport systems towards inland regions. This complex set of economic, logistic and commercial processes is not immaterial but has tangible impacts that spill over spaces and their transport infrastructures, from the railway systems to the large container platforms.

The trend towards a marked widening of gaze, i.e. oriented towards conceiving today's ports as complex urban and territorial devices, is even confirmed in much more recent times and demonstrates the need for new approaches and new categories to tackle the most urgent environmental and technological challenges. As Carola Hein illustrated in several recent studies (Hein, 2020), ports – conceived as large industrial complexes, urban territories and their neighbouring regions – share physical spaces, natural ecosystems, and social connections. To address climate change, the energy transition, changing technologies and the transformation of work conditions and economies, port-city regions need new regional collaboration and spatial reconceptualization. (Figure 1).

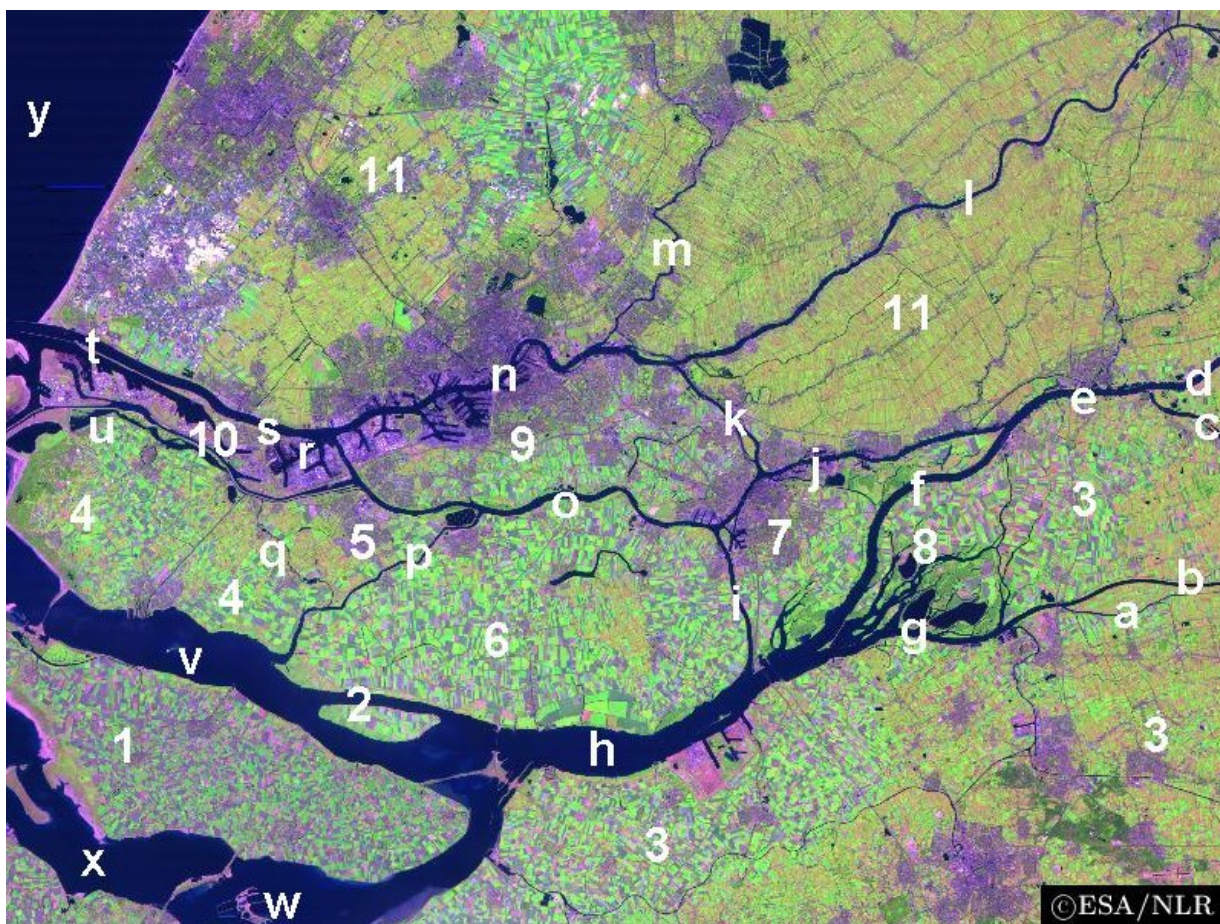


Figure 1. The Rhine–Meuse–Scheldt delta, 2007, (ESA + NRL, Wikimedia Commons CC).

Since the very beginning, ports can be considered drivers of agglomeration in the cities and territories that they serve and make functional. In the contemporary framework, though, the increasingly regional nature of these land-sea junctions has introduced not only the notion of “port region” but also that of



“port system”, or rather, “port cluster”. According to an economic perspective, which nevertheless reveals potentials related to the structuring of operational spatialities, port activities are shared among many municipalities and concentrated not only in port cities. Moreover, many times fewer port activities are found in port cities than in cities close to the actual ports. Thus, according to De Langen (de Langen, 2004), it is indeed possible to identify a “port region”. The idea of port clusters, as well as its morphological features and footprint, are closely linked to the notion of port regions. As early as 2001, in fact, the first definition of “port cluster”, provided by the Belgian scholar Elvira Haezendonck, defined this new *logistical weirdness* as «the set of interdependent enterprises engaged in port-related activities, located within the same port region and possibly with similar strategies leading to a competitive advantage and characterized by a joint competitive position *vis-à-vis* the environment outside the cluster». (Haezendonck, 2001)

Beginning from the late 19th-century applications in the industrial sector to the more recent uses in economic and regional geography, then, the idea of the cluster has become progressively interdisciplinary. (Vorley, 2008) Both an empirical and conceptual construct, the cluster is employed to portray conurbations, interconnected networks, and concentrations of firms and service companies having a high degree of collaboration, typically through a supply chain. Large-scale and cross-border projects take clusters into account to talk about networks and innovative *milieux*, economic and geographical disciplines employ the notion of regional clusters to refer to a geographically close group of interconnected companies, associated institutions linked by commonalities and complementarities, in the context of ports and beyond.

In the port sector, though, with Port Clusterisation phenomenon is meant the administrative aggregation of two or more single ports that, active in the same region, have been institutionally merged to form port clusters. Thus, depending on the contexts and national legislative conventions, we are more likely to encounter the term “port systems” or even “port networks”. Nonetheless, the idea of clusters seems, for the time being, to ignore space: in other words, its spatial implication and potential application in urban and territorial design still appear incomplete and overlooked.

In maritime economics and geography, scholars such as Ducruet and Notteboom maintain that, regarding the notion of spatial patterns in port systems, key issues related to spatiotemporal dynamics remain unexplored (Ducruet & Notteboom, 2020). Planner Pavia argues that in Italy, despite the formation of national port systems in 2016 (Pavia, 2016), planning tools related to a single port continue to operate and/or to be drafted, confirming how politicians, planners and researchers are charged with the task of steering the spatial development of port clusters.

However, we can argue that the notion of cluster applied to land-sea territories and to the system of large infrastructural complexes bears witness to a further rapidly consolidating process which it is impossible to deny has the size to influence not only ports and their complex equipment and logistical externalities, but above all “the cities of these ports” affected by the merger mechanism. Not only a supplanting of administrative borders, the clustering process consists of an intense “spatial stretching”: a physical and relational expansion of coastal and marine spaces that, through these evolutions, become polycentric, interlinked, multidimensional and pooled. Implying a new kind of “spatial engagement”, this stretching generates new spatial patterns of functional relationships for port-city-territory interfaces, as well as the system of infrastructures and architectures that function as places of separation and interaction, both hinges and grafts between land and sea. Ultimately, and with a renewed focus on the role of space as a strategic tool, the formalization of clusters in the port world introduces the process of “spatial clustering” in technical land-sea territories. It also highlights the latent potential of the territories linking those ports and increasingly motivates a study on the Port-Cluster Landscape, i.e., the spatial product of the Port Clusterisation phenomenon. The notion of the Port-Cluster Landscape is better comprehensible if connected, for example, to that of Port Cityscape, already theorized by Carola Hein in 2019. (Hein, 2019) Hein wrote that «many contemporary ports are surrounded by high fences and are controlled by special institutions, but their spatial footprint – for example through infrastructure, warehousing, and logistics networks – as well as their environmental impact – for example, air, water, soil or noise pollution – extends far beyond the port’s demarcated borders into



neighbouring cities and regions. The result is a port cityscape, a networked space that extends from land to sea, including ships and pipelines, port facilities and warehouses, industrial and logistic structures, headquarters and retail buildings, but also housing and leisure facilities. This port cityscape is administrated, planned, imagined and represented by multiple institutions and rarely as part of a shared vision.» (Hein, 2019).

Building on this and referring to the PULSE research being implemented (see *Acknowledgments*), the article states, as its main thesis, that the clustering of contemporary ports is a topic that should also and above all be dealt with spatially, i.e. that it has important impacts on the management of territories and therefore cannot be ignored by disciplines such as planning, urbanism and architecture. Among the many aspects of the complex clustering process, the article questions in particular the lack of a spatial component and design approach to port clusters and, consequently, aims to investigate through several research tools the spatial impacts introduced by port clusters in the field of architectural and urban design.

The contribution is consistent with the ambitions and purpose of the journal in which it is issued, as the proposal and investigation of spatial clustering processes are intrinsically linked with the need to discuss emerging social and economic challenges and problems facing global cities within other scientific fields (in the case of port clusters, geography and maritime economics support investigation in the field of urban and architectural design), and to develop theoretical and methodological foundations in respect of the social and economic problems of contemporary urbanization (by providing tools for analysing and interpreting port clustering phenomena, comparing different territorial scenarios).

In terms of structure, the article reports on the main research questions in progress and aims to provide initial insights into the first phase of the research methodology, corresponding to Work Package 01, entitled “Investigation”. In addition to a review of the relevant literature, this phase is aimed at the definition of an Indicator System able to record the main aspects of the cluster dimension. As illustrated in the “Materials and Methods” chapter of this article, thanks to the support of the network of Italian Port System Authorities and the Association of Italian Ports – Assoport, the research will disseminate a thematic Questionnaire as a “data collection tool” to build an updated picture of the situation of port clustering in Italy and to structure an “evaluation tool”, the Indicator System, aimed at registering the spatial and morphological impacts introduced by port clusters. In the “Results” chapter of this article, the main parameters that have inspired the Questionnaire and the expected early results will be provided: the Questionnaire is in fact in the process of being disseminated and, at the current moment, final data are not yet available. The choice to address these issues as they unfold is linked to the principles of transparency and cooperation for open and replicable science, understood as scientific knowledge accessible to all and at all stages of elaboration. Finally, in the concluding chapters, “Discussions” and “Conclusions”, the opening questions of the research are taken into account and the topic of the port cluster is repositioned within broader themes related to the key concepts of *planetary urbanization*, *complete urbanization* and *urbanization of the sea* (Couling and Hein, 2020).



WP1
INVESTIGATION
 [year 1 - months 1/9]

ACTIVITIES

Historical Research & Literature Review (HReLRev)
 Interviews & Field Visits (InFV)
 Glossary Survey (GLOSS)

TOOLS

Questionnaire
 to collect and record data on spatial impacts
 (*preliminary* state of clustering)
 > to 16 Port System Authorities (IT)
 via Assoport [referent: Tiziana Murgia]

Interviews
 to collect and record data on spatial impacts
 (*advanced* state of clustering)
 > to international reference cases (EU, IBD)
 via AIVP [referent: José Sanchez]

RESULTS - WP1

INDICATOR SYSTEM

- to record the cluster's *spatial impacts*;
- to enable the system indicator cross-referencing in the CROSSING phase (WP2).

1st TOOL-KIT COMPONENT

GLOSSARY

new lexical categories
 developing a new language to define the cluster dimension.

Figure 2. Structure of Work Package 01 “Investigation” : Activities, Tools, Results.
 (Developed by Author).

2. Material and Methods

2.1 Advanced and Early Cases of Port Clusterization in Europe

Logistics platforms, intermodal centres, integrated stations and interports, port calls and dry ports, trans-shipments and roll-on/roll-off (ro-ro) have become part of a new urban lexicon and, at the same time, of a global race to the infrastructure that is profoundly changing, and at a surprising speed, large regions of the planet, from the North to the South of the world, in Africa, Asia, South America and Europe.

The Port Clusterization phenomenon, previously illustrated in its main aspects, has been affecting many European ports for at least a few decades. It is a phenomenon of an administrative nature at least initially: the port authorities, often following national regulations, are merged into systems of several ports, primary, secondary and of various sizes and operational functions, in order to rationalize their structure procedures, their spaces of influence and, in fact, restructure their governance.

Undoubtedly, the port clustering process has also been strongly impacted by globalization, ongoing port expansion projects, by extensive needs for sustainable infrastructures and energy transitions that collectively have led port institutions to demand more land. With the aim of engaging deeply with their hinterland logistics platforms and inland freight transport systems, these institutions are being challenged to reshape the borders between city, port and territory, to reform the institutional apparatus of ports and promote their economic competitiveness.

Considering the European framework, we can already preliminarily note port systems in which the cluster regime was introduced about twenty years ago or so: in these long-established and noteworthy port clusters we can therefore detect “advanced stages of clustering” which offer important examples of reference and comparison. Contexts such, e.g., as the Rhine/Meuse Delta (North Sea Ports, ports of Antwerp-Bruges, Rotterdam-Dordrecht and Amsterdam), the Copenhagen-Malmö Port between Denmark and France or the HAROPA Port in France are paradigmatic cases in which we read, first of



all, the existence of individual mono-call ports and, following the administrative unification, the birth of the port system, extended both on land and sea. In many of these cases, the origin of the cluster exploits an existing morphological-geographical Situation (in France, the river branch of the Seine along which the ports of Paris, Rouen and Le Havre are naturally aligned) or coincides with a major infrastructural transformation (in Denmark, the opening of the Øresund Bridge in 1999, a combined railway and motorway viaduct which connects the networks of the Scandinavian Peninsula with those of Central and Western Europe).

In parallel, other countries present evolving port clusters: relatively recently established systems which, for research purposes, are therefore an expression of an “early stage of clustering”. This is believed to be the case in Italy where, in 2016, Legislative Decree no. 169 imposed a general reorganization of the port system: in line with the provisions of the Strategic Plan of Ports and Logistics, the law rearticulated the governance of the entities, overcoming the rationality of the port authority structured as an administrative entity typically coinciding with a single port organism and proposing the replacement of the old port authorities with new Port System Authorities (AdSP) to which several ports belong. The consequent reduction in the number of port authorities has merged 62 Italian ports reducing the government bodies from 24 to 16. (Figure 3)

Already in the Guidelines for the Drafting of the Regulatory System Plans (PRdSP) issued in March 2017 by the Ministry of Infrastructure and Transport, there are promising innovations regarding the systemic approach of the new regulatory and planning tools for port spaces. The PRdSPs, in fact, should aim to delimit the scope of the ports constituting the system and at the same time draw the overall layout of them: these actions are preparatory to providing addresses for planning. Other innovations are also of great interest. For example, the PRdSPs define the *layout* of the port system as the planned layout of each of the ports making up the system. From a technical point of view, the law states, that the layout cannot but include the seabed: it is therefore a plano-batimetric layout that extends well beyond the solid land-sea frontier.

It is interesting to note at this point how the new 16 Italian port realities are spatially configured and named. Their new articulations follow an evident geographical factor which, on the one hand, does not always respect the regional administrative borders, for example uniting ports between Liguria and Tuscany or between Marche and Abruzzo by pandering to predispositions and relationships of other nature. On the other hand, the new Italian Port Systems are characterized by names that refer to the seas they overlook and to which they belong: therefore we have the *Authority of the Western Ligurian Sea* (ports of Genoa, Savona, Vado Ligure), that of the *Central Adriatic Sea* (ports of Ancona, Falconara, Pescara, Pesaro, San Benedetto del Tronto, Ortona) or even that of the *Sardinian Sea* (ports of Cagliari, Foxi-Sarroch, Olbia, Porto Torres, Golfo Aranci, Oristano, Portoscuso-Portovesme and Santa Teresa di Gallura). The toponymic datum is not just a marginal note but a precise will to attribute the sea to its port: an approach that transcends the vision of the port, or rather the port cluster, as a mechanism of movement but which conceives it as a complex infrastructure that alters the terrestrial and marine territories by introducing unprecedented potential for land-sea projects.

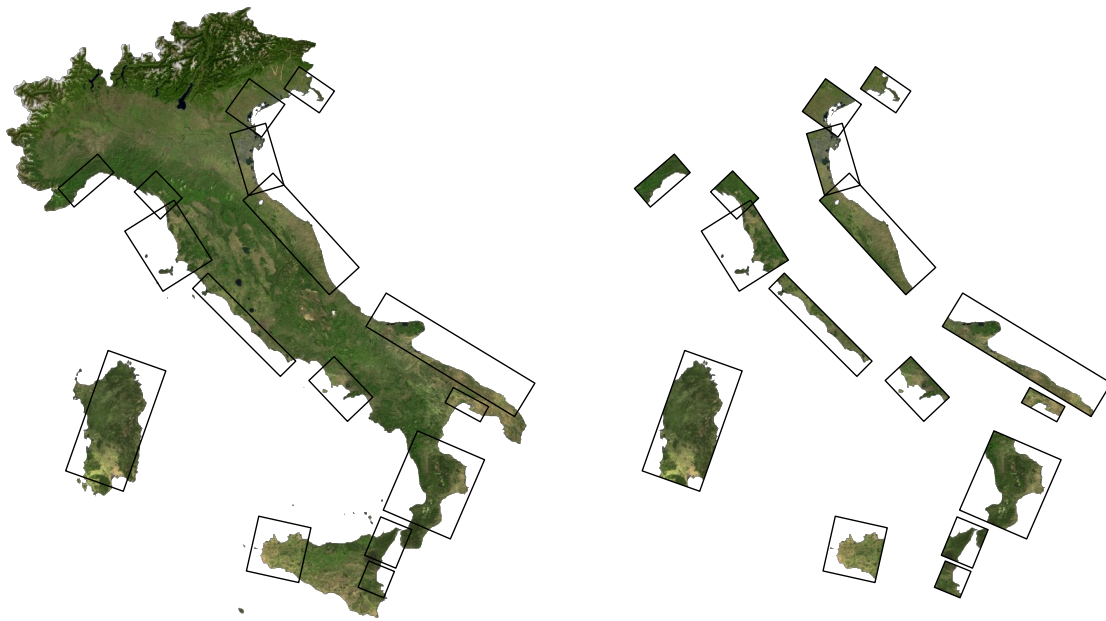


Figure 3. Port Systems in Italy (since 2016): From 62 single ports to 16 Port System Authorities. (Developed by Author).

2.2 Tools Towards a Spatial Approach

The clustering of ports causes the emergence of a broad phenomenology of new spaces and unprecedented formal-relational conditions, which we can bring back to the previously introduced Port-Cluster Landscape. This landscape is only partially grasped by current interpretations and, at the same time, it cannot be assumed as the exclusive product of some local specificities, as often observed from the port-city literature. To confirm this, by a preliminary exploration of the bibliography on port clusters, port regions and port ranges, it can be seen that spatial disciplines are mostly absent on these subjects: in other words, these are topics widely and seriously treated by disciplines such as regional economics, port logistics and, undoubtedly, maritime geography, while urban planning, spatial analysis and architecture seem to struggle to approach the theme, probably not perceiving it as their own competence or specific knowledge.

For these reasons, the ongoing research PULSE, partly presented here, aims to build and employ an Indicator System to record the Port-Cluster Landscape's spatial and morphological impacts, namely those that are affecting the form and the scale of contemporary port-city territories. A space-based methodology that aims to make the project's results measurable, allowing other specialists, coming both from the world of scientific research and from that of institutions, to assess them in other research activities.

The Indicator System of the morphological-spatial impacts of the cluster is created with the intention of supporting, and at the same time reaffirming, the spatial turn process that is affecting anthropic territories, as well as technical land-sea ones. «Planners and landscape architects have taken a more spatial approach to gain a better understanding of the multiple issues of port cities, including issues around water, design and heritage, and their cultural dimensions» (Hein, Luning, & van de Laar, *PortCityCultures, Values, or Maritime Mindsets: How to Define and Assess What Makes Port Cities Special*, 2021). From this, the “spatial approach” brings space and its potential back to the centre, making it possible, especially in the port field, to reason on processes and entities such as “spatial scale”, “spatial patterns” and “spatial history”.

Intended as an “evaluation tool”, the Indicator System will be structured following a knowledge phase conducted through an experimental “data collection tool”, namely a thematic Questionnaire. Disseminated between June and August 2023 thanks to the operational collaboration established with



the Association of Italian Ports – Assoport, the Questionnaire will be addressed to the Italian Port System Authorities (AdSPs) currently involved in the management and planning of national port systems. The Questionnaire exploits the knowledge and communication network of Assoport, an association of national calibre that brings together the 16 Port System Authorities and offers the Ministry of Infrastructure and Sustainable Mobility, the other Ministries concerned and the European Union any useful consultation and contribution to port issues, also highlighting, in the various national and international venues and occasions, the role and importance of our ports for the Italian and Community economy. By reaching the various Italian port systems through transversal work tables and plenary meetings, the Questionnaire aims to photograph the current state of the Italian port system in terms of port clusters and, in particular, regarding the planning and project tools implemented or being implemented in the various local contexts.

2.3 The Questionnaire: structure, goals and target groups

In order to gather the required data for the study, the Questionnaire has been structured into six distinct sections as follows:

1. Section 1: Personal Information and Permissions
2. Section 2: Governance (Addressing Governance and Formalization of Port Clusters)
3. Section 3: Plans and Projects (Focusing on Planning, Project Tools, Spatial and Morphological Impacts of Clustering, and the Definition of Port Cluster Layouts)
4. Section 4: Future Outlook (Exploring Challenges, Potentials of Port Cluster Structures, Ongoing System Projects, and Initiatives in Other AdSP Sectors)
5. Section 5: Glossary (Providing Brief Definitions, Comprising Three to Five Words or Short Expressions, for Port-Cluster Landscape Configurations)
6. Section 6: Concluding Remarks

While Sections 1 to 5 are mandatory for the participants, Section 6 is optional but intends to collect free suggestions and comments, also aimed at improving the research and its tools.

The Questionnaire, which consists of a total of 10 open questions plus an optional final note, has an interdisciplinary attitude: its purpose is to reach out to individuals and groups from different sectors of the port systems' governing bodies, from planning, economic development and governance, to promotion and communication to the city and the community.

In terms of ethical considerations, privacy policy and research data management, the Questionnaire guarantees the anonymity of the respondents, who are adequately informed about the objectives of the project, the methodology and the progress of the research through free consultation of the project official webpage. An Information Sheet will be also provided to the target subjects and groups to manage and protect the dissemination of personal data that will be used exclusively for research purposes.

Following the dissemination of the Questionnaire (June-August 2023), the data collection process will include a preliminary analysis phase of the received replies (September 2023) and initial dissemination of the results following a critical interpretation that will also take into account the geographical origin of the answers, their depth and the professional/scientific field of the participants.

The quality of this analysis lies in particular in the systematic layout of the survey, which allows for comparability of the participants' responses. To give a few examples, some of the questions addressed to the Italian AdSPs were: 2.5) "From a governance point of view, what impacts has the formalization of the cluster produced so far and what impacts can it potentially produce on the cities of these ports - namely "the cities of the cluster" - also part the cluster? And also, what impacts has/can produce on the territories that divide and, at the same time, connect them?"; 3.2) "The relation system of the port cluster has to be built to develop an integrated vision of the logistics extended coastal territories. Do you agree with this statement?"; 3.3) "According to your professional experience, what are the main spatial and morphological impacts brought in by the Port Clusterization phenomenon? In other words, by what is the configuration and physical form of the port cluster characterized and/or influenced?".



From the spatial and morphological impacts of the clustering reported by the Questionnaire and, also, from research evaluations carried out through the literature on the topic, an initial version of the Indicator System will be drafted, which will then be refined and implemented in 2024.

The participants in the Questionnaire, intended as data subjects, were selected from within the Italian port system authorities (AdSPs): in particular, the questions were addressed to the port systems that autonomously and through the support of Assoportici solicited the professionals and technicians with the greatest expertise on the issues to respond. On a voluntary and free assessment basis, AdSPs were also free to disseminate the Questionnaire to other categories of workers asking them to take part in filling in the Questionnaire. Those involved had to be connected in the port world and competent on PULSE topics: they could be private concessionaires, port operators and companies, municipalities or other public institutions.

3. Results

3.1 Spatial Parameters and Spatial Impacts: Early Research Results

The systemic approach and the definition of a common language are certainly two fundamental starting points for bringing the port clustering process to fruition. In recent years, from 2016 onwards, Italian ports have been working on the delineation of an overall territorial and socio-economic structure in order to be able to imagine, through the consequent drafting of Port System Master Plans, a strategic cluster structure. This work of redefining the new extended context has been often entrusted to preparatory tools for planning and projects, such as the Strategic System Planning Document (DPSS), drafted, for example, by the Port System Authority of the Western Ligurian Sea in April 2021. These preliminary documents reveal new and crucial fields of influence and, in certain cases, effective intervention by ports united in systems. On the one hand, the areas of interaction between port and city where functions, relations and forms of intermingling are found along the urban-port boundary. On the other, the back-port areas that, for the first time, are considered of absolute importance for port development strategies on a wider territorial scope than the port boundaries or the administrative boundaries of the municipality(ies), extending the same to the target market.

Building on these considerations, the PULSE project, which is partially illustrated here for the aspects that concern research questions and methodologies and data, focuses on the morphological-spatial impacts resulting from the formalization of the cluster in a coastal arc dotted with two or more ports. As a new spatial and institutional entity, in fact, the Port-Cluster Landscape can expand the knowledge on port clusters by contributing to emphasize how the cluster's relational strength and pervasiveness are leaving deep imprints on spaces. Although still in full implementation and therefore still the lack of results that can be considered definitive, the research preliminarily identifies a set of parameters to be used as input for the construction of the Questionnaire, intended as a "data collection tool", and the resulting "evaluation tool", the Indicator System.

Among the parameters, e.g., the one of "optimisation" highlights how, within the cluster's different poles, the use of spaces and resources can be pooled. The concrete optimisation impacts will then be to avoid duplication of large infrastructures along the same coast/river and, as a result, to reduce land occupation and to produce benefits in land reclamation and port pollution. Other parameters, yet to be confirmed and verified in the progress of the research, can be "complementarity", "rationalisation", "inclusiveness" and "proximity". In terms of complementarity of equipment, the mobility system can be more hierarchical and intermodal. This spatial impact, supported by regional scale bodies, will trigger sustainable ways of transport, favouring different speeds and levels of permeation into the urban fabric and empowering new lifestyle behaviours. Rationalising investments and sharing costs within the components of the cluster, instead, will lead to potential redistribution and relocation of catalytic functions within extended port city territories, resulting in freeing up seafront areas, reducing coastal consumption or decommissioning abandoned artefacts. Architectural port-city heritage can be regenerated as a common system of territorial centralities. The renewed governance of port clusters will improve territorial inclusiveness among primary and secondary ports: it will also help institutions accelerate processes using the advantages of proximity. A cohesive planning between ports of the same



cluster will deal with the new port-city-territory interfaces which, places of both separation and interaction, are hinges and grafts between land and sea. They are crucial fields for the development of design projects that can support the authorities in reassessing communities' harmful perceptions of the port.

On the basis of these parameters, which aim to be applicable and verifiable in different port contexts in Europe and beyond, a very first selection of spatial impacts introduced by the cluster can be drawn up. They are, e.g.: a) *degree of sea-land connectivity*, b) *infrastructure sharing/rationalisation*, c) *services pooling/optimisation*, d) *amount/size of functional and operational linkages*, e) *linear/areal occupation of the coast*, f) *proximity/inclusiveness of firms/industries*, g) *co-ordinated planning and project tools between ports in the cluster*, h) *port-to-city or land-to-sea hinge and grafts points*, i) *port-city-territory-interfaces extension/heterogeneity*; j) *dual-function architectures*; etc.

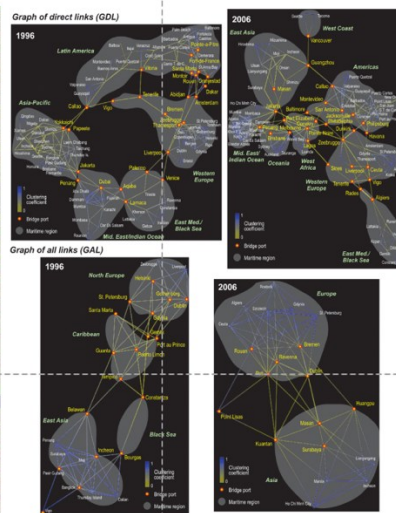
This early selection will be of fundamental importance in the Questionnaire to guide the contribution of the participants, offering a shared ground for spatial analysis. Furthermore, the preliminary spatial parameters and impacts recorded here align with the radical rethinking of the urban and built environment, advocated by Christian Schmid. Indeed, it is suggested that the analysis and recognition of impacts, such as the “degree of sea-land connectivity” or the “port-to-city or land-to-sea hinge and grafts points”, can contribute to the recognition of novel patterns of *extended urbanisation* by favouring cataloguing of products of the spatial turn process and by triggering the development of ecosystem projects able to «draws together the milieus of nature, the built environment, and human beings.» (Schmid, 2020).

3.2 A new Glossary about Port Clusters

The topic of port clusters certainly belongs to the field of interest of public institutions on a local and territorial scale. However, the topic is particularly crucial and unexplored in the field of scientific research on spatial analyses and interpretations: as already mentioned, while disciplines such as geography and maritime economics have been dealing with similar subjects for decades (Figure 4), the design of port systems – or even better the design of port infrastructures – seems not to be a subject of urban studies, as well as architecture.

There are a few examples of research groups or thematic laboratories of excellence: e.g. the *PortCity Futures* of the Universities of Delft, Leiden and Rotterdam in the Netherlands (PortCityFutures, 2020) and the *Coastal Design Lab* based at the University of Genoa in Italy (CoastalDesignLab, 2014). These laboratories deal with ports in a contemporary and multidisciplinary key, i.e. as organisms of the metamorphosis of anthropic spaces and relations with their cities and their architectural typologies.

To fill this gap, this research aims, among other expected results, to develop a “new language” – in the form of a *Glossary* – to describe the cluster dimension. That is, it is proposed to process a set of lexical categories to define the spatial and morphological configurations of the Port-Cluster Landscape. The Glossary is a widely used tool in scientific research: however, in the case of port clusters, the implementation of an appropriate terminology would be fundamental to provide scholars and operators with the first shared reasoning and planning instruments. When faced with the incessant production and transformation of the socio-spatial organisation across scales and territories, such as “conurbations,” “city-regions,” “urban regions,” “metropolitan regions,” and “global city-regions”, Neil Brenner and Christian Schmid have argued that «[...] a new conceptual lexicon must be created for identifying the wide variety of urbanisation processes that are currently reshaping the urban world and, relatedly, for deciphering the new emergent landscapes of socio-spatial difference that have been crystallizing in recent decades. Last but not least, we require adventurous, experimental, and boundary-exploding methodological strategies to facilitate the empirical investigation of these processes». (Brenner & Schmid, 2013)



Source: realized by authors based on LMIU data and TULIP software

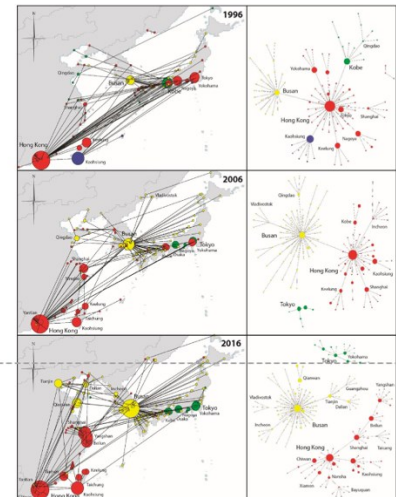


Figure 3: Single linkage analysis of Northeast Asian container flows, 1996-2016

Figure 4. Gallery of Port Clusters, Systems and Maritime Linkages representations, 1996-2016 and 2012.

4. Discussions

4.1 A multi-speed picture and potential study limitations

The contribution here presented focuses on a particular operational part of a broader research still in full swing on the theme of European port clusters. From a methodological point of view, this part of the research is aimed at gaining knowledge of the state-of-the-art, through data collection (the Questionnaire), and at building a first terminological vocabulary (the Glossary) to, on the one hand, orient oneself in the broad notion of cluster and, on the other, to formulate tactics by which to apply this notion to specific spatial contexts (the Indicator System).

The results that will be gathered in the next months of the research through the Questionnaire (expected within 2023) will then be employed in a subsequent phase of the work, the Work Package 02 “Crossing”. Through this phase, the spatial and morphological impacts recorded thanks to the Indicator System will be applied in the territories of selected Italian port clusters that are in a preliminary clustering stage; subsequently, they will be cross-referenced with those of European port clusters seen, instead, as advanced and reference cases. Performed using mostly maps, the crossing process stresses the role of mapping as a tool for deciphering spaces.

The contribution is conscious and, therefore, seeks to confront the dynamic character of port territories. By definition in motion and disposed to change, the technical spaces linked to large infrastructure complexes on the coast are constantly evolving, requiring tools capable of interpreting and supporting processes in the process of becoming. This is also true in the case of the port clustering phenomenon which, for example, in Italy, 7 years after its formalisation, is particularly different in the various port systems. Therefore, the Questionnaire aims to capture this multi-speed picture by highlighting and enhancing the peculiarities of each context and recording potential prospects. This also gives rise to potential limitations of the study that can be assumed from the outset. The response rate to the Questionnaire (which, as illustrated, is voluntary) and the different responses from the various Italian port contexts may constitute elements of inconsistency within the critical analysis. In these cases, the PULSE research aims at assessing these imbalances as qualitative features and elaborating alternative solutions to the exclusive comparison in order to pursue the interpretative phases.



4.2 An Open Debate between Academia and Port-City Institutions

The proposed experimental methodology aims to be widespread and potentially lends itself to be applied in the presence of other complex spatial formations, such as “urban-port regions”, “land-sea built ecosystems” and “port-related spaces”. The replicability of the methodological tool, as well as of its future results, helps to open up the collective discussion on the topics covered by the research. Indeed, on one front, the direct involvement of public actors (i.e., the Italian Port System Authorities and Assoporti) in the implementation of the work guarantees the establishment of a strong alliance and the development of a debate on an administrative, managerial and highly operational level linked to strategic planning. On the other front (not in an opposite position but complementary to the previous one), the discussion moves to the European framework of scientific research aimed at the production of knowledge and the circulation of excellent results. In adherence to European policies, in particular the New European Bauhaus Initiative, the scientific and strategical outcomes of this research address AIVP – Association Internationale Villes Portuaires’s 2030 Goals (AIVP, 2020) adapted from the UN’s Sustainable Development Goals – SDGs (UN, 2015), tackling especially the goals of “Sustainable Mobility”, “Renewed Governance” and “City Port Interface”.

In terms of the magnitude of the project’s contribution to the expected scientific, societal and economic effects, then, insight into these topics could in time positively affect sectors of the European population who live in coastal and fluvial areas and move for study/work within large and extended territories. The specialisation of public systems and services and the multiplication of job opportunities within the same cluster, for example, will benefit their relationship with highly urbanised and infrastructured territories.

Last but not least, the open debate on these issues aims to offer port planning, i.e. to urban-port institutions, operational instructions for introducing the spatial component in the drafting of the new Port Regulatory Plans, overcoming the tendency towards a mono-port approach linked to borders administrative and municipal, and instead engaging in a concrete dialogue with the relational aspect of contemporary land-sea technical spaces.

5. Conclusions

5.1 Extended Urbanization: some theoretical standpoints

As early as the end of the last century, urban growth patterns began to change. On this, Christian Schmid affirms in his *theory of the urban* that « [...] the process of urbanization has become undirected; existing urban forms are beginning to dissolve; centrality is becoming polymorphous; and eccentric urban configurations are evolving.» (Schmid, *Networks, Borders, Differences: Towards a Theory of the Urban*, 2013). This made way for a wide variety of places: specifically, polycentric urban regions are increasingly taking shape, extremely heterogeneous in structure and processes of metamorphosis. (Figure 5) Centrality can be found anywhere in cities: it is the new feature of urbanisation that disrupts urban unity as a principle in favour of overlapping urban realities with indistinct boundaries. Growing cities – including port cities which constitute an *urbanity* in their own right (Moretti, 2020)– should therefore be conceived as general phenomena. Again Schmid, taking up a crucial theory of the French philosopher Henri Lefebvre about the integration between the categories of the “urban” and the “space”, introduces key concepts for the reading and design of contemporary extended territories, such as the clusters: they are the networks, the borders and the differences. Visualised as systems of interaction, the networks are based on material infrastructure that determines the orientation of urban spaces. The framework of interactions can be read through parameters that characterize and together differentiate them, such as the intensity of the interaction they establish, the *extension* of their range of action and the heterogeneity given by the overlapping of various types of networks. Borders are «cuts in the continual flow of interaction.» (Schmid, *Networks, Borders, Differences: Towards a Theory of the Urban*, 2014). They follow laws, custom, and traditions, they are places endowed with specific liminal characteristics and represent the first components of a project of change: it can be argued that there is a spatial quality of the edge, made up of permeable potentials that are triggered in the moment of collision between two territories or two different orders. Borders



are places of difference. Far from being fragmentations, the differences of contemporary spatialities act as welding of the more extensive territories since it is in the juxtaposition of different things that reactive opportunities can be found.

5.2 The Cluster as a New Inclusive Spatial Device and Architectural Formation

Standpoints of this kind, mostly matured between the 20th and 2000s in the light of the proliferation of increasingly less codified urban forms, provide a strategic reference framework for reasoning related to port cities and, more recently, to port systems or port clusters. In line with the questions posed at the beginning of this contribution, the cluster – that of several ports and several cities – is nothing but the spatial product of global processes (institutional, economic, infrastructural, etc.) which today lead to a necessary reconceptualization of complex spatial forms, such as “conurbations”, “extended territories”, “city-regions”, “urban regions”, “metropolitan regions” and “global city-regions”.

Although the study to which this article refers (the EU PULSE research) is still in full development and it is not yet possible to rely on final results, it is believed that the conclusions of this contribution may be of interest not only to scientific research on these issues but to policymakers, urban planners and architects involved in the transformation of contemporary coastlines and ports. It is no coincidence after all that the PULSE project is involving the sphere of territorial government bodies and the professional sphere in its development from its early stages (consider, e.g., the involvement of Assoport and the Italian AdSPs in the Questionnaire). Thereby, the introduction of such themes in the world of institutions active in the territory of ports (and their cities) is considered instrumental in triggering a mindset shift: i.e. to fully exploit the cluster regime and dimension in the field of planning and design of coastlines, infrastructures and architectures directly involved in urban-port life.

Linking the reasoning on port clusters to those studies which were revolutionary in the field of terrestrial urbanization but also of that which has involved seas and oceans for decades, allows first of all to conceive the *cluster as a space*, or rather a series of spaces concatenated together. Composed of infrastructure networks, settlements and architectural centralities, intersected by natural or anthropic borders and an emblematic place of differences and contradictions, the cluster is one of the most interesting architectural formations of the beginning of the century. As illustrated in the contribution, its regime introduces and produces parameters such as optimisation, complementarity, rationalisation, inclusiveness and proximity of equipment, buildings, and even communities, in the spaces of port cities and regions. While remaining linked to tangible components, the cluster offers an unprecedented *design filter* that goes beyond the very valid concept of the system, thus attributing a surface, a horizontal and polycentric impact to the new clustered reality.

The spatial component of the port cluster which, as already specified, is scarcely covered by the current literature, is instead a specific, and rather limitless, ambit of research and application of the spatial and architectural disciplines. This is because the cluster offers opportunities for a redefinition of territorial borders and intermodal and sustainable infrastructures. It introduces the delocalization and redistribution of goods and resources aiming at the functional differentiation of land-sea infrastructures, rather than at their obsessive replication, in favour of the liberation of highly exploited coastal spaces. The cluster rationalizes the function and identity of primary and secondary ports, opening up horizons for the regeneration of the architectural and industrial heritage still disused by the obsolescence of mid-twentieth-century port technologies. For all the reasons given above, this article claims that the cluster is an *inclusive spatial device* that, trying to undermine the deep-rooted process, which has often fuelled an operational strategy of “port-out – city-in” (Van den Berghe, Louw, & Pliakis, 2023) in port cities and port-related spaces, acts as a priority on the conflicts of the city-port and land-sea interface.

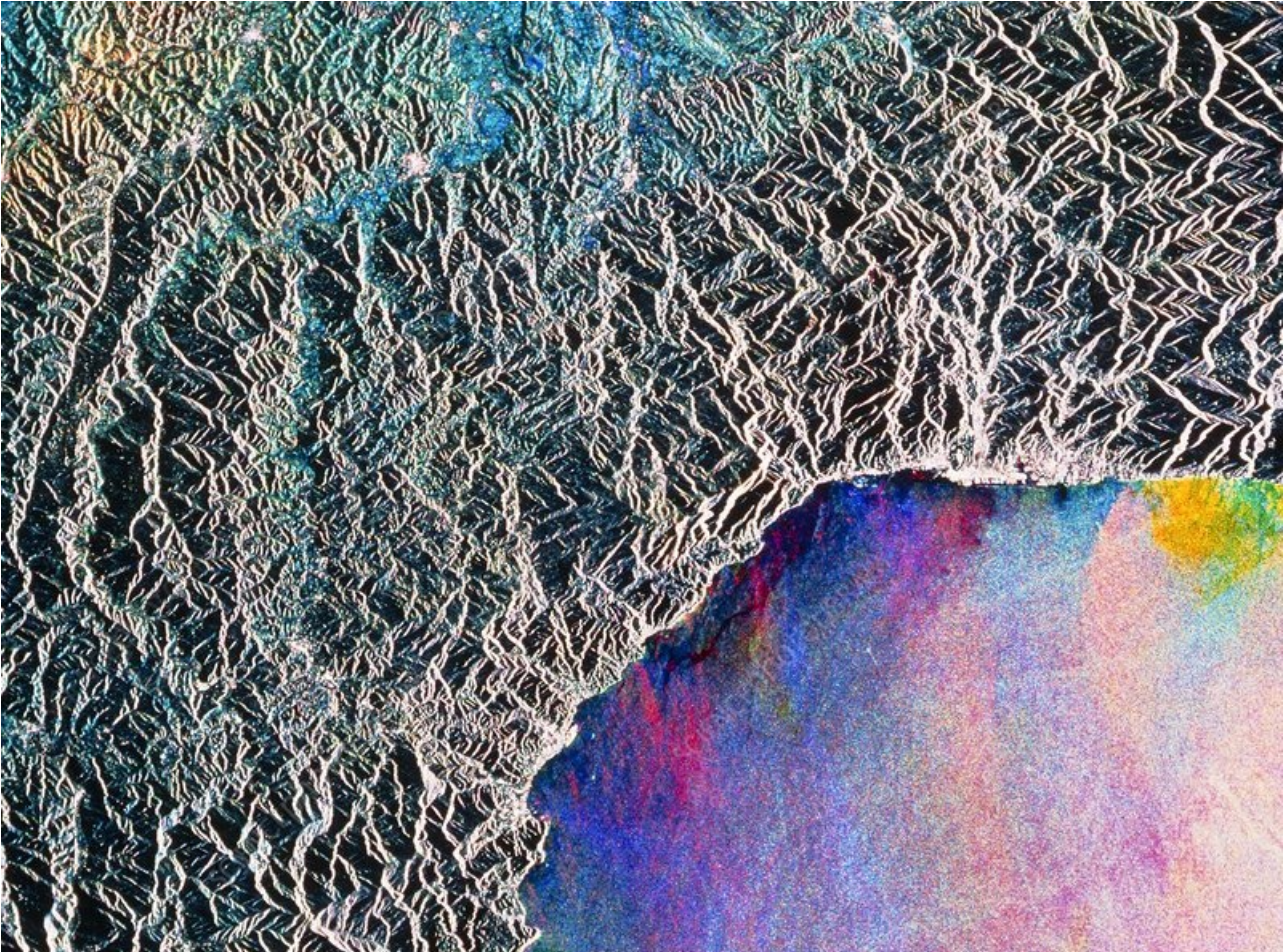


Figure 5. Coloured radar satellite image of the Ligurian Range (ports of Vado Ligure, Savona, Prà, Genoa), (ESA, EURIMAGE / SCIENCE PHOTO LIBRARY).

Acknowledgements

Association of Italian Ports (Assoporti) – for supporting the dissemination and management of the PULSE Questionnaire and meetings with the 16 Italian Port System Authorities. Assoporti’s contribution is regulated by the Framework Convention and Implementation Agreement, signed with DAD – UniGe (contract No. 2840 of 18/05/2023); the 16 Italian Port System Authorities (AdSP) – for taking part, as data subjects, in the PULSE Questionnaire.

Conflict of Interests

The author declares that there is no conflict of interest.

Funding

Winner of the “Young Researchers” Call, PULSE has received funding from the Italian Ministry of University and Research, as part of the implementation of the National Recovery and Resilience Plan (NNRP) – Mission 4 “Education and Research” – Component 2 “From Research to Business” – Investment 1.2 “Funding projects presented by young researchers”, within the Next Generation EU Recovery Package. For more information, please visit PULSE official webpage: <https://pulse.unige.it>

Data availability statement

Regarding the early results and methodological aspects of PULSE presented in this article: The data that support the findings of this study are available on request from the corresponding author, B.M. Regarding only the replies to the PULSE Questionnaire: “Due to the nature of this research,



participants of this study did not agree for their data to be shared publicly, so supporting data is not available.”

CRedit author statement

Conceptualization: B.M. Data curation: B.M. Funding acquisition: B.M., DAD. Investigation: B.M., Asso. Methodology: B.M. Software: B.M. Project administration: B.M., DAD. Validation: DAD, Asso. Visualization: B.M. Writing—original draft: B.M. Writing—review and editing: B.M.

Note: B.M. is Beatrice Moretti

DAD is Department of Architecture and Design, University of Genoa (UniGe)

Asso. is Assoport

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How to cite this article:

Moretti, B. (2023). Technical Land-Sea Spaces. Impacts of the Port Clusterization Phenomenon on Coasts, Cities and Architectures. *Journal of Contemporary Urban Affairs*, 7(1), 208-223. <https://doi.org/10.25034/jcua.2023.v7n1-14>