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Co-Planning Port–City 2030: The InterACT Approach as a Booster for Port–City Sustainable Development

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Abstract: Port–city ecosystems face pressing challenges, such as land regeneration and environmental conservation, while striving to foster conscientious governance models among stakeholders. An innovative solution to address these issues lies in Information and Communication Technologies (ICT), acknowledged by sustainability frameworks as essential for sustainable urban development. Although ICT is regularly employed by ports for logistics and traffic management, its untapped potential for urban planning is substantial. Starting from studies conducted on port planning and management and the use of ICT as a decision support system, this research seeks to explore the feasibility of devising an innovative model to facilitate deliberative decision-making for the regeneration of port–city interaction areas. This study adopts the InterACT approach to support planning efforts by constructing an open and implementable Geographic Information System (GIS). This approach has been tested on the Port of Naples in Italy to provide the Port System Authority (AdSP) of the Central Tyrrhenian Sea with strategic guidance as part of their efforts to draft a new Port Master Plan. The initial achievements encompass the establishment of an operational database to facilitate stakeholders within the Port, in conjunction with the implementation of a deliberative decision-making process enriched by ICT. Additionally, a tool was devised to seamlessly combine visualization and spatial data integration, thus fostering engagement and collaboration between port and urban stakeholders.

Keywords: port–city integration; waterfront; GIS; port heritage enhancement; port governance; sustainable development

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1. Introduction

The Council of Europe in 2008 defined ports as crucial infrastructure for developing the social, economic, environmental, and technological aspects of cities. This recognition requires an innovative strategic approach to integrate digital technologies with sustainability initiatives. As nodes in the logistics system supporting international trade, ports are key realities for local economic growth, capable of producing substantial effects on the well-being and quality of life of surrounding cities [1,2]. For tourist ports, this direct relationship, based on sharing a common identity with cities, has remained constant. However, the same cannot be said for large commercial ports, which have gradually become separate enclaves, often ignoring the surrounding territories. According to several studies [3–7], the reasons for the progressive separation between cities and ports are deeply rooted and can only be understood through a global perspective. It is crucial to view this issue from a trans-scalar and ever-changing perspective to fully grasp its complexity.

The maritime industry has undergone significant changes over time, particularly with the rise in container and bulk cargo activity [8]. This shift has resulted in the development of new areas that are distinct from the old ports, leading to the abandonment of previously

used spaces and buildings [9,10]. The phenomenon has led to a crisis that can be described both in social and urban planning terms. Socially, the crisis emerged because the changed relationship of the community with urban spaces and their functions contributed to the disruption of established patterns of interaction between people [11]. From an urban perspective, separation has led to a gradual thinning of transitional spaces, often interrupted by physical barriers able to produce urban disvalue [4]. In this context, the dismission of industrial heritage has created significant voids in the port areas, with abandoned or disused buildings ready to be regenerated and reused [12]. As highlighted in the literature, the reuse of abandoned or underutilized historic buildings is central to revitalizing communities and improving their quality of life [13]. The historical and architectural values of such buildings and spaces should be considered as a resource that can trigger new scenarios for sustainable development. The first step in addressing this issue may be the punctual investigation of the substrate of our port spaces, from a perspective that leads to a new reading of the spaces and thus the creation of a renewed identity that can be relied upon for their reuse. This process does not end with the recognition of buildings and spaces but involves a careful evaluation of the choices of valorization, regeneration, and "resemantization" [14] of them.

The revitalization of port areas is one of the most pressing challenges faced by coastal cities [15]. This is because they often function as suburbs within cities, and existing port governance models are sometimes inadequate. The cycle of abandonment, neglect, planning, realization, and revitalization of old port areas, as well as the required construction of port infrastructure, involves a complex network of various actors and interests. Different entities, such as shipping companies, logistics operators, research centers, transportation companies, and more [16] play a crucial role in the functional reorganization of these areas. However, conflicts often arise due to the multitude of actors and their relationships, leading to environmental, spatial, and social issues. To proceed with the physical reorganization of port spaces and to build renewed and sustainable port–city relations, it is first necessary to renew existing governance mechanisms [17].

In recent years, several studies [18,19] have demonstrated that information and communication technology (ICT) plays a vital role in enabling sustainable development by facilitating city management and dialogue within public administrations [20–22]. Among these, Geographic Information Systems (GIS) are the most widely used to date, mainly because they enable the analysis of large amounts of georeferenced data and the management of large-scale information exchange. However, such technologies are still little used in the field of urban planning of port–city interface areas, while their use is mainly related to internal management factors [23]. The gap is also reflected in the literature. Research is scarce regarding the utilization of ICT in the design and development of port–city regions. This is primarily because the connections between these areas have not been extensively investigated from a social and spatial point of view. The use of ICT can reduce urban environmental impacts, encourage accountability practices, and monitor urban development through increased participation in innovation.

Based on these premises, this study aims to investigate the possibilities of developing an innovative, interactive, and shared model to facilitate deliberative decision-making for the regeneration of port–city interface areas.

After considering the matter, the research has posed the following questions: How can stakeholders be directed towards more informed and collaborative governance models? What actions and interventions can aid in achieving sustainable development goals in port cities?

The research aims to investigate the potential of the InterACT approach as a shared and replicable method for planning port–city interface areas, advancing knowledge on the topic. The approach was tested on the Port of Naples in Southern Italy. The aim was to provide policy guidance to the AdSP of the Central Tyrrhenian Sea as part of the drafting of the new Port Master Plan. The approach involved three steps:

(1) Analysis,

(2) Construction, and
(3) Tools and Data Processing.

As a result, an open and scalable Spatial Information System was structured, which contained information on the port's historical–architectural heritage. The system also presented possible types of intervention and re-functionalization of the port in physical, functional, and energetic terms. The resulting GIS interface is designed as a tool to support deliberative decision-making [24,25] useful for establishing roles and responsibilities in port regeneration.

This paper follows a clear structure: Section 2 presents a literature review on the topics of urban planning, port governance, and ICT; Section 3 describes the methodological approach and tools used for processing, with a focus on the InterACT methodology applied to the case study of the Port of Naples; Section 4 presents the first results of this study; Section 5 discusses the opportunities and limitations of the work and presents initial conclusions.

2. Literature Review

Through the literature review, this paper demonstrates that the background of this study is defined by the intersection of three topics:

1. Urban planning of port–city interface areas;
2. Governance and management mechanisms of port areas;
3. Use of ICT tools as planning support.

The relationship between ports and cities has changed over time as industrial processes and new technologies related to maritime transportation have evolved. Scholars and organizations have studied port–city relations and developed theories that have influenced literature on the subject for years. In 1982, Hayuth introduced the concept of the port–city interface [7]. The researcher approaches the concept from a spatial and functional point of view, considering the interface primarily as a geographic demarcation line between port-owned land and urban areas or, from a time-oriented perspective, as a transition area between the port and urban land uses.

Hayuth had previously noted that the issue of interfaces is not only caused by the constant demand for waterfront space by city stakeholders but also by the timing and way port projects are approved by the authorities.

In 1988, Brian Hoyle's study "Port–City Evolution Model" identified six stages of the port–city relationship. Initially, there was a symbiotic relationship between ports and cities, followed by an expansion of port spaces where commercial and industrial development led to their development outside of urban centers. However, mutual relations were still maintained. Hoyle's study summarizes centuries of history of the relationship between cities and ports, leading up to the contemporary period (addressed in the sixth phase of the Port–City Evolution Model) where he emphasizes the importance of integrating ports and cities through waterfront redevelopment interventions.

Ducruet, on the other hand, explicates the relationship between port cities and their respective cities by highlighting the tension between economic benefits and spatial restrictions [26]. He uses a matrix of port–city relations, which builds on the concepts of centrality and intermediacy presented by Hayuth and Fleming [27]. This matrix proves helpful in classifying port cities based on factors such as their location, population size, importance, and volume of port traffic [28,29].

Over the last two decades, a second group of scholars have challenged the effectiveness of models relying solely on a spatial approach, as described earlier. They argue that such models have become outdated and no longer suitable for studying port–city interface areas [30,31]. Instead, these areas are being examined using an approach related to management mechanisms. First, interfaces are defined as areas of conflict between different actors and forces. It is believed that in these areas, which are characterized by the overlap of multiple levels, the physical territory represents only one aspect [32,33].

Notteboom and Winkelmans [34] provide an intriguing definition of ports as "nodes of contacts and contracts", within which complex networks of relationships among stakeholders, as well as strategic alliances within and beyond competing ports, originate.

In his 2007 paper titled "Sustainable Development of the European Port–City Interface" [4], Tom Daamen suggests overcoming decision-making barriers by prioritizing relationships and coalitions among actors, rather than perpetuating the existing separations and divisions. He cites the examples of Rotterdam and Hamburg to demonstrate the best practices in this regard.

Later, Hein points out that the link between ports and cities began to break down with the rise of "monofunctional" maritime-related neighborhoods separated from residential and recreational areas. As a result, the city and port began implementing separate planning strategies. According to the researcher, the growing separation between ports and cities, evident in both urban planning considerations and industry-related procedures, is believed to have led to the fragmentation of the decision-making process, resulting in a powdering of the stakeholder chain [35].

The issue of conflict between actors is apparent in Mediterranean ports, especially in Italian ports. Here, the adoption of L.n. 84/1994 led to a shift from a governance model based on direct management by port authorities to a landlord model inspired by free market principles [36,37]. Under this new framework, port system authorities have been created as public entities responsible for policymaking, coordination, and control functions, while private operators are responsible for providing port operations and services.

As highlighted by several studies [38–41] economic aspects tend to be prioritized in this decision-making process [42–44]. However, actors with greater decision-making power do not perceive the issue of urban regeneration in the port–city interface as urgent. To address this imbalance, collaboration between different stakeholders is essential. Port authorities should establish partnerships and collaborative processes with cities to enhance cooperation on shared economic, environmental, and social initiatives, as well as foster links with nearby municipalities. Furthermore, the current dichotomy between cities and ports can be overcome by developing broad and collaborative governance models [45], in which the forces involved work together to rebuild relationships and urban fabrics that have deteriorated over time. Within this new model, port authorities and local authorities are called upon to work and communicate with private stakeholders, implementing integrated planning by recovering the heterogeneous spaces of port–city interaction areas, transforming them from interstitial spaces into places where common development strategies can be implemented [46–48].

In this regard, in a recent study, Carta states that the main policy recommendation for initiating an integrated regeneration process is to understand the relationships that exist between the city and the port, using spatial analysis tools and evaluating national, regional, and local plans and policies to define realistic objectives [15]. The traditional tools used by public administrations are no longer effective, so new mapping processes must be developed to address the socio-spatial reintegration of cities and ports. In addition, consideration must be given to what Van Hooydonk describes as "soft values", which are historical, sociological, artistic, cultural, and governance functions that provide added value.

When discussing the socio-spatial reintegration between ports and cities, it is necessary to consider that ports, although recognized as engines of economic development of territories, develop impacts that influence the conditions of well-being and quality of life in the cities located behind them. Environmental pollution, traffic congestion, and increased criminal activity negatively impact port areas, reducing urban competitiveness and hindering investment attraction [49]. Port operations should prioritize environmental and social sustainability [50]. This objective may be accomplished by recognizing novel services and functions that can enhance port performance and city development in an integrated manner. The United Nations 2030 Agenda serves as a unique guide in this direction, promoting through seventeen goals the sustainable development of our cities. One of these

goals, Goal 9 "Industry, innovation and infrastructure", aims to enhance resource efficiency and promote innovation by building resilient infrastructure. Goal 11, "Sustainable Cities and Communities," includes among its targets the realization of urban transformations capable of preserving the built and natural heritage and minimizing the impact of urban agglomerations on the environment through a participatory approach. Moreover, the SDGs outlined in Agenda 2030 have been adapted by the Association Nationale Villes et Ports (AIVP) to better fit the specific context of port cities, resulting in a comprehensive agenda of ten goals and forty-six actions aimed at promoting sustainable development and improving port–city relations. Among the goals, "Port city interface" aims to provide residents living near port activities with accommodation, and recreational and cultural facilities in the port–city interface. The aim will be pursued by reviewing the status and heritage of the ports to reflect the historical significance of the sites, and by developing public spaces and recreational or cultural services capable of attracting investment and citizens. The "Renewed Governance" goal aims to facilitate dialogue between ports and citizens by implementing a renewed governance approach. This approach is designed to balance the pursuit of economic and environmental performance with the well-being and aspirations of the population. This can be achieved through the adoption of open and transparent information systems and the development of collaborative approaches to support decision-making. As highlighted by Del Giudice et al. in a recent study [51], digitalization is one of the most influential factors in economic, lasting, and sustainable growth.

In this regard, the International Telecommunication Union's Focus Group on Sustainable Smart Cities argues that "a smart, sustainable city is an innovative city that uses ICT and other means to improve the quality of life of its citizens while meeting the needs of present and future generations, taking into account economic, social and environmental aspects". In their ability to facilitate the creation and sharing of information and networks, ICTs as digital platforms act as binds [23] between socio-economic agents, public administration, and citizens. The innovative capacity of the port and maritime industry can determine the efficiency of its production processes, increase performance, improve process efficiency, and improve the quality of products and services in terms of sustainability [52]. The current best practices in Europe for the use of ICT in port management can be found mainly in the logistics and management area, especially in the Northern Range ports (Rotterdam, Antwerp, Bremen, Hamburg). Port Community Systems provide examples of these practices. The Portbase Port Community System in Rotterdam serves as an exemplary tool for promoting dialogue among key players within the Dutch maritime cluster and other countries [53,54]. Among the tools developed for Mediterranean ports, the PORTIC of Barcelona can be included. Despite being a procedural innovation, it remains underexplored in the relevant scientific literature, and it serves as a tool designed specifically for port-related purposes. Identifying and developing an approach to create new, appropriate digital technologies and infrastructure is the first step in promoting the evolution towards next-generation ports [55]. The widespread application of ICT assets would lead to the promotion of open port spaces, the democratization of information and knowledge [56] as well as consensual, transparent, fair, and inclusive governance. While studies and examples of utilizing ICT in managing supply chains and port traffic exist in Europe, Asia, and America, there are few studies regarding the application of ICT in planning port–city interaction areas. However, employing these technologies could lead to significant benefits in reducing conflicts between port actors and citizens, as well as activating deliberative decision-making processes.

3. Materials and Methods

The research, based on the reflections in the previous paragraphs, considers the use of ICT in planning as a potential for the sustainable development of port–city interaction areas.

The InterACT approach is structured into three distinct phases, each serving a specific purpose: Analysis, Construction, and Tools and Data Processing. Its goal is to offer a methodological framework that is both scalable and reusable. This framework is de-

signed for defining Territorial Information Systems that are tailored to the interaction areas and for repurposing disused or underused public facilities within them. This proposed methodology enables a concise examination and exploration of intricate port interface areas. Furthermore, it establishes a shared terminology among stakeholders, making it easier for all Port System Authorities to adopt and implement.

3.1. The Case Study: The Port of Naples

The methodological framework was applied to the Port of Naples, a multifunctional port of national economic significance located in Southern Italy. It spans 1,426,000 square meters from the "La Pietra" in Bagnoli to the west, extending to the "Pietrarsa" area in San Giovanni a Teduccio to the east. The Port of Naples ranks among the top five ports of national importance with diverse functions and represents the foremost industrial entity in the Campania Region, both in terms of turnover and direct employment. According to data provided by the AdSP of the Central Tyrrhenian Sea, in 2022, the Port of Naples experienced notable growth, which remained steady after a pandemic-induced decline, particularly in terms of goods and passenger traffic. Container traffic reached 687,005 TEUs, RO-RO traffic amounted to 4,643,188 tons, and the cruise sector recorded 1,144,246 passengers, marking a substantial 354.4% increase compared to the previous year.

The Port of Naples (Figure 1), although relatively young, carries the weight of a complex history marked by various significant events.

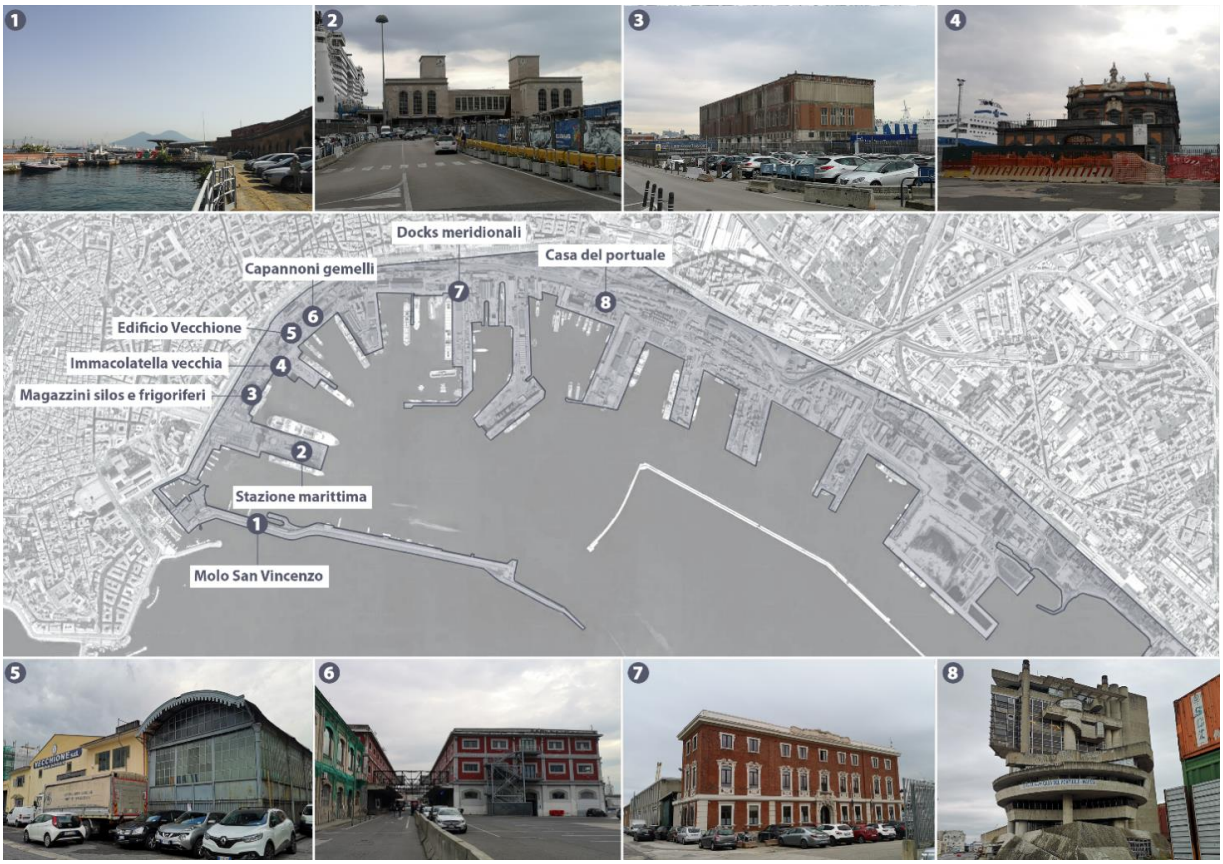

Figure 1. The Port of Naples heritage.

It was a "fundamental component of the city and regional industrialization program during the early 20th century, a poignant departure point for southern emigration, a critical part of the empire, a symbol of wartime devastation, a beacon of hope for economic recovery and urban rejuvenation, and yet, a representation of the challenges the local economy faces in a broader competitive context" [57].

Today, the Port of Naples retains many of the structures that have played a pivotal role in its history, such as the Immacolatella building, the military dock, the Bourbon dry dock, and the Molo San Vincenzo (Figure 2). The properties situated in the area between the city and the Port of Naples hold historical, urban, and economic significance. The historical and iconic value of the port's buildings and spaces is deeply ingrained in the local population's identity [58,59]. While this complexity can make the process of regeneration challenging, it also presents significant potential for the revitalization of the entire city.

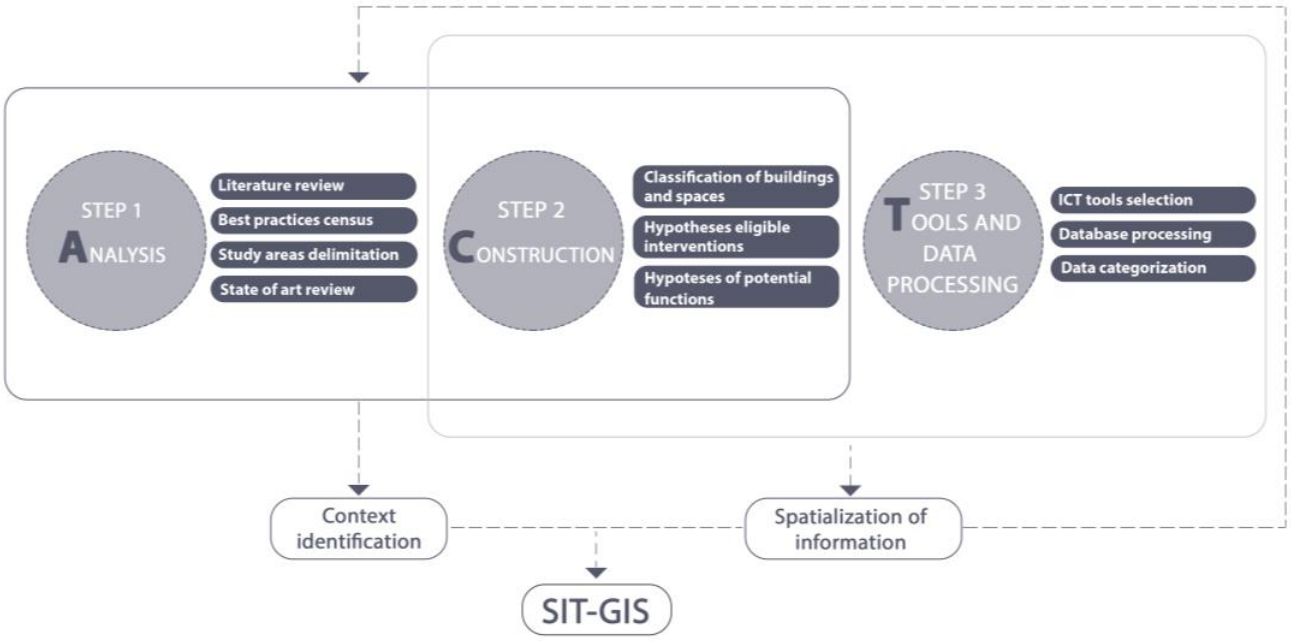

Figure 2. The methodological framework InterACT.

The configuration of the Port area as it stands today began to take shape in the 1880s. Since that time, the Port has expanded eastward, initially with the construction of the fill between the Molo del Carmine and the Immacolatella, to conclude the definitive closure of its functional boundaries through the construction of the Molo Progresso and the new dock of Levante.

In terms of infrastructure, the Port System Authority of the Central Tyrrhenian Sea recently approved the Strategic System Planning Document (DPSS), as mandated by Article 5 of Law 84/94 and subsequent amendments. The DPSS serves as a crucial instrument for defining and guiding the management strategies of the Port of Naples and all port and logistics activities in the Campania region. It outlines the medium and long-term development objectives of the port system in alignment with European directives on ports, the National Transport and Logistics Plan (PNTL), and the National Strategic Plan for Ports and Logistics (PSNPL).

From a planning perspective, the Port of Naples is anticipating the new Port System Master Plan. In this context, the Port System Authority (AdSP) has developed a Three-Year Operational Plan (POT) for 2020–2022 and individual Master Plans to realize the established goals. The POT reflects the AdSP's commitment to establishing a port planning system that works collaboratively with the municipalities and regions hosting them. Through a process of dialogue and engagement with various stakeholders, the AdSP aims to achieve port development that harmonizes with the economic growth of the surrounding areas. This includes activating strategies and initiatives that prioritize environmental protection and societal well-being. Sustainable development in this context involves the revitalization of historically significant buildings and spaces, such as Molo San Vincenzo and the old Immacolatella building.

Within the framework of these planning initiatives and sustainable development, the comprehensive inventory of historically significant buildings and their surrounding environments can be viewed as the initial step in creating a decision support system for public institutions. This system facilitates urban environment management and promotes sustainable development in interface areas. The inventory, one of the research outcomes, seeks to establish a knowledge base that proves invaluable for developing projects to enhance the historical and architectural heritage of the Port System Authority of the Central Tyrrhenian Sea, particularly in the regions where the port and city intersect.

3.2. The InterACT Methodology

The InterACT framework is designed to introduce an innovative methodology for facilitating the planning of port–city interface areas. InterACT is structured into three key phases (Figure 2):

1. Analysis,
2. Construction, and
3. Tools and Data Processing.

The first phase, Analysis, is designed to structure the decision problem and serves as the foundational step in the InterACT framework. This step involves several components, including an extensive review of thematic scientific literature and the prevailing port regulatory framework in Italy. It also encompasses a comprehensive survey of best practices at both national and international levels. Furthermore, a desk analysis of the most pertinent documents is conducted to establish the contextual reference and identify the diverse domains intersecting to define information requirements. It also verifies the availability of data from reputable sources and reprocesses the acquired information in line with the research objectives. Initially, drawing from studies conducted on European port situations [60] five essential dimensions for regenerating interface areas were identified. These dimensions are then adapted to the specific operating context:

- Port and maritime culture involves the development of attractions or landmarks, and the presence of museums, art galleries, cinemas, and theaters.
- Port, innovation, and creativity: focuses on the growth of innovative activities or services related to art, culture, entertainment, design, architecture, industry 4.0, start-ups, research, and the maritime economy.
- Port, education, and human capital: relates to the establishment of degree programs, master's courses, and workshops tied to business and the maritime economy, as well as training. It also encompasses the implementation of measures, agreements, and partnerships for collaborative port–city planning.
- Port, knowledge, and dissemination: pertains to the port's capacity to promote its activities through the creation of Port City Centers, regular updates through newsletters, organization of port activity tours, and more.
- Port in transition: addresses the structures and spaces that, due to their type and construction techniques, can contribute to the energy transition through retrofitting and/or clean energy production.

In a subsequent phase, an extensive examination was conducted of the Port of Naples, focusing on its historical and architectural heritage [57,61,62]. This analysis was predicated on graphic and documentary materials provided by the Planning and Programming Office, the State Property Office of the AdSP, and the DPSS. The primary aim of this analysis was to delineate criteria for the evaluation of the Campania port, with particular emphasis on the intersection of the aforementioned dimensions, all while taking into consideration the functional partitioning of the port area. This step culminated in the identification of three distinct types of port–city interaction areas within the Port, as delineated in the 2021 DPSS developed by the AdSP:

- Urban View: this phenomenon occurs where port functions align harmoniously with urban activities, thereby rendering the port accessible to the city.

- Urban Penetration: this scenario unfolds when exclusively urban functions or activities assert themselves within the port's domain, leading to the reconfiguration of the port's boundaries.
- Edge qualification: this situation arises when port functions are incongruous with urban pursuits. For reasons of internal operation and security, the port is inaccessible to the city. In such cases, the margin should be cultivated as an inherent background element, contributing to the character of the city and, when feasible, furnishing pedestrian pathways for utilization.

Building upon the outcomes of the analysis phase, the subsequent Construction phase involved a detailed examination of specific buildings and spaces within the Port of Naples. A selection of forty buildings and spaces was made, grounded in their historical and architectural significance, as well as their geographical placement. These selections initially considered buildings restricted under Legislative Decree no. 42 of 22 January 2004. For each building and space, a comprehensive evaluation of their present condition and utilization status (in use, partially in use, disused, abandoned) was undertaken, incorporating direct on-site assessments and an exhaustive review of documentation provided by the AdSP. This analysis facilitated the categorization of buildings and spaces based on their geographic location and primary attributes, resulting in the identification of various distinct categories:

- Buildings of Historical/Architectural Significance: distinguished architectural structures of remarkable value;
- Industrial Archaeology: abandoned industrial buildings with prominent roles in the history of the city and its citizens' collective memory;
- Port–City Hinge Buildings: located in areas of porosity, serving as intermediaries between the port and the urban environment;
- Urban Landmarks: acknowledged as prominent visual or landscape reference points;
- Port–City Hinge Spaces: Analogous to the preceding category, these spaces are found in practical intersection areas;
- Spaces Linked to the Sea: areas in direct proximity to the sea.

Following this categorization, hypotheses for potential interventions were formulated based on the conservation state of the buildings and associated parametric costs, with a rough estimate of the overall cost for each building or space. In a subsequent phase, potential functions were outlined, considering the dimensions mentioned above, for all surveyed buildings and spaces, excluding those housing functions directly related to port management, such as the AdSP headquarters and Maritime Health facilities.

The final phase, Tools and Data Processing, is designed to create a geodatabase and develop a Geographic Information System (GIS) interface. This GIS interface served as a comprehensive platform for the management, acquisition, archiving, extraction, processing, and visualization of various data types. It encompassed not only spatial data but also historical, technical, architectural, and functional data [63] collected regarding the heritage of the Port of Naples.

The process of census and cataloging produced an operational information database crafted in Excel and Google Looker Studio formats. Within this database, the key characteristics and potential functions of each building and space have been documented. An illustrative map with the location of the building, an identification code (ID), and a photograph was also included.

In harmony with prior research and studies [64–66], the database was structured according to the principle of scalability. This means that the existing data structure can be expanded both vertically by adding more detail and horizontally by introducing new data categories. Notably, data concerning the census of historically and architecturally significant buildings, industrial archaeological sites, and emblematic urban spaces within the Port of Naples were integrated into the Excel database.

Looker Studio software, a tool accessible online, was used to transform census data into intuitive information dashboards and reports. These reports are easily readable, shareable, and entirely customizable through the inclusion of specific filters for analysis.

Subsequently, the selected data were processed using the open-source Q-GIS 3.20.0 software. The resulting shapefiles were georeferenced to a common coordinate system (WGS-84) to facilitate overlay.

Starting from the initial identification of the reference context and the spatial representation of data, a Territorial Information System was established. This virtual space enables the association of various data types with specific points within a known spatial reference system [67]. The entire infrastructure was devised and implemented using open-source software components, to render research data accessible to scientific and professional communities for both further development and technical applications.

Following this last operation, hypotheses were formulated on the potential functions of the selected buildings and spaces. These hypotheses were based on their locations, predominant characteristics, and the dimensions for regenerating the interface areas, as previously explained. The entire project culminated in the estimation of parametric costs required to initiate the redevelopment activities for the buildings and spaces within the three ports.

4. Results

The obtained results serve to elucidate the challenges and potentials of planning, facilitating the engagement of key stakeholders in achieving consensus, validating various alternatives, and establishing hypothetical and desirable partnerships among the involved parties. The framework consists of three incremental steps that aim to create a deliberative decision-making process for interface areas, using ICT and spatial data.

The initial stage of InterACT, corresponding to the Analysis of the current state of the art, facilitated the identification of the context of the Port of Naples and the structuring of the decision-making issue. The examination of literature, existing urban planning tools, and nationally and internationally recognized best practices highlighted a significant issue within Italian ports, particularly in Naples: the existing imbalance between public and private interests. This imbalance has a significant impact on the economic aspect of the port, which is the most dominant when viewed from the perspective of sustainable development, and it results in a lack of action in other domains: the environment, society, but above all, governance, which constitutes the fourth pillar of port sustainability.

Within this context, the study of literature clarified the need to reevaluate the relationships between the port and the city through the introduction of new functions capable of enhancing both port performance and urban development in an integrated manner. The exploration of best practices and sustainability agendas (e.g., Agenda 2030 and Agenda AIVP) corroborated that housing, recreational facilities, and cultural amenities in interface areas can fulfill this role. The recognition of the five dimensions for regenerating port areas and their application to the Port of Naples area facilitated the identification of five drivers for its sustainable development: culture, creativity, human capital, training, and energy.

Subsequently, the identification of the types of port–city interaction (urban view, urban penetration, edge qualification) allowed us to understand which areas can effectively undergo co-planning processes and which, on the other hand, should be autonomously managed by the port and the city.

Starting from this premise, the Construction step aimed, through the classification of port spaces and buildings, at formulating hypotheses for acceptable interventions and potential functions for each of them. It also aimed to raise stakeholders' awareness regarding the issue of built heritage. From a practical perspective, a survey of the Neapolitan port heritage was conducted, which serves both port stakeholders and city residents as a valuable knowledge base for developing projects to enhance the historical and architectural heritage of the port–city interaction areas.

The third step, Tools and Data Processing, facilitated the transition from a non-spatial census to a spatial one and was aimed at further assessing the previously proposed hypotheses regarding transformation toward sustainability. The analyses conducted previously, processed through software such as Google Looker Studio and Q-GIS, enabled the in-

tegration of data with its spatial component. Spatializing information concerning the maintenance status of buildings, their usage status, and concessionary regimes aids in managing the real estate heritage and areas under the port's jurisdiction. Furthermore, systematizing the information, allows for a more detailed assessment of the previously proposed hypotheses regarding their transformation towards sustainability, considering their specificities within the context of the port–city interface areas.

The identification of the context and spatialization of information led to the development of a Geographic Information System (GIS) containing spatial information for the regeneration of buildings and spaces in the Port of Naples. The GIS for the Port of Naples was created based on a database structured in a hierarchical organization with two levels of detail [64,65], embedded within a descriptive and general macro-level that provides non-spatial information about the ports under study.

The first level of the database involves the cataloging of data and basic characteristics of surveyed spaces and buildings, including information such as name, location, intended use, usage status, legal regime, regulatory allowable intervention type, and preservation status (Table 1).

Table 1. The first level of the database: "building and spaces".

Level 1	Type		Description
Buildings and Spaces	ID		Unique identification number
	Name		Name and short description of the object
	Intended use		Prevalent use (from the Port Regulatory Plan)
	State of use	■ In use ■ Disused ■ Partially in use ■ Decommissioned	
	Legal regime	■ In granting ■ Not in granting	
	Other properties		Legal regime other than the granting
	Listed building (Law 42/2004)	■ Listed ■ Not listed	
	Customs area	■ Yes ■ No	
	Period	■ <1850 ■ 1850–1900 ■ 1901–1950 ■ 1951–2000 ■ >2000	
	Dimensions	■ Surface (s) ■ Max height (h) ■ Volume (v) ■ Number of floors	

Table 1. *Cont.*

Level 1	Type	Description
Buildings and Spaces	Admissible interventions	■ Restoration and preservation ■ Restoration and functional recovery ■ Modernization and completion ■ Interventions up to the category of new construction ■ Building renovation
	State of conservation	■ Good ■ Average ■ Bad

The second level (Table 2), on the other hand, contains information about the port–city interface areas categorized into three distinct types: urban oversight, urban penetration, and edge qualification. By combining spatial and non-spatial data from the first two levels, it was possible to define hypotheses regarding potential functions.

Table 2. The second level of the database "type of buildings and space" and "type of port–city interaction areas".

Level 2	Type
Type of building and space	Landmarks
	Port–city hinge buildings
	Port–city hinge spaces
	Sea-hinge spaces
	Buildings of historical/architectural interest
	Industrial archaeology
Type of port–city interaction areas	Urban overlook
	Urban penetration
	Edge qualification

In the specific context of the Port of Naples, the five dimensions for the regeneration of interface areas, defined based on studies conducted on European port realities, have been articulated as follows:

1. Port and Maritime Culture: Within this dimension, the conceivable function for disused or abandoned buildings is an "Art, History, and Archaeology Center". Buildings that are particularly suited for this function are those falling into the category of urban landmarks and within the port–city hinge areas, such as the "Magazzini generali silos e frigoriferi" of the Port of Naples. As already has occurred in cities like Liverpool and Marseille [66], repurposing disused or poorly preserved buildings for cultural uses would initiate processes of regeneration and cultural revitalization in these areas, making urban penetration within port precincts natural and essential;
2. Port, Innovation, and Creativity: The potential functions in this dimension include "Cultural and Creative Enterprises", "Industry 4.0", and an "Incubator for Start-ups". Buildings that are most suitable for hosting such functions have been identified in industrial heritage sites and port warehouses known for their spacious and versatile nature, such as Capannoni Gemelli and the Docks Meridionali building. Due to the less public nature of these functions, they can be located in areas immediately adjacent to the port–city hinge zones, creating a buffer zone between the operational port and the city;

3. Port, Education, and Human Capital: The chosen function within this dimension is "Universities and Research Centers in Maritime and Shipping Studies". The most appropriate buildings for this purpose are those that are highly representative of the port and, despite possessing remarkable architectural qualities and being near the city, have fallen into disuse. This category includes the Immacolatella Vecchia Building and the row of buildings at the base of Molo San Vincenzo;
4. Port in Transition: The potential role of these buildings and spaces is the "Adaptation for Energy Efficiency, Clean Energy Generation, and/or Urban Heat Island Mitigation." In alignment with the Sustainable Development Goals outlined in the 2030 Agenda and the imperative of transitioning to cleaner energy sources, all structures within the Port of Naples are suitable for fulfilling this chosen function.

Within the Geographic Information System (GIS) Information Database, the spatial data about the identified buildings and areas have been categorized into thematic groups, each of which has been assigned a specific color scale or screen type. This approach enabled the association of geographical information with its graphical representation, linking it to the data gathered during the cataloging phase stored in attribute tables, which are accessible through the querying of mapped elements (Figure 3).

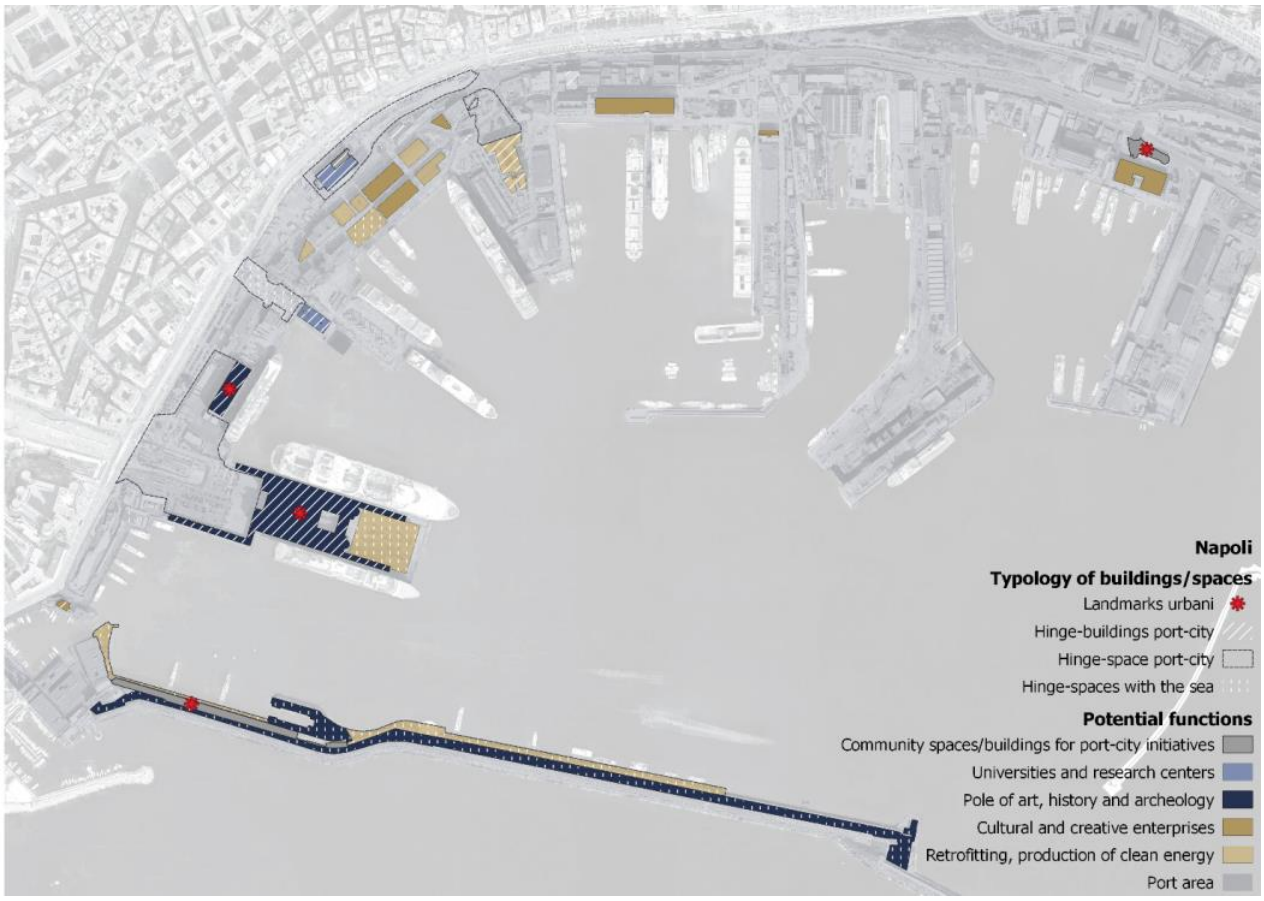

Figure 3. The Geographic Information System of the Port.

Moreover, by mapping the buildings and spaces within a GIS environment, it became feasible to generate thematic layers that, when overlaid and combined, allow for the identification of coherent subsystems. This system serves as the foundation for managing a wealth of information, including constraints, infrastructures, as well as the hypothesized functions for each building, and the associated construction costs for implementing renovations. Utilizing GIS visualization provides an immediate grasp of the spatial distribution of phenomena across the aforementioned port areas.

Analysis of the maps reveals that a significant portion of the surveyed buildings and spaces falls within the "edge qualification" category. It is evident from the explanation provided by the Central Tyrrhenian Sea Port System Authority (AdSP) regarding these areas that, despite efforts to open the port to the city, there are still many points where functional incompatibility between the entities dominates, hindering the creation of usable spaces through mutual interpenetration. The only locations that seem to attract some of the city's activities are parking spaces and seaside squares, although, as is the case with the San Vincenzo Pier and the inner square of the Maritime Station, they are only accessible on particular occasions. The Maritime Station stands out as the only place that truly serves as a point of interaction between the port and the city, acting as a gateway from the sea to the city. Many of the buildings in the Port of Naples hold historical and architectural significance but simultaneously suffer from moderate to poor states of preservation. Most urban landmarks are in a state of disrepair, symbolizing the overall condition of the port spaces. Only representative buildings, law enforcement offices, and the newly renovated Immacolatella building are in good condition, but, notably, they remain unused or underutilized.

Building on the earlier discussion, it is crucial to highlight that the GIS analysis extended far beyond a mere geometric representation of artifacts and objects. Instead, it facilitated the establishment of direct spatial relationships among various elements and spaces within the Port of Naples. Furthermore, the process of overlaying data allowed for a comprehensive analysis of information gathered from multiple sources [68], including the Port System Authority and other relevant entities. This approach, in turn, enabled the superimposition and in-depth examination of specific details related to areas of interest, thereby contributing to a deeper understanding of how well the projects proposed by the AdSP and research centers can align and intersect with each other.

5. Discussion and Conclusions

Throughout the history of civilization, the symbiotic relationship between cities and their ports has consistently represented a fundamental element in the spatial organization and socio-economic fabric of society. This mutual reliance between urban areas and their adjacent ports symbolizes a profound interdependence, fusing cultural diversity unique to these city types. While ports have historically thrived as economic hubs, cities have evolved as cultural centers. To ensure the sustainable development of port cities and foster the harmonious reconnection of these two poles, it is imperative to adopt innovative, integrated solutions aligning with the principles of urban development in the European Union, taking into account economic, social, and environmental aspects, as outlined in the Sustainable Development Goals (SDGs).

As emphasized by the European Committee of the Regions (assembly of local and regional representatives that provides sub-national authorities as regions, counties, provinces, municipalities and cities with a direct voice within the EU's institutional framework), sustainable development in port cities necessitates the identification and strengthening of synergistic relationships between these two entities. The document underscores the essential requirement for balanced development in port cities, calling for innovative, integrated solutions in line with the integrated development principles in the European Union, with due consideration of the economic, social, and environmental dimensions of these regions.

With these principles as a foundation, the proposal aimed to achieve the primary objective of the research: to establish an innovative, interactive, and collaborative model that encourages the deliberative decision-making process for regenerating port–city interface areas. This objective aligns with the research questions introduced in the first paragraph: how can stakeholders be guided toward more informed and cooperative governance models? Which functions and interventions can facilitate the achievement of sustainable development objectives in port cities?

In addressing these research questions, the document formulated the InterACT evaluation and planning approach to facilitate dialogues among stakeholders and define

alternatives for the revitalization of abandoned and/or disused structures and spaces in the Port of Naples.

In this context, the Analysis and Construction phases signify the initial phase of knowledge development, which necessitates further exploration in future studies. The challenge lies in fostering dialogue among stakeholders within a network that includes public, private, social, and civic actors regarding the possibilities for reusing port spaces and structures. Engaging citizens and associations in co-planning discussions could give rise to new shared scenarios. This collaborative approach, informed by expert knowledge and local insights, could catalyze an innovative dialogue on territorial visions from a win-win perspective that benefit all stakeholders.

The third phase, Tools and Data Processing, aimed to address the identified gap concerning the limited application of information and communication technology (ICT) in sustainable planning for port–city interface areas, an area that remains relatively unexplored. The Territorial Information System has helped to identify various perspectives for port heritage linked to the five dimensions developed for the regeneration of interface areas: maritime culture, innovation and creativity, education and human capital, knowledge and dissemination, and the evolving port. By establishing art hubs, creative businesses, university campuses, and community spaces, and retrofitting suitable buildings to accommodate these functions, the Port of Naples could attract people and new investments.

The spatialized database, a valuable tool for importing, archiving, reviewing, processing, and visualizing spatial data, serves as an effective decision support system for public and private entities. These databases allow users to interact with spatial references in real time, offering precise position data and thereby enhancing decision-making frameworks. This tool aids local stakeholders in understanding the various resources at their disposal, fostering cooperation in heritage management and the design of services that promote the reconnection of the port and the city. Moreover, the outcomes encourage public debate on co-planning scenarios by visualizing decisions, ultimately enhancing comprehension and transparency in the decision-making process at different scales.

The resulting tool empowers local stakeholders to comprehend the various resources at their disposal, encouraging their collaboration in the management of cultural heritage and the design of new services, ensuring the effective reconnection of the port and the city. Moreover, the tool's utility extends to enabling public discourse on co-planning scenarios through the visualization of decisions, to enhance understanding and transparency in the decision-making process across different scales and levels.

A significant advantage of this tool is its capacity to improve data comprehension and accessibility, bridging the skill gap among technicians in ICT usage and resolving issues related to data heterogeneity and accessibility for Public Administrations (PAs). Furthermore, the tool offers the added benefit of allowing multiple technicians to simultaneously access the data on the network, even when located in different places. Additionally, the work consolidates comprehensive data on regulatory, technical, and functional aspects of various types of buildings and spaces within a single system.

Following the described process, through the InterACT methodology and the subsequent creation of a Territorial Information System, the goal of establishing a connection between digital and planning tools has been realized. The result is a practical tool at the disposal of Public Administration and citizens for the sustainable rejuvenation of port–city interface areas and for evaluating the conditions and preferable alternatives for port structures and spaces.

The approach is innovative as it successfully integrates database analysis and structuring with data visualization and spatialization, creating a user-friendly interface capable of supporting decision-making processes related to land use and environmental planning, among other aspects. If pursued further, this process has the potential to yield significant progress on multiple fronts. Firstly, it opens up new co-planning scenarios between the port and the city. The initiation of the deliberative decision-making process aids in defining the roles and responsibilities of stakeholders collaboratively, to reduce institutional barriers in

port city contexts. To facilitate this process, the GIS tool presented could be transformed into a participatory GIS supported by multi-criteria analyses. This would enable participants in the process to map data and share insights on the utilization of port heritage, sustainable development issues, and other key variables.

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