International Ports in Medium-Sized Cities in Greece – Coexistence Problems and Planning Challenges in the Era of Smartness and Sustainability

Yiota Theodora and Afroditi Pitouli(✉)

Department of Urban and Regional Planning, Spatial Planning and GIS Laboratory, National Technical University of Athens/School of Architectural Engineering, Athens, Greece
ptheodora@arch.ntua.gr, afrod.pit@gmail.com

Abstract. In the current era of blue growth and smart green development, port cities are undoubtedly in international competition as key drivers of the global maritime transport and trade system. In this evolving context, port and spatial policies are challenged to reconcile global trends with the specificities of each port city in order to ensure sustainable urban development. For small and medium-sized cities in particular, the operation of a port of international importance is a complex, contradictory and challenging planning issue. On the one hand, medium-sized cities face multiple pressures from port operations due to their limited size; on the other, they cannot always support the global role of their ports, mainly due to lack of infrastructure. Under these circumstances, it is crucial to reconsider the difficulties/risks facing this specific category of cities to address critical resilience issues. Taking as case study cities with international ports in the Greek periphery, the article presents a methodology for the correlated study of their dynamics, based on spatial and development criteria examined at three basic spatio-functional units, i.e. the city, the port and the waterfront. At the same time, through a consideration of the development policies and planning practices of ports and their cities, the article seeks to highlight challenges and dilemmas at the level of spatial perspectives, reintroducing issues of urban resilience and sustainability.

Keywords: City-Port Relations · Green and Resilient Port Cities · Regional and Urban Development · Sustainable Planning · Risk Assessment and Management · Waterfront Regeneration · Competitiveness · Spatial Cohesion

1 Research Framework

The dangers of climate change for cities are widely recognised. As a result, the growing political interest in combining *economic growth* with *green development* is at the top of the global urban agenda. Specifically, the EU aims to achieve climate neutrality by 2050 as part of its Growth Strategy for a sustainable future [1, 2]. In this context of adapting to climate change and smart development, the issues of maritime spatial planning and

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integrated coastal zone management remain open. In this sense, and with the EU's Green Deal calling for a green transition, port cities are facing a new set of developmental and planning challenges and opportunities [3]. This is because ports are key drivers of local-regional-national and international development through their role in multi-modal transport and logistics, energy, industry, leisure and tourism. In this respect, the growing emphasis on resilient/sustainable port development models creates new conditions for port cities to address key strategic planning issues.

At the same time, current transport system conditions and the emergence of new intermodal hubs, together with port industry restructuring, are dramatically affecting port-city interactions, challenging the traditional mutually beneficial relationship between these two systems. Historically, ports and cities have been characterised by a high degree of interdependence and proximity. However, the emergence of a new economy based on trade and new transport technologies in the 19th century created the need to develop a new type of port, one that would no longer function as an international trading centre but as a transshipment point in the global transport chain [4]. As a result, many ports and their host cities have grown apart, especially since the end of the 19th century. Over time, port operations have moved away from city centres due to other changes in shipping, such as larger ships and/or rapid urban industrialisation in most developed countries. Consequently, some ports have moved to new purpose-built sites outside urban areas. However, most ports remain in or near cities. This confirms that the world's major ports are still urban, as argued by Hall and Jacobs [5]. Despite the debate about the separation of cities from their ports and the resulting weakening of direct links, port cities tend to retain specific economic, social and cultural identities [6]. Ducruet and Lee define port cities as the result of the integration of port and city, sharing both common and specific characteristics [7]. Based on the above, port cities are undoubtedly a category of place that requires simultaneous and dynamic monitoring of the port and the city, and the relationship between these two systems [8, 9].

In this sense, the article argues that in a port city, urban and port functions are interdependent and interact at different spatial levels and in different ways in time. This requires both a broader view of port cities as an organic part of the wider national and international transport and urban systems, and a consideration of how the main spatial levels of a port city (i.e. port, city and waterfront) interact in the urban environment. In the context of the above basic assumptions, the article aims to formulate a multifactorial methodology for optimal understanding of port-city relations and their impact on port city sustainability in a highly competitive international environment. Taking five Greek regional cities with an international port as a research area for the proposed methodology, the focus at this stage is on the simultaneous monitoring of these cities using criteria/indicators of regional scope. The aim is to critically identify coexistence problems and key planning issues to be further addressed at city level in the next phase, using quantitative/qualitative indicators. In this context, the article is intended to serve as a basis for recognition at the regional level. It also provides an opportunity to consider how the next stages of research should be organised. This reflection is already underway in the five participating port cities (Alexandroupolis, Kavala, Igoumenitsa, Volos, and Patras - from north to south) (Session 3).

In approaching the object of research, the article is divided into seven sessions. The first introduces the problem to be addressed. The second is an attempt to set the stage for developing the framework of the proposed methodology for assessing the dynamics of port cities. In particular, a brief review of key milestones in the current literature emphasises the need to simultaneously monitor how both systems operate /interact. The third is a description of the proposed methodology. The fourth presents the case of medium-sized mainland Greek cities with international ports. The fifth examines the importance of the five port cities studied as hubs in the European and Greek transport network, while the sixth assesses their dynamics as part of the Hellenic urban network focusing on three spatial levels, i.e. the port, the city, and the waterfront. Finally, the seventh presents the results of the comparative study of the Greek port cities studied and identifies critical issues for further research.

2 Assessing Port City Relationships – The Need for a Dynamic Multifactorial Approach

In an era of network organisation, technological revolution and the threat of climate and energy crises, the functions and scope of ports are constantly changing. This fact is shaping a new reality, which implies the need to rethink development policies and urban and regional planning practices in an era of smart, green and blue sustainability, due to the complex port-city relationships and their multiple impacts on the resilience of natural, cultural and man-made ecosystems.

In this dynamic context, the current literature has formulated numerous approaches to assess and measure port city dynamics. At this stage, the aim is not to present these approaches in detail, but to highlight the dominant trend that emerges from them, namely the need for a holistic perspective in order to have a better understanding of port city relations and their impact on urban-regional development. This is the objective of the proposed methodology (Session 3). Therefore, an attempt is made to briefly present the current debate by reviewing the approaches that could be considered as milestones in the construction of the proposed methodology (principles, spatial reference units, main thematic areas of criteria/indicators), since they clearly support the need to study the port and the city simultaneously. Specifically:

The Context of the Discussion: a Brief Literature Review. Although the assessment of the port-city relationship and its impact on local development involves both qualitative and quantitative aspects, several researchers mainly use quantitative indicators [9]. However, it is interesting to note that these indicators are increasingly used to create composite indicators, i.e. the two systems (port and city) are not assessed independently, but are inextricably linked. For example, many studies focus on the dynamic relationship between port operations and urban development. In this respect, Ducruet and Lee's approach to port-city relations is based on the study of the population and container throughput of port cities in combination with other critical indicators such as transport activity, port infrastructure, sea and land networks and urbanised area [7, 10]. The correlated port-city view using quantitative indicators is reinforced by Guo et al.'s approach, piloted in China's maritime cities, which attempts to construct a more

multi-factorial assessment of the port-city relationship using environmental and socio-economic indicators [11]. Equally interesting are the approaches to assessing the port-city relationship, focusing on evaluating the competitiveness of both systems, i.e. the port and the city. This is a key parameter for sustainable development [12]. For example, Xiao and Lam propose a systems-based sustainability framework for Singapore's port cities. They consider the port one system and the city another. From the perspective of these two different but interrelated systems, they propose thirteen economic, social and environmental indicators [13]. Equally interesting is the approach of Oraga et al., who introduce the criticality of port governance as a crucial aspect of ensuring port city sustainability/competitiveness at local-supralocal level [14]. Taking Western Indian Ocean region as a study area, they propose an indicator framework to assess port city relations and dynamics, focusing on the simultaneous study of port city development (*socio-economic aspect*), marine/urban ecosystem sustainability (*environmental aspect*) and existing regulatory framework (*political aspect*). In a similar context, Merk and Dang propose a set of port city indicators to provide an overview of the effectiveness of port city development. These indicators mainly combine policy objectives in several areas: natural - cultural environment, transport, research - innovation, communication networks and spatial cohesion [15].

Existing Knowledge as a Driver to Develop a Multifactorial Methodology. The proposed methodology is based on the need to consider the simultaneous monitoring of the port and the city, and is enriched by the criticality of considering the waterfront, an area that is contested by the two systems. In order to ensure optimal assessment of competitiveness and sustainability of port cities, existing knowledge is used to organise the main themes of criteria/indicators that allow multifactorial monitoring of port city relations and their impact on local and regional development. The aim is to create a pool of criteria/indicators that can be updated and enriched, with the possibility to use them on a case-by-case basis.

In conclusion, the literature review highlights the challenges associated with establishing a suitable set of indicators for measuring port city performance. Moreover, the richness/complexity of the issues related to port cities is reflected in the large number of indicators identified. The majority of studies in the review propose an indicator-based approach. This involves measuring key relationships for a number of indicators related to the port and the city. This is a key priority that has led to formulating the proposed methodology and identifying the evaluation criteria. Both focus on the spatial expression of the relationship between these two often contradictory but mutually reinforcing systems.

3 Methodology and Main Stages of Research

In the context of the international debate on the evaluation of the city-port relations, the article formulates a multi-factorial methodology, based on spatial criteria, to study the different aspects of this interaction and its contribution to local - regional development. Given the size and scope of ports and related supralocal activities developed in the wider urban environment of their cities, it is argued that the port-city relations should be studied at all scales (i.e. local, regional, national and international), using a dynamic and critical

approach. It is also emphasized that the dynamics of port cities need to be considered in a broader perspective, as this specific category of space functions not only as a node in the (supra)national transport network, but also as part of the (supra)national urban network. It is therefore emphasised that the assessment of the port-city relationship must be considered in three spatial units simultaneously, i.e. ***the port***, ***the city*** and ***the waterfront***. Attention is given to the waterfront for two reasons. First, it is an area of increased vulnerability, simultaneously claimed by the port and the city to satisfy their particular development needs. Second, it is under increasing pressure from urbanisation, tourism and the development of human activities on land and at sea, with multiple impacts on natural, cultural and man-made ecosystems.

Based on the above assumptions, the article attempts a comparative study within a dynamic multi-level and multi-factorial approach, incorporating spatial criteria in six thematic areas, namely ***centrality*** *(*geographical location/geopolitical gravity*)*, ***demographic*** **and** ***socio-economic characteristics*** (population, production sectors, entrepreneurship, economic indicators, etc.), ***accessibility and connectivity*** (transportation network), ***natural - cultural heritage***, ***built environment*** (density, urban quality, functions/land uses, public space, etc.) and ***supra-local infrastructure*** (production, technical and social).

The choice of the above six themes is not arbitrary. On the one hand, they highlight the multiple aspects of the port city relations and its role in their development. On the other hand, they allow the development of indicators (quantitative/qualitative) that can be used in a next step to assess and measure the resilience and competitiveness of port cities. At this stage, attention will be given to the following indicators per spatial level: a) port: ***port functions/services***, ***turnover/profit***, ***traffic value***, and ***port governance***, b) city: ***population*** (size, % change), ***unemployment rate***, ***gross domestic product*** (**GDP**), ***administrative role*** [seat of regional unit (NUTS 3) or region (NUTS 2)], ***city scope*** (centrality in the national urban network as defined by the government or scientific approaches), c) waterfront: ***accessibility/connectivity***, ***natural-cultural ecosystems***, ***built density, land /sea uses***, and ***public space***. The contribution of above criteria to assessing waterfront quality, spatial continuity and organic integration into the urban environment is considered significant. In the current phase, the approach to the criteria is attempted in the broader context of an initial survey and mapping of the dominant land uses. The aim is to have a better understanding of the relationships so that a more detailed study can be attempted in the next phase. In all five cases, research is already underway in this direction.

The above criteria/ indicators are complemented by crucial issues such as ***port-city-waterfront governance***, ***ownership status***, ***port and spatial policies and planning approaches***, ***stakeholders and participatory planning***. At this stage, addressing these issues is indicative and supportive. The aim is to differentiate the dynamics of the five cases studied and to identify the common problems they face. At a later stage, an attempt will be made to conduct a detailed study combining quantitative and qualitative indicators at the level of specific port cities to draw conclusions for each case. To approximate the quantitative indicators, official databases were used [16] (Fig. 1).

The proposed methodology was tested in five medium-sized cities with international ports in mainland Greece. The choice was not made at random. In four of them, ports are

located within the urban fabric and close to the city centre. This spatial correlation creates a number of interdependencies, but also various conflicts/tensions. The main impact is on urban and coastal environmental quality, but also on the degree of open access to the waterfront. Of particular interest is the case of Kavala, where the port is adjacent to the city centre. This increases interdependencies, impacts or conflicts. Despite the fact that two of the five cities are considerably larger and more dynamic (Patras, Volos), they face problems similar to those of the three smaller and less developed cities (Alexandroupolis, Kavala, Igoumenitsa). The correlative monitoring of the five port cities confirms this.

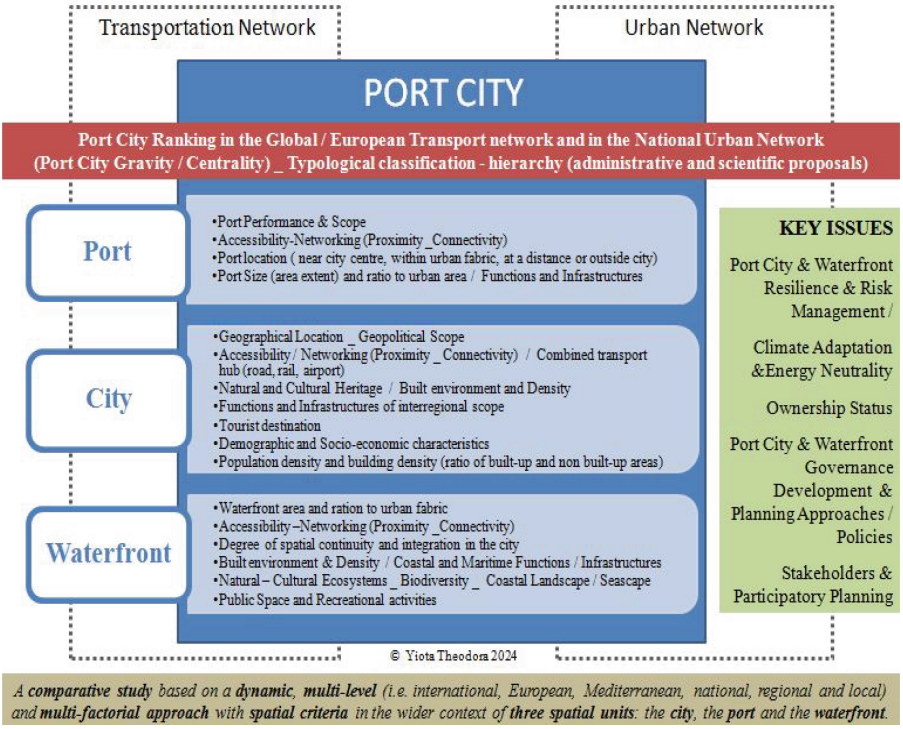

Fig. 1. Main Research Themes by Spatial Reference Level [own elaboration]

In conclusion, the proposed methodology aims to contribute to the scientific literature by proposing a framework for understanding and quantifying the dynamics of a port city from the perspective of port-city integration. It is worth noting that although the proposed methodology and criteria have been applied to medium-sized regional cities with an international port, they can be applied to any port city, regardless of size, location or scope. Its practical value lies in the ability to approach the following planning issues: a) identifying port-city linkages, b) evaluating policies and planning approaches, and c) highlighting opportunities and risks at the spatial organisation perspective level, reintroducing urban resilience/sustainability issues. This is undoubtedly a methodology that can provide the basis for moving from a correlated view of port cities to the next phase,

which will emphasise the spatial dimension, using indicators to assess the evolution of city-port relations over time and by city [17, 18].

4 International Ports in Medium-Sized Cities on the Greek Mainland

Port cities continue to be a key parameter in the transport and spatial planning of local and regional development. Therefore, in countries with an important maritime history and activity, port city planning should be a priority and part of their strategic development. Greece is such a case because of its geostrategic importance (south-eastern gateway to Europe and part of the trans-European network), its strong coastal/island character and diversity of port systems, and its global dynamism. The country has an extensive network of ports. Each plays a different role in the national /international transport network and is expected to develop differently. According to the Greek National Ports Policy (2007), ports are divided into four groups: ***Ports of International Interest***, ***Ports of National Importance***, ***Ports of Major Interest*** and ***Ports of Local Importance*** [19] (Fig. 2).

Specifically, the group of *Ports of International Interest* includes sixteen ports. Ten are located on the mainland and the rest are on islands. In particular, *international ports* are located in ***metropolitan areas*** [Athens Metropolitan Region (Piraeus, Elefsina, Lavrion and Rafina) and Thessaloniki Metropolitan Region (Thessaloniki)], ***medium-sized cities*** (Alexandroupolis, Kavala, Igoumenitsa, Volos and Patras - from north to south), and **insular regions** [Mytilene (capital of Lesvos, North Aegean Region), Corfu (Ionian Island Region), Rhodes (Dodecanese Complex, South Aegean) and Crete (Heraklion, Souda in Chania) - from north to south), as well as on **small islands** that are international tourist destinations (Mykonos). Although all sixteen port cities belong to the same group, they differ in terms of their geographical location (i.e. centrality in the global transport system and in the national urban network), the specialisation and reach of their ports, the characteristics/peculiarities of their cities (i.e. accessibility, city size, density, land use/infrastructure, local identity), but also the quality of their waterfronts and the extent of their integration into the urban fabric.

Particular attention is being paid to small/medium sized mainland cities with international ports, as the naval functions now operate in a completely new, globalised and highly competitive environment. This group includes the five port cities studied, from north to south, **Alexandroupolis** (capital of the regional unit of Alexandroupolis) and **Kavala** (capital of the regional unit of Kavala), both in the region of Eastern Macedonia & Thrace; **Igoumenitsa** (capital of the regional unit of Thesprotia) in Epirus Region, and the larger and more developed port cities of **Volos** (capital of the regional unit of Magnesia) and **Patras** (capital of the regional unit of Achaia) in the regions of Thessaly and Western Greece, respectively. The five port cities are expected to play a key role in the national-regional development of Greece as hubs of global transport networks and, in particular, as strong intermodal hubs. This is due to the location of the cities on the Trans-European Roads: Egnatia Odos, Ionian Odos, Olympia Odos, P.A.TH.E (Patras-Athens-Thessaloniki-Evzonoi) and the presence of a railway and an airport. Igoumenitsa is an exception. It has no rail or air connections (Fig. 2).

There are many reasons for focusing on the Greek periphery. First, despite the fact that European and national spatial policies support ensuring polycentric spatial development as a condition for territorial/socio-economic cohesion in the context of globalisation/networking, Greece is still dominated by the Athens-Thessaloniki dipole, which exacerbates regional inequalities [20, 21]. In this regard, the two metropolises are still the main beneficiaries of investment, while many small/medium-sized regional cities are left behind and have significant infrastructure deficiencies. The question is whether and how these regional cities can support international port activities [17, 18]. Second, new port reform initiatives are emerging around the world. They aim to attract private investment in regional ports, either through the sale of controlling stakes or through the granting of concessions for port operations. Discussing this issue is challenging and raises many questions. This is especially true in Greece, where the diversity of regional port cities, due to the different dynamics of the cities and the size/scope of their international ports, poses crucial planning dilemmas to ensure sustainability. These dilemmas must be addressed to ensure local development. The different characteristics of medium-sized regional cities with international ports have led to the formulation of the proposed multi-criteria methodology to assess the peculiarities of these cities, applied simultaneously to the three key spatial units that define the port-city relationship (i.e. port, city and waterfront). Third, the operation of an international port in a medium-sized city raises many planning issues related to the coexistence of the port and the city at all different spatial scales (local, regional, national) in an era of climate-energy crises.

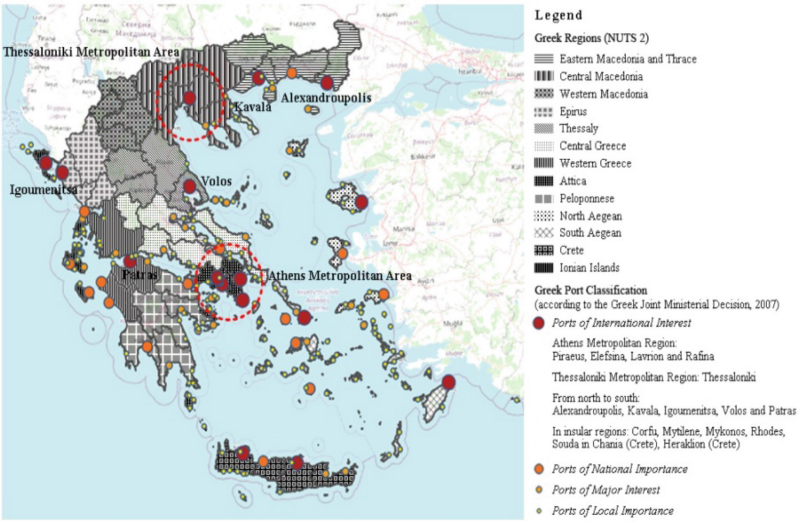

Fig. 2. Official Greek Port Classification [19] [own elaboration]

Last but not least, the selection of international ports in continental Greece makes it possible to study them combined with other transport systems (road, rail and airport). This is a crucial parameter for spatial planning - development in an intensively globalised economic environment, in which ports do not function in an autonomous way, but rather

as hubs of global supply chains [22]. More than ever, supply chains have an impact on port performance. They have become a relevant area to analyse for competitiveness and resilience. The interdependence of the supply chain and the ports has given rise to a new reality. This has many implications for the relationship between the port and the city. The creation of more efficient links between ports and their hinterland is one of the fundamental needs of this new reality. This requires integrated planning considering both port and city [17, 18].

5 Greek Regional Port Cities of International Scope as Hubs of the Global Transport Network. Accessibility, Proximity and Networking

As the quality of the inland transport infrastructure is becoming one of the most critical factors in the competitiveness of ports, the approach to the land transport networks is a key component in the dynamics of port cities. The new Trans-European Transport Network (TEN-T) guidelines also recognize the need to connect the port to the mainland. The importance of Greece in the global and trans-European transport network is crucial due to the geo-strategic and geo-political position of the country. Greece functions as a regional entity in the southeastern Mediterranean, far from the EU's powerful centre. Greece is also the main gateway to the EU from the east [23].

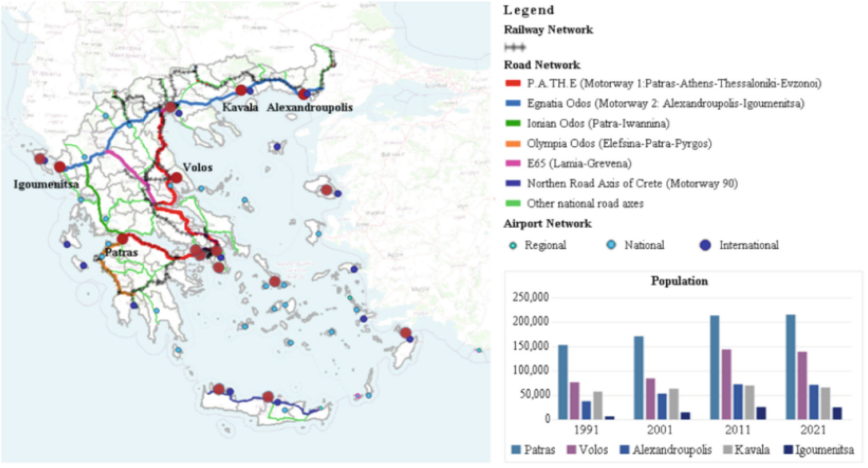

Fig. 3. International Ports in Medium-sized Greek Cities as part of the National Transportation Network (road, rail, and airport) [16] [own elaboration]

The main challenges for the competitiveness of the Greek transport network include overcoming the constraints imposed by the country's geomorphology (i.e. mountainous areas, insularity) on the development of road and rail networks, and exploiting the rich network of mainland and island ports. Regarding the port network, the ranking of the 25 Greek ports (Regulation (EU) 1315/2013) in the TEN-T recognizes their contribution

to the European economy. To be more precise, these ports are part of the south-eastern Mediterranean corridor and most of them are located on islands. Among the regional ports of international scope studied, Patras and Igoumenitsa are part of the national network, while Volos and Kavala are also included in the extended network. Note that the TEN-T network does not include the port of Alexandroupolis. This is despite its strategic location (Fig. 3).

At the national level, hinterland accessibility was also identified as one of the most critical factors for port city competitiveness. Land access to seaports is closely linked to the existence and quality of road, rail and air networks, both spatially and functionally [24]. In this sense, the accessibility of Greece is considered by taking into account the geographical proximity of the port cities studied to the main national motorways and railways. Road transport has historically captured the largest share of the freight market, both within the port area and in the hinterland. The European Union is making a major effort to promote alternatives to road-based transport. Despite the strategic importance of port-rail links for port development in economic and competitive terms, most regional ports in Greece have no direct rail links, such as the port of Alexandroupolis. This prevents them from becoming global intermodal hubs.

Finally, the use of substitute/complementary modes in maritime and air transport is of growing interest in transport planning [25]. Providing fast and efficient connections between ports and airports is becoming increasingly important. As two nodes, ports and airports are always connected by road and their proximity is an approximation of their distance. For Kavala, Volos and Patras, the distance is between 32 and 39 km. The closest airport to the port of Igoumenitsa is in Ioannina. Administratively, in all the port cities studied, except Igoumenitsa, the ports and their nearest airports are in the same regional unit.

6 Greek Regional Port Cities of International Scope as Part of the National Urban Network – Features, Peculiarities and Dynamics

After examining the importance of the five regional port cities in the global transport system, this session moves on to understand cities' dynamics by identifying their role/centrality in the national urban system (Session 3). The aim is to identify the regional cities that appear to have difficulties in supporting the operation of international ports and ensuring a balanced relationship between port and city, and to highlight the degree of difference in the dynamics of the five cases studied.

6.1 The Port – Approaching Its Performance and Scope

In order to assess the dynamics of the five ports, particular attention is paid to the analysis of data related to spatial criteria, such as: ***port functions and services***, ***turnover /profit***, ***traffic*** (vessels, passengers, vehicles and containers) and ***port governance***. These are criteria that can have a key role in the typological classification of the port cities studied, in order to better understand their dynamics at the local and supra-local level on the basis of different dimensions of their port specialisation/scope [26]. Specifically:

Port functions/services (2009–2020) An analysis of the functions carried out in the five ports studied shows that most of them cannot be considered as specialised. Kavala is an exception, as the new port of Nea Karvali, 8km from the city, specialises in commercial transport, while the main port, close to the city centre, has developed tourism, coastal and fishing activities. The other four ports have a wide range of cargo and passenger handling services. Specifically, the main activities of the Port Authority of Alexandroupolis are the conventional general cargo and bulk cargo, the storage and the coastal passenger transport. The Igoumenitsa Port Authority, on the other hand, mainly handles passengers and vehicles. Concerning container traffic, only the Port of Volos had such services until 2017, while the Port of Patras has been providing container handling services since 2018 [16].

Turnover/profit (2009–2020) To approximate the dynamics of the five ports, turnover/profit rates were selected from the annual accounts published by each port authority. In particular, the ports of Patras, Igoumenitsa and Volos are different from those of Alexandroupolis and Kavala. Alexandroupolis has the lowest rates, capped at €800,000 per year. Kavala port reported a steady increase from just fewer than €1 million in 2015 to around €2 million in 2019. Volos recorded the largest variations. In 2016, Volos port recorded a significant increase in turnover/profit ratio of almost €1 million, the highest ratio of the year. The port of Patras recorded the highest turnover/profit ratio in 2015 (€5,753,311). In 2019, it reached 6,375,385 €. Furthermore, the port of Igoumenitsa had the highest turnover in 2018 (€5,843,169) and Patras was in second place (5,687,350 €). Igoumenitsa and Patras have had similar turnover rates since 2017 [16].

Traffic volume (2009–2020) The analysis is based on the data collected by the Hellenic Association of Ports (ELIME). It is worth noting that the way Greek ports are organised and operate has changed in recent years. This is mainly due to the COVID-19 pandemic. Overall, the pandemic period is characterised by a significant reduction in coastal passenger traffic and very limited cruise activity. The performance of Greek ports in the freight sector is unstable. In particular, similar trends in port ranking can be seen in the analysis of coastal shipping and passenger transport. In both categories, the port of Igoumenitsa ranks first, followed by Kavala, with Alexandroupolis firmly in fifth place. In the coastal passenger category, the ports of Patras and Volos ranked third and fourth respectively. Generally speaking, vehicles handled followed a similar trend to passengers. Igoumenitsa is almost every year the number one port in terms of truck traffic. The same indicator is low and stable in Alexandroupolis. In addition, the port of Volos is a leader in the cruise ship sector. It was only in 2017 that more cruise passengers arrived at the port of Igoumenitsa (9,088) than at the port of Volos (7,618), although the number of cruise ships arriving at the port of Volos was slightly higher. On the contrary, Alexandroupolis port was almost every year the port with the fewest cruise ships and passengers. Notably, none of the four ports offered cruises in 2009. The COVID-19 outbreak and subsequent travel restrictions and border closures resulted in lower cruise ship and passenger arrivals in 2020 in all ports studied [16].

Port governance (1999–2024) In recent decades, it has undergone profound changes. Port reform initiatives have been launched in two major ports: Piraeus (2016) and Thessaloniki (2018), which were transformed into public port companies in 1999 (L.

2688/1999). Two years later, ten ports of national importance (Alexandroupolis, Corfu, Elefsina, Heraklion, Igoumenitsa, Kavala, Lavrion, Patras, Rafina and Volos -in alphabetic order) were turned into autonomous port administrations (L. 2932/2001). Since 2016, Greek ports have been structured as comprehensive port authorities. They are controlled by the State [27]. Undoubtedly, the privatization of the ports of Piraeus and Thessaloniki has decisively influenced the Greek port system's governance model and development prospects. In recent years, the privatization of the international ports of Alexandroupolis, Kavala and Igoumenitsa has been at the centre of the debate; but only Igoumenitsa was privatized [16].

6.2 The City – Identifying Characteristics and Developmental Prospects

For a better understanding of the importance of port cities within the global transport system and the Greek urban system, it is necessary to assess not only the dynamics of their ports, but also the dynamics of their urban environment (i.e. accessibility, functions of supra-local scope) within their wider spatio-functional area at the regional level. Thus, particular attention is paid to the demographic, socio-economic and spatial characteristics of the port cities, including ***population***, ***unemployment*** and ***GDP rates***, ***administrative gravity*** [position in national administration: region (NUTS 2); regional unit (NUTS 3)], and ***city scope*** [importance/gravity of port cities in the Greek urban network] (Session 3). The following results can be derived from the comparative study:

Population (1991, 2001, 2011, 2021) At the national level, Patras is the third largest city in Greece, after Athens and Thessaloniki. Patras and Volos followed by Alexandroupolis, Kavala and Igoumenitsa, with significant population differences. Between 1991 and 2021, Patras and Volos are always in first place, while the other three smaller and less developed cities change places. Specifically, in 1991 and 2001, Kavala and Alexandroupolis ranked third and fourth respectively among the five port cities studied. But Alexandroupolis climbed from fourth to third in 2011 and stays there in 2021. Igoumenitsa remains the least populated city in the study period. By 2021, Patras will have eight times the population as Igoumenitsa. It is also interesting to consider the ratio of the population of the port cities studied to the other cities- seats of regional units in their region. In the total population of Western Greece Region, Patras makes a significant contribution. In the region of Thessaly, Volos is the second largest city after Larissa, and together they form a strong urban dipole with national reach. Alexandroupolis and Kavala are the most populated cities in their region (Eastern Macedonia and Thrace), while Igoumenitsa is the least populated city in its region (Epirus). Finally, the population change in the five port cities increases until 2011. However, the population of Alexandroupolis, Kavala, Igoumenitsa and Volos will be in decline between 2011 and 2021. Only Patras will see a slight increase [16] (Fig. 3).

Unemployment rate (1991, 2001, 2011, 2021) Overall, Alexandroupolis had the lowest unemployment rate in all the years examined. Conversely, Patras had the highest unemployment rate in 2001 and 2011. On the other hand, although Igoumenitsa started with the highest unemployment rate, it fell from first to second place in 2001, when it was overtaken by Patras. In 2011, it ranked fourth. Finally, the unemployment rates of Kavala and Volos were very similar over the period under study. Comparing the five port cities' unemployment rates with the regions to which they belong, Patras, Volos, Kavala

and Igoumenitsa have higher rates over the period studied. The Alexandroupolis case in 1991 is similar. Finally, in terms of percentage change, the unemployment rate in all port cities was dramatically on the rise over the period. Only Alexandroupolis recorded a slight decrease in 2001 [16].

Gross domestic product rate (1991, 2001, 2011, 2021) The richest regional unit is Achaia (Patras), followed by Magnesia (Volos). GDP levels are similar in the Evros (Alexandroupolis) and Kavala (Kavala) regional units. Kavala ranks third, followed by Evros. However, the order is reversed in 2011, 2012, 2016, 2020 and 2021. It's notable that Thesprotia (Igoumenitsa) was always last. In terms of their GDP contribution to the total GDP of their regions, Evros and Kavala are the richest regional units (NUTS3) in Eastern Macedonia and Thrace (NUTS2). Magnesia follows Larissa in the case of Thessaly. Finally, Thesprotia still contributes the least to Epirus' total GDP, while Achaia contributes the most to Western Greece's total [16].

Administrative role Of the five port cities studied, only Patras is a regional capital (NUTS 2). The others are seats of regional units (NUTS 3). Greece's current administrative division was formed based on the *Kallikrates Programme* (L. 3852/2010).

City scope Both politically and scientifically, assessing the gravity/ importance of Greek cities in the national urban network has proven to be challenging. In the first, the population and the administrative role of the city are taken into account [28], while in the second, the supra-local infrastructure, which affects the centrality/gravity of the city, comes to the fore [21]. At the political level, the milestones in the assessment of urban dynamics and the classification of Greek cities over the last fifty years have been the following three proposals. The first was the proposal of the "*rival cities*" in 1979 [metropolitan regions of Athens and Thessaloniki; urban centres/dipoles of national reach: Kavala, Kozani- Prolemaida, Ioannina, Larissa-Volos, Patras-Aigio, Heraklion (Crete)]. The second was the "*open cities*" proposal of 1984, which divided Greek cities into five levels according to population size, namely *metropolitan centers* (1st level: Athens, Thessaloniki), *major national poles* (2nd level: *regional headquarters-serve about 500,000 inhabitants*), *secondary national poles*(3nd level: *prefecture headquarters*- serve about 100,000 inhabitants), *national poles* (4th level: *municipal headquarters* - serve about 50,000 inhabitants), and *other settlements* (5th level: *towns /villages*). Finally, the third proposal, supported by the *General Framework for Spatial Planning and Sustainable Development* (GFSPSD) (2008), adopts the five levels proposed by the "*open cities*" proposal of 1984 for classifying Greek cities. The current proposal has been criticised for using methods and criteria that do not correspond to contemporary conditions of network organisation (L. 2742/1999). According to this proposal, Patras, Volos and Alexandroupolis are considered as *major national poles* according to the GFSPSD, Kavala is a secondary national pole and Igoumenitsa a limited national pole due to its small population, although its international port is a national western gateway [28].

On the other hand, at a scientific level, the assessment of urban dynamics generally confirms that urban gravity depends more on the type, quality and intensity of concentration of supra-local infrastructures than on the size of the population. In other words, it is the lack of infrastructure that prevents the cities that have an international port from being competitive. This hypothesis is confirmed by the study of Theodora and Loukakis,

which shows that the centrality of cities depends not only on their population, but also on their geographical location, accessibility and the presence of supra-local infrastructure in the fields of administration, production and services (industrial and technological parks, SMEs), transport, education/innovation (universities, research centres, etc.), health, culture, tourism and leisure. According to this study, when population is disregarded and infrastructure of supralocal scope is weighted, the five port cities, with the exception of Igoumenitsa, belong to the group of cities of major importance. However, in terms of population, Patras and Volos still stand out (*interregional/national*), Kavala (*regional*) and Alexandroupolis (*inter-prefectural*) are downgraded, while Igoumenitsa is consistently limited *prefectural* [21].

6.3 The Port City Waterfront – Assessing Spatial Continuity and Urban Integration

Port city relations can be competitive, complementary or even indifferent. The waterfront is where this unique relationship becomes really visible. It is a special category of space where competition, public access and environmental concerns are making the issues of planning and management more relevant to urban policy. These problems seem more acute in small/medium sized cities where the waterfront is an important part of urban fabric and local identity. In this respect, a key challenge for coastal and urban sustainability in port cities is to ensure free access to the water through planning approaches that guarantee the waterfront's spatial continuity and integration into the city and daily life of residents and visitors [17, 18, 30].

Based on the above, at this stage the study of the urban waterfronts of the five port cities was based on the identification/mapping of the dominant land uses along the coastline and in the wider city. Figure 4 shows these main spatio-functional units as defined by the digital map of the Greek Ministry of Environment and Energy and the official master plans of each of the five port cities and their waterfronts (i.e. city centre, urban public space, waterfront public space, port uses, industrial uses). Using this data, the article takes a first step towards identifying key similarities and differences between cases [16]. The next step, which is currently underway, is to focus on the city scale, aiming to identify coexistence problems and prioritize interventions (Fig. 4).

Preliminary results show that the current condition of waterfronts varies. This diversity of port city waterfronts is mainly determined by ***geomorphological/spatial factors*** (coastline, landscape/sea features, location of the port in relation to the city centre and its interaction with other urban/maritime land uses, etc.) and ***developmental factors*** (the relative importance of the port to the city and the development prospects of the city). This spatial study shows that, particularly along the waterfront, the proportion of port uses and green/public space varies, but in most cases port infrastructure is dominant. Igoumenitsa is an example of that, because although the urban fabric extends along the sea, the relationship between the city and the sea is insufficient/problematic, since the port occupies most of the waterfront [17, 30]. The study also shows differences in port locations compared to city centres. Interesting cases are Alexandroupolis and Kavala, where the city centre is largely adjacent to the port. Another key parameter in the changing nature of waterfronts is the shipping industry. The port-city interface is greatly influenced by the spatial dimension of port infrastructure. In this context, ports

are recognised as engines of economic development. However, they can also have a negative impact on the attractiveness of the cities they serve. In order to address the diverse local impacts of port activities, urban studies are required for each city. This is beyond the scope of this study. However, given its importance for the sustainability of port-city relations, it is worth mentioning. But what's really important, and what emerges from the comparison of the five port cities, is that while they are different, they all share a vision of making the most of their main asset - their relationship with water. In order to achieve such a goal, a multi-level and multi-factorial study of the waterfront, which is inextricably linked to the city, is required. There is therefore a need to develop a methodology that can address quantitative and qualitative indicators simultaneously. These indicators, based on the broader context of the main criteria already presented in the proposed methodology (i.e. *accessibility/connectivity*, *natural-cultural ecosystems*, *built density and land /sea uses*, and *public space*), will emerge in the next phase of the study (Session 3).

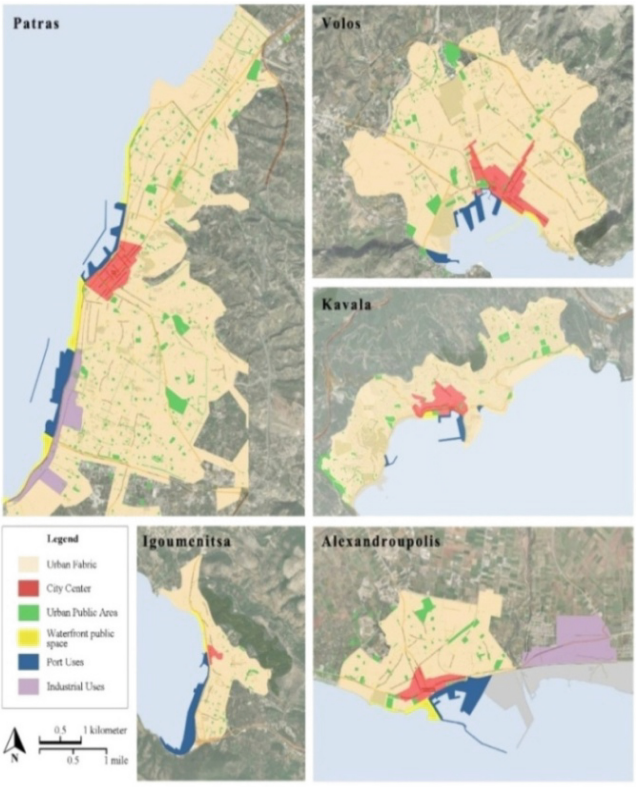

Fig. 4. Main Spatio-Functional Units in the five Port Cities [16] [own elaboration]

In conclusion, we can classify the five port cities typologically into three groups, based on the correlation analysis of gravity/centrality in terms of international/national transport networks. In the ***first group*** are Patras and Volos, the largest and most dynamic

port cities. In the ***second group*** are Alexandroupolis and Kavala. These ports are less dynamic but have significant development potential. Finally, Igoumenitsa is placed in the ***third group*** because of a number of infrastructure weaknesses of global importance. These weaknesses prevent Igoumenitsa, in spite of its geo-political importance, from playing a key role in the international transport network and in the national urban network. The city has only a small business park, no logistics and freight centres, and no rail or airport connections that would allow it to become a hub for intermodal transport. Igoumenitsa also suffers from limited economic activity and lacking social infrastructure (education, research-innovation, health, etc.). On the other hand, Igoumenitsa has great development potential due to its international port and centrality in the national road network [at the junction of the Egnatia and Ionian Odos] and the Trans-European Transport Network (Northwest Gateway). At the same time, the geomorphology of the city, urban development and the demands of the port put increasing pressure on the natural, cultural and man-made environment. It is the coexistence of these characteristics that makes Igoumenitsa an interesting pilot case.

7 Insights from the Comparative Monitoring of Greek Regional Port Cities of International Scope and Open Issues

Over the past 20 years, and especially during the multifaceted crisis, transport infrastructure has been central to Greece's development as a competitive option. The close link between transport infrastructure and development is reflected in Greek transport policy. Thus, the implementation of the *National Transport Plan for Greece (NTPG)* is expected to improve the overall efficiency of the transport sector and enhance the sector's capacity in order to support economic growth, environmentally sustainable practices, road safety, accessibility and regional/international connectivity [31].

Although the NTPG recognizes the need to improve the connectivity and accessibility of the outermost regions, most of the investment proposals are still concentrated in the two metropolitan areas of Athens and Thessaloniki. In particular, Epirus, the poorest region in Greece, still has very few investment plans, even after the completion of the Egnatia and Ionia Odos (Reference Scenario 2027). However, significant measures have been proposed for the development of the port cities studied. These measures are to be implemented by 2037. The relevant long-term plans include interventions in the rail network by creating new connections at Alexandroupolis, Kavala and Volos, and the development of new freight sacks at Larisa -Volos, Igoumenitsa and Patras (Reference Scenario 2037) [31].

On this basis, and although investigations are still underway, the comparative analysis of the five port cities has shown significant differences between ports, cities and waterfronts. Thus, ports differ in size and function. Cities have different strengths and weaknesses, and waterfronts have different characteristics/dynamics that affect port-city relations. In particular, Igoumenitsa seems to be the most vulnerable city, despite its international port. On the other hand, Alexandroupolis' port performance is very low. However, the host city appears to be more dynamic mainly due to the supralocal concentration of infrastructure in the education, health, energy and army sectors. At regional level, the two border regions of Eastern Macedonia and Thrace, and especially Epirus,

appear to be the most vulnerable as regards population and GDP distribution, while there are significant differences in the performance of their ports. However, the involvement of the private sector in the management of the port of Igoumenitsa is the most notable difference. While this process has had a positive impact on the competitiveness of ports, new socio-economic, spatial and environmental challenges for port city planning are emerging. Especially in cases like Igoumenitsa, where the city seems unable to support international port operations [17].

The multifactorial and multi-level research shows that the dynamics of the port cities studied are very different. This is due to the deformation of their characteristics/peculiarities. Therefore, as the majority of national investments seem to favour the more competitive metropolitan areas, dynamic monitoring at the port city level in the wider national and international context is crucial. In addition, the dominance of port functions on the waterfronts of port cities creates a wide range of constraints and difficulties for sustainable urban development. In an era of climate and energy neutrality, these need to be addressed.

The port city relationship is undoubtedly being redefined by the new requirements for sustainability and resilience. Today, ports and cities should work closely together for effective green port and spatial policies which help port cities grow and increase their resilience. The interdependence of port and city in implementing policy comes at a time when the privatisation of the regional ports of Alexandroupolis, Kavala and Igoumenitsa is dominating the national debate. This raises further questions and dilemmas at the level of urban-regional planning and local development in relation to the resilience of the port city. In this dynamic context of discussion and review of the sustainability and competitiveness of ports, the importance of a multifaceted approach to the port-city relationship is more than crucial [17, 18].

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