



# Applied Research Topics in **Transport and Logistics**

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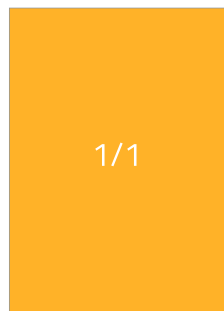
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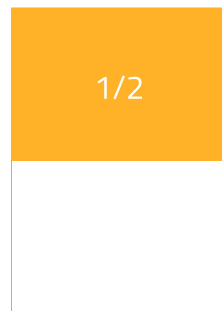
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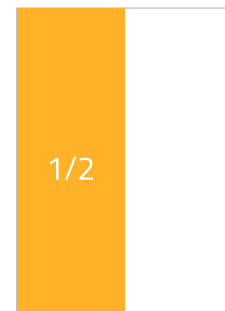
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## Editor's note

*The publication Applied Research Topics in Transport and Logistics is a bilingual supplement issued alongside the influential international scientific journal Promet – Traffic & Transportation, published by the Faculty of Transport and Traffic Sciences, University of Zagreb. It is our pleasure to present this third edition, focusing on the critical topic of logistics infrastructure.*

*Today, the ongoing and inevitable digital transformation within the logistics industry continues to revolutionize operational processes. The adoption of advanced technologies, such as artificial intelligence, automation, and IoT, enables process optimization, transparency, precise shipment tracking, and faster responses to unforeseen events. High-quality infrastructure, modern logistics facilities, transportation resources, and institutional support for the development of the logistics industry are crucial in this era of technological advancements. Observing this synergy is particularly fascinating, given the rapid pace of technological development and the uncertainty surrounding its future direction.*

*The themes of this third edition in 2024 center on the challenges related to logistics infrastructure, whose level of development represents a significant operational and financial hurdle for the industry. Nuccia Basanić from the prominent company Colliers has contributed a remarkable article addressing the current state and potential developmental opportunities and needs for logistics infrastructure, drawing from her extensive research experience in the field. Additionally, Associate Professor Tomislav Rožić, Ph.D., from the Department of Transport Logistics at the Faculty of Transport and Traffic Sciences, has written about the potential of hinterland terminals as critical elements of logistics infrastructure. As a leading expert in this field, Professor Rožić is among Croatia's foremost researchers on this topic.*

*We also invite you to the Ergonomics 2024 conference, an international event organized by the Croatian Ergonomics Society since 2001. Co-organizers include the Faculty of Transport and Traffic Sciences, Faculty of Mechanical Engineering and Naval Architecture, Faculty of Graphic Arts, and Faculty of Textile Technology at the University of Zagreb. This conference traditionally gathers enthusiasts, experts, and scientists worldwide to share the latest ideas and research across all areas of ergonomics.*

*Enjoy reading this professional supplement, which focuses on addressing market needs and bridging the gap between science and industry!*

*Ivona Bajor, Editor in Chief*



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01

# LOGISTICAL INFRASTRUCTURE IN CROATIA

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*For many years, the Republic of Croatia was characterized by a lack of modern warehouses capacity, which has changed over the past few years and today we are witnessing the development of logistics parks that serve as the basis for the development of logistics capacities.*

Located at the intersection of major European corridors, Croatia has significant potential to position itself on the European and global logistics map as an important transit hub. Since joining the European Union in 2013, Croatia has improved its accessibility and goods flow and with its entry into Schengen in 2023, it eliminated the need for border controls, thus enhancing its competitiveness. For many years, Croatia was characterized by a lack of modern warehousing capacities. However, this has changed in recent years and today we are witnessing the development of logistics parks that serve as a foundation for expanding logistics capabilities.

## Geostrategic position as Croatia's main asset

Even though Croatia has a great geostrategic position, it has not fully taken advantage of it. The logistics routes and transport hubs that pass through Croatia offer a great opportunity to position the country on the European and global logistics map. According to the Global Logistics Performance Index developed by the World Bank, Croatia is currently ranked 43rd out of 139 countries, indicating an opportunity for

improvement in logistics, especially in efficiency and reliability. The World Bank Index considers several key factors when ranking countries:

- Efficiency of customs and border management
- Quality of trade and transport infrastructure
- International shipments and the ease of organizing them at competitive prices
- Competence and quality of logistics services
- Ability to track shipments
- Timeliness of shipments in reaching their destination within a specified timeframe

One of Croatia's biggest advantages is its strategic geographic position, serving as a bridge between Western and Central Europe and the Mediterranean. Its location at the crossroads of important European transport corridors provides easy access to the markets of Western and Central Europe. The available transport routes in Croatia – by road, air, river, and rail – represent a certain advantage that Croatia should strategically use with continuous investments and improvements to become a key player in regional and international logistics. Investments in the container terminal of the Port of Rijeka and the expansion of its

capacity represent an important opportunity for positioning Croatia on the logistics map of Europe and beyond. The Rijeka Gateway project is one of the most comprehensive projects in the Republic of Croatia, with an investment of 187 million euros aimed at significantly modernizing the Rijeka coastal zone and contributing to economic development. Some of the key components of the project include a comprehensive revitalization of the area, directly impacting Croatia's competitiveness as a logistics destination. As stated on the official Rijeka Gateway website, essential parts of the project include the following:

- Construction of the maritime passenger terminal
- Extension of the Adriatic Gate Container Terminal
- Video surveillance system project implementation
- Construction of state road D-404
- Construction of the new Zagreb Deep Sea container terminal
- Redevelopment of Delta and Porto Baroš

The Rijeka Gateway project is one of the shining examples of enhancing Croatia's competitiveness while also attracting foreign investors. Danish Maersk, one of the largest shipping carriers in the world, has already recognized Croatia's potential and opened its first warehouse within the business zone in Kukuljanovo and it is expected that the aforementioned project will further attract foreign investors. There is room for further development and modernization of Croatia's railway system, which would make the country more quickly and easily accessible.

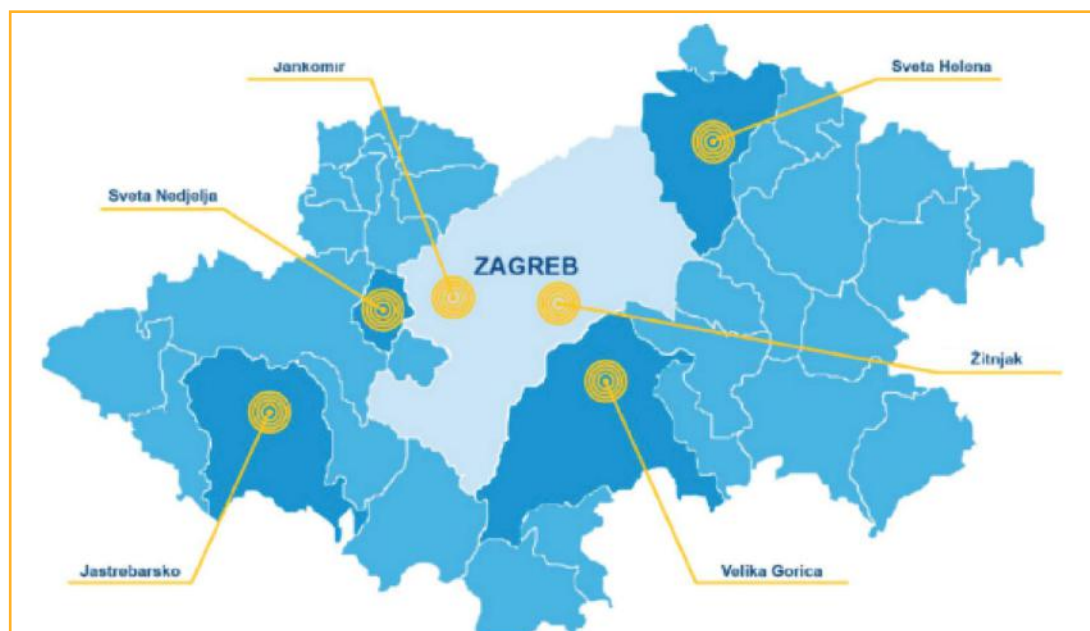
### Storage capacities in Croatia

For many years, Croatia has been characterized by a lack of modern warehousing capacities, with many tenants using inadequate spaces and searching for better, newer alternatives that would meet their long-term needs. Given some key facts that characterize the Croatian market, such as the limited availability of suitable land for the development of logistics parks, unconsolidated or unprepared land for such development (primarily due to unresolved ownership issues and insufficient space for

construction), as well as the calculation of municipal fees based on the cubic meter of the planned facility instead of the area, these factors have posed certain obstacles for investors. For them, cost predictability and timeline certainty are crucial factors when choosing new investments. Many companies over the past decade have chosen the built-to-suit model, where a facility is constructed precisely according to their needs, with pre-agreed lease terms with a selected developer who can build the facility for them. In this case, the company commits to a long-term period with the developer by signing multi-year lease agreements, with the developer retaining ownership of the property. Since real estate is not the core business for many companies, they often prefer the leasing model over their own investment, as it provides much more flexibility in terms of potential capacity expansion or relocation, allowing them to invest in their operations rather than in property.

### Construction of modern Class A facilities

The outbreak of the COVID-19 pandemic has significantly impacted certain sectors, including logistics and especially e-commerce. Supply chains became challenging, and during the pandemic, it was important to secure larger inventories to meet the demands of the local market. By the time of the pandemic, many companies were already searching for adequate warehousing capacities, and the accumulated demand was at its peak. Since 2020, the consolidation of the Meridian 16 zone in Velika Gorica has been completed, and the first modern logistics park in Croatia has been built in this area. Alongside the one in Sveta Nedelja, it has added approximately 60,000 m<sup>2</sup> of Class A



Main industrial zones / warehousing capacities in Zagreb, Source: Colliers.



warehousing capacity to the market, with users and tenants of this park being renowned international companies.

Current warehousing capacities in Croatia amount to approximately 1.3 million m<sup>2</sup>, of which only a small portion consists of modern warehousing facilities. These capacities are located in larger cities in Croatia, with the highest warehousing capacities found in Zagreb, Rijeka, Split and Osijek. The zones in Zagreb are located within the city and in satellite cities around Zagreb, such as the zones in Sveta Nedelja, Jankomir, Žitnjak, Buzin, Lučko, Stupnik, Jastrebarsko, Sveta Helena, Velika Gorica and Rugvica.

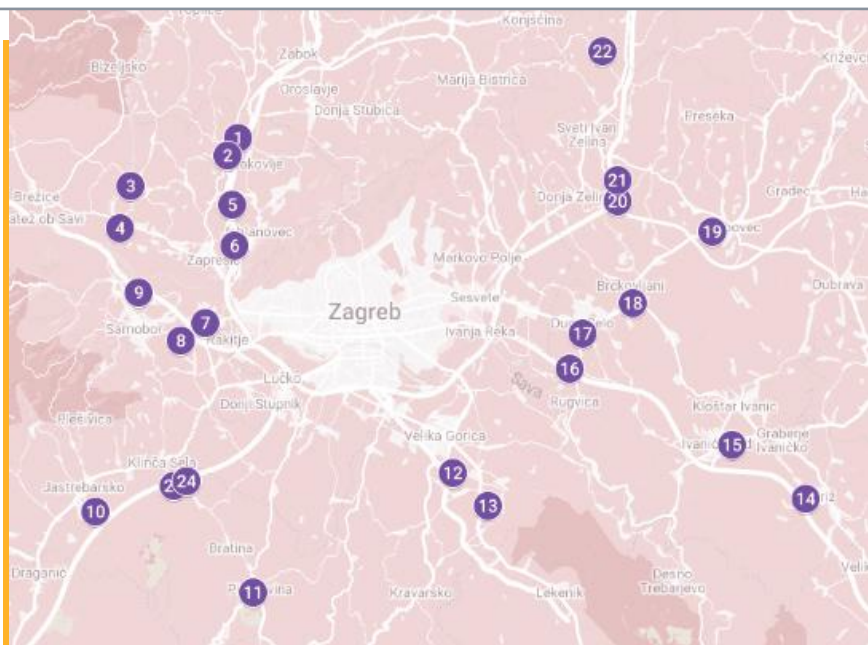
According to available data from the spatial plans of cities and municipalities, there are a total of 57 zones in Zagreb County, of which about 20 are active. The total area of zones in Zagreb amounts to 3,603 hectares, while individual zones range in size from 5 to over 300 hectares. Currently, around 20 zones are active in the vicinity of Zagreb.

According to data from the Croatian Bureau of Statistics, the number of issued building permits in the logistics segment has been increasing over the past few years. The number of issued building permits spiked in 2021 compared to 2022, with an increase of 25% in the number of permits issued. Although the number of permits has not been in constant growth since 2019, it is noticeable that the area designated for warehousing and industrial capacities has been increasing from 2019 to the present.

### Characteristics of modern warehouse facilities

Modern warehouse capacities imply a quality construction or structure built from durable materials such as concrete to ensure longevity and safety for the user. Additionally, the clear height of modern facilities reaches 10 meters or more, with cement floors having

- 1 Jakovlje, North zone
- 2 Luka zone
- 3 Marija Gorica, Kraj zone
- 4 Brdovec, Ključ zone
- 5 Bistra zone
- 6 Zaprešić, South zone
- 7 Sveta Nedelja zone
- 8 Samobor zone
- 9 Bobovica zone
- 10 Jastrebarsko, Jalševac zone
- 11 Pisarovina zone
- 12 Meridian 16
- 13 V. Gorica, Rakitovec zone
- 14 Križ zone
- 15 Ivanić Grad, North zone
- 16 Rugvica, North zone
- 17 Dugo Selo, Puhovec zone
- 18 Brckovljani, Božjakovina
- 19 Vrbovec, Poduzetnik zone



Source: Colliers

a load capacity of 50 kN/m<sup>3</sup> to support automation and efficient operations within the warehouse. Such warehouses typically feature one modern loading ramp for every 800 to 1,000 m<sup>2</sup> of storage space, LED lighting and an advanced HVAC system to maintain optimal temperatures within the warehouse during both winter and summer. They are often certified by one of the international green building certifications, such as DGNB or BREEAM. In addition, the facilities are equipped with fire protection systems such as sprinklers or smoke detectors and they are enclosed

Building Permits Issued for Industrial and warehouse buildings					
Year	Number	yoy %	Floor area (sqm)	yoy %	Floor area (sqm) per building
2006	426		404,686 m <sup>2</sup>		950 m <sup>2</sup>
2007	357	-16%	564,416 m <sup>2</sup>	39%	1,581 m <sup>2</sup>
2008	325	-9%	341,632 m <sup>2</sup>	-39%	1,051 m <sup>2</sup>
2009	230	-29%	247,863 m <sup>2</sup>	-27%	1,078 m <sup>2</sup>
2010	237	3%	269,603 m <sup>2</sup>	9%	1,138 m <sup>2</sup>
2011	215	-9%	237,780 m <sup>2</sup>	-12%	1,106 m <sup>2</sup>
2012	173	-20%	178,330 m <sup>2</sup>	-25%	1,031 m <sup>2</sup>
2013	137	-21%	143,060 m <sup>2</sup>	-20%	1,044 m <sup>2</sup>
2014	186	36%	268,180 m <sup>2</sup>	87%	1,442 m <sup>2</sup>
2015	185	-1%	394,723 m <sup>2</sup>	47%	2,134 m <sup>2</sup>
2016	234	26%	311,656 m <sup>2</sup>	-21%	1,332 m <sup>2</sup>
2017	229	-2%	230,040 m <sup>2</sup>	-26%	1,005 m <sup>2</sup>
2018	282	23%	296,116 m <sup>2</sup>	29%	1,050 m <sup>2</sup>
2019	238	-16%	211,264 m <sup>2</sup>	-29%	888 m <sup>2</sup>
2020	242	2%	361,094 m <sup>2</sup>	71%	1,492 m <sup>2</sup>
2021	303	25%	459,982 m <sup>2</sup>	27%	1,518 m <sup>2</sup>
2022	291	-4%	554,060 m <sup>2</sup>	20%	1,904 m <sup>2</sup>
2023	277	-5%	623,103 m <sup>2</sup>	12%	2,249 m <sup>2</sup>
2024 (5)	122	7%	341,996 m <sup>2</sup>	48%	2,803 m <sup>2</sup>

Source: Bureau of Statistics, processing by Colliers



Source: Meridian 16 zona

from local authorities and the project team, which facilitates assistance, especially in the process of purchasing and obtaining permits. The zone hosts users who are also investors in storage capacities, as well as developers who have built according to the built-to-suit model to meet the needs of tenants. Some of the tenants or users within the zone include Atlantic Group, Eurospin Hrvatska, cargo-partner, Electrolux, Kuehne & Nagel, DHL, InterCars and many others.

and secured with surveillance cameras. Around the warehouse, there is a traffic solution in place to ensure smooth loading and unloading of goods, and the site includes an adequate number of parking spaces for cars, trucks and trailers. Modern facilities also have a modular layout that allows users to easily expand or reduce their capacity. They are located near larger cities, major roads, airports and similar infrastructures.

Such facilities typically host renowned companies that lease several thousand square meters or more to meet their long-term business capacity needs.

### Case study – Meridian 16 Business Park

The Meridian 16 Business Park is one of the largest business zones in Croatia, featuring larger and smaller plots of land for the construction of logistics and industrial facilities. It is located in Velika Gorica and is characterized by its proximity to the airport as well as its readiness for investors regarding ownership structure and infrastructure. Many users have settled in the Meridian 16 Business Park to meet their long-term logistics needs within modern storage capacities. The business park spans over 85 hectares of land, which is the result of twenty years of ownership consolidation efforts. Additionally, this zone has a unique concept as it is certified with the DGNB green certificate and follows the principles of green building.

In addition to straightforward buying and selling and the necessary infrastructure, users will get support

### Opportunities and challenges for Croatia

As a member of the European Union, Croatia has numerous opportunities for economic growth and development. In this regard, there are many possibilities for utilizing EU funds for infrastructure projects, digitalization and the development of renewable energy sources, which can increase competitiveness and reduce the need for energy imports. The negative aspects include demographic decline and underdeveloped transportation infrastructure, particularly regarding railway traffic, which is a significant transport channel for logistics. Reforms in the judiciary and public administration are necessary to improve the system's efficiency and attractiveness to investors. Insufficient economic diversification and reliance on tourism represent a weakness for Croatia because larger external shocks, such as global crises, can significantly impact its economy.

Logistics is increasingly shifting towards nearshoring, which presents an opportunity for Croatia. This is especially promising if infrastructure continues to develop, making Croatia an attractive option for companies looking to move closer to the European market. The Port of Rijeka offers a significant opportunity to connect the Mediterranean with Central Europe, enhancing Croatia's attractiveness and potential for attracting further investments.

# 02

## THE IMPACT OF INLAND TERMINALS ON THE CONNECTIVITY BETWEEN SEAPORTS AND HINTERLANDS



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*The hinterland transport system is important for planning and optimizing supply chains. The goal of connecting ports and hinterland is to achieve accessibility and overall cost efficiency with the required quality of logistics system organization.*



Container transport, as one of the most important transportation solutions of the 20th century, is directly linked to the growth of international trade. The increase in the growth rate of container transport leads to the establishment of container routes, and with the liberalization of global markets (globalization), there is also an increase in trade exchange, in which container transport plays a crucial role in the fast and secure transportation of goods between producers and end users.

Currently, there are approximately 500 regular container lines in the world (mostly operating on a weekly basis) that transport goods valued at over 14 trillion \$. When observing the financial value of maritime traffic and the types of goods involved, it is important to note that container traffic accounts for 52% of the total value of maritime trade, while the transport of crude oil, petroleum products and gas makes up 22% of the total trade value, and 26% is attributed to the transportation of bulk dry cargo.

The growth of container traffic has led to the creation of critical points in the supply chain, where overcrowding of port container terminals, congestion in ports, delays on access roads or inadequate railway networks create delays in cargo delivery and

increase overall transportation costs. Due to all of the above, seaports and maritime carriers are striving to achieve integration with the interior (hinterland) based on many road and railway networks. In this context, inland terminals can be viewed as “extended gateways” of seaports through which the transport of goods can be adjusted to the conditions at the port. The following text will illustrate the importance of connecting seaports and their hinterlands through inland terminals, which facilitate the alleviation of port surface congestion, increase the gravitational area and provide the same services as those offered at the port itself.

### FACTORS OF PORT COMPETITIVENESS

The goal of every port is to be more competitive than the surrounding ports in terms of its services, pricing and connectivity with the hinterland.

The increasing number of ships and containers arriving at the port presents port authorities with demands for greater productivity and faster cargo handling. These demands can be met by reconstructing existing capacities, expanding current capacities and/or those nearby and developing new capacities at new locations. The reconstruction of existing

spaces involves maximizing the utilization of current capacities through the redesign of terminals and the modernization of facilities and handling machinery, in order to maintain and increase handling capacities and enable the docking of exceptionally large container ships. The reason for implementing this strategy is the inability to expand the port to nearby locations. Examples of this strategy are the ports of Hamburg and Long Beach, which are located near city centers, limiting the possibilities for expanding port terminals. As a solution, the ports have built modern terminals equipped with advanced terminal management technology and handling machinery, which allows for the accommodation of exceptionally large ships as well as a high volume of containers. This has enabled an increase in productivity and efficiency of port operations and accelerated the shipment of cargo to the hinterland.

If there is potential for expansion near the port, the container terminal could be expanded to relieve congestion and thus gain a competitive advantage over other ports. At the same time, the port must adopt modern technology in order to provide quality services at competitive prices. An example is the Port of Singapore, which in 2003 constructed a container terminal with berths measuring 360 meters in length, equipped with automated quay cranes that could accommodate the largest container ships of that time (Shenzen, measuring 323 meters). With the construction of ships over 400 meters, the port built a new terminal in 2005 with a berth length of 418 meters. It was located closer to industrial facilities and achieved greater commercial value for the terminal. In addition to the Port of Singapore, this strategy has also been used by the ports of Hong Kong, Shenzhen and Port Klang.

In some cases, port authorities decide to construct new terminals away from the city center with the aim of long-term port development. The main reason for implementing this strategy is the urban expansion that hinders the growth of port spaces. The construction of new terminals can be located outside the boundaries of the city to which the port belongs, as exemplified by the Port of Shanghai. This strategy has also been employed by the ports of Busan, Dubai and Guangzhou.

It can be concluded that the largest ports in the world utilize all the aforementioned strategies to achieve a competitive advantage over other ports

and maintain their status as hub ports. However, the expansion of port capacity should be undertaken when the terminal's capacity does not meet future demand; otherwise, terminal congestion may happen, leading to delays within the entire supply chain. The most significant negative effects can be expected if congestion occurs in hub ports, which serve as the starting point of the supply chain, potentially leading to increased costs for all port users. An increase in congestion of 10% leads to a 0.7% rise in overall transportation costs, which is associated with the quality of logistics services. There is also a possibility when the terminal capacity exceeds future demand needs, leading to terminal overcapacity. This creates new costs for the terminal, which can affect the increase in overall handling costs. Terminal overcapacity is sometimes inevitable, especially in countries that have a significant imbalance between the volumes of cargo imports and exports. This creates a significant difference in the number of import containers – ports that accept containers are often filled with a large number of empty containers that must be stored somewhere due to a lack of exports from a particular country. In such cases, the port must adapt to the economic situation of the country and build spaces to store empty containers, for which it will not be able to charge for its services. Therefore, the plan for future expansion of the port and terminals should be carried out systematically, taking into account all aspects that may influence the development of the port. It is essential to determine the appropriate development approach, ranging from the modernization of existing capacities to the construction of new capacities, while adequately meeting the demand for services.

The development of a country's port depends on several factors, primarily the growth of the country's GDP, population growth, an increase in exports, heightened production resource intensity and a quality connection with the hinterland<sup>1</sup>.

In order for a port to become competitive and establish itself as a hub port, it must serve as a collection and distribution point for its national hinterland as well as for areas beyond its national borders. An example is the Port of Rotterdam, which serves as a receiving point for cargo for the Netherlands, the Benelux countries and regions in Northern, Central and Western Europe, as well as for shipping cargo from these countries and regions to other parts

1 Y. A. Park, F. Medda, „Classification of Container Ports on the Basis of Networks“: 12th WCTR, Lisbon, Portugal, 2010.

of the world<sup>2</sup>. The same is true for the Port of Singapore, which serves as a receiving point for cargo for countries in Southeast Asia, parts of India and nations in Oceanija<sup>3</sup>.

According to their functions, ports can be categorized into those that primarily serve as gateway ports, acting as an interface between continental and maritime cargo routing, and transshipment ports, which serve as an interface for the exchange of cargo on maritime routes [4].

The geographical location of seaports can be limited by:

- Access from the sea: The difference between high and low tides (the port should not be built in a location where the tidal difference exceeds three meters). The water depth must be sufficient to accommodate the largest container ships, measuring up to 400 meters in length.
- Characteristics of the coastal zone: There must be sufficient land area available onshore for the future expansion of the port.
- Infrastructure: A sufficient number of berths, cranes, warehouses and other facilities must be available.
- Access from the land: The quality of the transport infrastructure connecting the port with its hinterland<sup>4</sup>.

According to research, the factors that most influence a port's competitiveness include the port's productivity, transportation costs, adaptability to user demands and its status as a hub port<sup>5 6 7 8 9</sup>. Port competitiveness is also influenced by factors such as tradition and organization, accessibility, government support, productivity and connectivity with the hinterland.

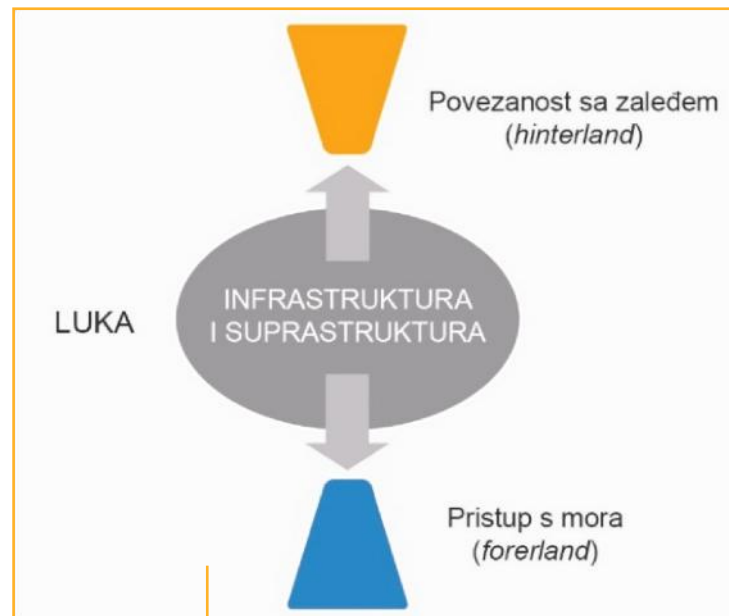


Figure 1 Structure of seaports

## CONNECTIVITY WITH THE HINTERLAND AS A FACTOR OF PORT COMPETITIVENESS

The transportation system in the hinterland is a crucial part of the supply chain. Selection methods, supplier choice and long-term strategic perspectives are important for designing an efficient hinterland transportation system and supply chain strategies. To be properly considered, the shipper must understand that hinterland logistics has unique characteristics and dynamics. The hinterland transportation system is no longer an isolated part of the supply chain but an integral part of the overall network and total offering. The logistics service provider must be able to manage both horizontal and vertical coordination and collaboration within the supply chain. Horizontal coordination is achieved by offering individual, multiple and combined modes of transportation. Vertical coordination is carried out by integrating various actors in the supply chain, such as carriers, shipping lines, ports, terminals and infrastructure managers, among others. Only in this way

- 2 R. Konings, „Opportunities to improve container barge handling in port of Rotterdam from a transport network perspective“, *Journal of Transport Geography*, 15:443–454, 2007.
- 3 K. Cullinane, W. Y. Yap, J. S. L. Lam, „The port of Singapore and its governance structure. Devolution“, *Port Governance and Port Performance*. Elsevier Ltd. Amsterdam. The Netherlands. 2007.
- 4 W. Y. Yap, „Container Shipping Services and Their Impact on Container Port Competitiveness“, *Institute of Transport and Maritime Management*, Antwerp, Belgium, 2009.
- 5 T. Notteboom, C. Coeck, J. Van den Broeck, „Measuring and explaining the relative efficiency of container terminals by means of Bayesian stochastic frontier models“ *International Journal of Maritime Economics*, 2(2):83–106, 2000.
- 6 J. Tongzon, W. Heng, „Port privatization, efficiency and competitiveness: some empirical evidence from container ports terminals“, *Transportation Research Part A*, 39:405–424, 2005.
- 7 P. De, „Total factor production growth: Indian port in the era of globalization“, *Maritime Economics and Logistics*, 8 (4):366–386, 2006.
- 8 S. Munisamy, G. Singh, „Benchmarking the efficiency of Asian container ports“. *African Journal of Business Management*. 5(4):1397–1407. 2011.
- 9 J. Wu, „The development of port and the container transport chain - A case study of Tianjin Port“ (Master's Thesis in Logistics and Innovation Management), University of Gefle, Sweden, 2011.

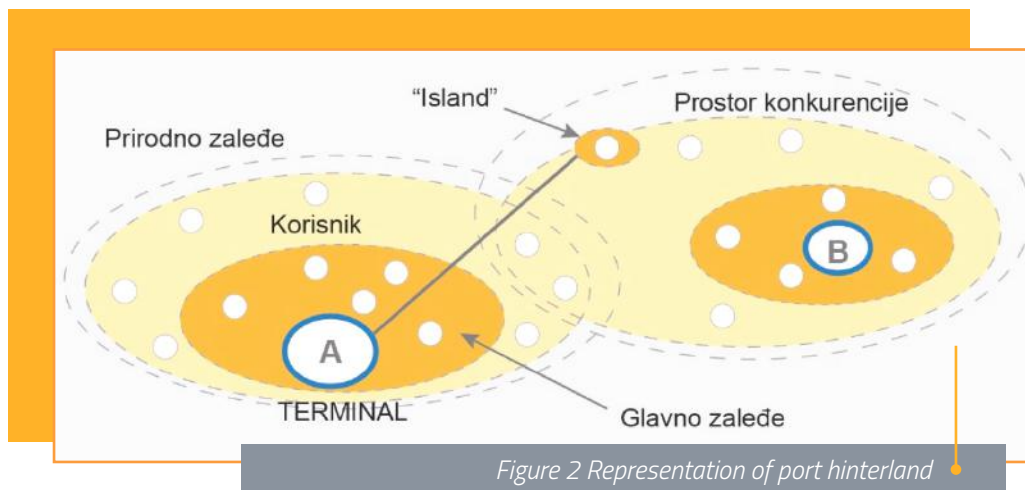


Figure 2 Representation of port hinterland

is it possible to manage the inherent advantages and disadvantages of individual modes of transportation and address the challenges of coordination among users.

As mentioned, various factors influence the development and competitiveness of a port, primarily connectivity with the hinterland, international cargo exchange and the political conditions of a particular country, as well as the ownership structure of the port.

It can be said that there is a close connection between maritime and land transportation (internal cargo transport). Until recently, each of these systems developed independently (Figure 1).

Every "significant" port must have good transport connectivity with its hinterland. Transport routes significantly impact the size of the hinterland, while regular maritime routes determine the extent of the port's foreland.

The hinterland is the area through which cargo transport centers, such as ports, sell their services and communicate with their users. It encompasses all customers directly connected to the terminal and the areas from which cargo is collected and transported.

The influence zone or access zone (foreland) of a cargo transport center consists of other cargo transport centers with which it is connected. For a port, this would represent other ports with which it is connected through maritime transport services. The same applies to airports. It can be said that the foreland is a mirror image of the hinterland.

There are two types of hinterlands:

- Fundamental hinterland, which refers to the area over which the cargo transport center has a

dominant market share; the majority of activities relate to the import and export of goods.

- Competitive hinterland, which refers to the area where two (2) or more cargo transport centers compete; therefore, important factors include cost, capacity, and so on.

In maritime ports, the foreland refers to the physical constraints of the location for conducting maritime operations. This includes the tidal range, specifically the difference between high and low tide. Classical container ships cannot withstand variations greater than 3 meters. The depth of water at the berth is also important for accommodating modern container ships. Modern Triple E container ships require a minimum water depth of 14.5 meters. However, about 70% of the world's ports have depths of less than 10 meters and cannot accommodate ships longer than 200 meters. Additionally, many ports are affected by sedimentation, especially those located at river deltas. This requires constant dredging (excavation of soil, spoil, sludge, mud, etc.), which increases the costs of port operations.

The goal of connecting the port and its gravity zones is to integrate the port system into a multi-modal transport network aimed at improving access to markets, cargo flow and integration into the industrial network. The port must have touchpoints between the main maritime trade routes and the economic activities in the port's hinterland. These touchpoints are represented by land (inland) terminals, which provide intermodal infrastructure and superstructure, as well as transport connectivity between the port and its hinterland. The level of multi-modality, quality and capacity of individual transport modes that connect the port and its hinterland can influence the expansion of trade<sup>10</sup>.

10 T. Notteboom, J.P. Rodrigue, „Port Regionalization: Towards a New Phase in Port Development“, *Maritime Policy & Management*, 32(3):297–31, 2005.

A strong and quality connection with the hinterland places certain demands on ports. First and foremost, this includes direct rail access to the port itself and connectivity with the rail network beyond the port's boundaries, as well as canals that connect it to the network of inland waterways, if such a network exists. In practice, such examples are rare, so before a container leaves the port, several unproductive handling operations must be performed, which undermine competitiveness compared to road transport. The solution to this problem lies in the design of the port space.

Ports strive for better connectivity with their hinterlands, with examples of various ports participating in the planning, development and sizing of land-based inland terminals. They connect with ports on inland waterways, facilitating and accelerating the transport of goods to the hinterland.

## METHODS OF CONNECTING SEAPORTS AND HINTERLANDS

The goal of connecting ports and hinterlands is to achieve accessibility and overall cost-effectiveness while maintaining the required quality of logistics. Achieving cost-effectiveness and quality in logistics largely depends on the ability to align the characteristics of the demand for material flows with the design components of the hinterland transport system.

In addition to the general characteristics of different modes of transport, it is also important to understand from the perspective of hinterland traffic that different geographical regions have significantly different prerequisites for a particular mode of transport. Therefore, there are significant differences between regions and countries when it comes to the use of different modes of transport. Some of the differences can be explained by geographical conditions. Other important factors include regulatory aspects, infrastructure status and occasionally technology.

Transportation corridors play a significant role in connecting ports and their hinterlands because they facilitate the shipment of goods to and from the port, enabling access to the hinterland. Due to the increasing global container traffic and the rising number of containers in seaports, new methods for dispatching containers from the port are emerging. One way to meet the quality of transport service and business as well as environmental requirements, without significant investments in the development

and improvement of port operations, is to enhance transport services to the hinterland by using rail transport and/or inland waterways, along with the development of a network of inland terminals.

Therefore, to provide a quality transport service between the port and inland terminals, it is necessary to ensure interoperability among different modes of transport and to analyze the structure and intensity of goods flows in a specific area to reduce transport costs and increase the security of supply for a particular market or market segment. With the continuous increase in the volume of handled containers and the ports' efforts to expand their gravitational zone, the transport modes mentioned are becoming an increasingly important aspect in the delivery of cargo to the hinterland of ports, primarily due to their low transport costs.

Ports increasingly rely on rail transport to ship containers out of the port as quickly as possible. Similarly, they also rely on inland waterways, where possible, to transport cargo to their hinterland in the most cost-effective and environmentally friendly manner. Special facilities in the hinterland, known as inland terminals, are required to receive these containers, where logistics services can be performed on the containers with cargo and then distributed to their final destination.

## IMPACT OF INLAND TERMINALS ON THE CONNECTION BETWEEN SEAPORTS AND HINTERLAND

Seaports are facing significant changes in their operations due to the increasing capacity of container ships and the logistical demands of users. Measures taken by seaports to enhance competitiveness vary depending on the complex business environment in which they operate [13]. Therefore, the criteria used by users to select a seaport are numerous. Some of them are:

- quality connectivity with the hinterland and the market in the port's gravitational area,
- constant support from logistics operators near the seaport,
- high involvement of the private sector in port operations,
- sufficient space for the expansion of the port and its capacities,
- reduction of transportation costs through the

inclusion of logistics operators<sup>11</sup>.

Fast and efficient cargo handling, reducing ship waiting times, expanding storage capacities and establishing quality connections with the hinterland represent significant financial, organizational and operational demands that not all global ports can meet. Those that can meet these demands become hubs for maritime and land transport and generators of cargo flows, as well as the most important transport hubs for specific regions, continents and the world, while others strive to maintain their market share.

The challenges faced by almost all global ports include optimizing the storage process, ensuring quality connections with the hinterland and meeting client demands for faster, cheaper and higher-quality cargo dispatch. Some of the criteria for selecting a port for cargo handling are related to the overall transport network, specifically the quality of its connection with the hinterland, which enables the fast and efficient dispatch of cargo to end-users and the expansion of its own gravitational area, allowing it to attract additional cargo volumes<sup>12</sup>.

The alleviation of storage spaces in the port, improved connections with the hinterland and the attraction of additional cargo volumes lead to the development of inland terminal systems. For the largest ports, this helps to relieve their storage capacities, while for less developed ports, it becomes a competitive advantage by enabling better connections with the hinterland and attracting new cargo volumes.

The system of inland terminals is most often seen as a way to relieve port storage areas. More recently, it has been recognized as a means of extending the port's gravitational zone, serving as a competitive advantage for individual ports and also as a place for servicing their own gravitational area. All of the above defines inland terminals as locations or



Figure 3 View of the inland terminal in Graz

facilities for extended activities of seaports, making them an integral part of the port.

Inland terminals are becoming an additional component in the contemporary supply chain and with intermodal transport, they enable the acceleration of transport processes and a reduction of total transportation costs by up to 20% through the use of rail transport. An inland terminal can be described as a facility that encompasses a wide range of logistics activities and systems in the hinterland of seaports, aimed at maintaining high service quality and meeting the demands of increasing cargo flows arriving at the ports.

In order to meet these objectives, ports must expand and develop new areas, facilities and equipment for loading, unloading and storing goods. Inland terminals represent a system situated in the hinterland of an industrial or commercial area, connected to one or more ports via rail, road transport or inland waterways. Inland terminals are the result of the development of the concept of transporting goods from ports to the interior of the continent, i.e., the improvement of cargo transportation to the port's hinterland. One of the most important tasks of back terminals is the collection of goods for overseas transport and from overseas transport over

11 T. Notteboom, W. Y. Yap, „The Interdependence between Liner Shipping Networks and Intermodal Networks” Proceedings of the Annual Conference of the International Association of Maritime Economists (IAME). 13–15, 2011.

12 C. Ferrari, F. Parola, E. Gattorna, „Measuring the quality of port hinterland accessibility: The Ligurian case”, Transport Policy, 1(2):382–391, 2011.





long distances, as well as the distribution of goods at local, regional and international levels. This is achieved by using various modes of transport (rail, air, road and inland waterways) that facilitate the further distribution of goods arriving from seaports.

These systems, in addition to providing additional services such as customs clearance, storage, packaging, repackaging, data updating and more, are multimodally oriented and equipped with all the necessary logistics services, facilities and equipment needed by shipping companies and freight forwarders from seaports.

Inland terminals, on the one hand, relieve the port container terminal and increase throughput by up to 40% without the need to build additional container storage areas. On the other hand, an inland terminal with sufficient space allows for the distribution of containers to their inland destinations and provides easier road access compared to the seaport [8].

## IMPACT OF INLAND TERMINALS ON PORT COMPETITIVENESS

Inland terminals help maintain competitiveness by improving the performance and capacity of seaports, enhancing the accessibility of the port's hinterland, diversifying port services and increasing overall traffic.

The inclusion of inland terminals in the port container system can improve the performance of seaports, primarily through an increased frequency of container ship arrivals, which requires not only a quality connection with the hinterland but also operational productivity at the berth<sup>13</sup>. This includes enhancing reliability in cargo distribution to end-users<sup>14</sup>, improving the efficiency of seaports<sup>15</sup>, reducing transportation costs<sup>16</sup> and increasing the productivity of port terminals (reducing the time ships spend in port)<sup>17</sup>.

The inclusion of inland terminals in the system of seaports enables the improvement of port efficiency by reducing the dwell time of ships and land transport

vehicles in the port, providing suitable pickup and delivery times for cargo in the port and minimizing the storage time of cargo at the port.

If a seaport is connected to its hinterland through an inland terminal that can accommodate various modes of transport (road, rail and inland waterways), it will enable its users to efficiently dispatch cargo within the desired timeframe, increase response speed to customer demands, reduce cargo dwell time in the port and attract additional cargo due to available space in the container yard. This will also reduce transportation time to the end user and in the end enhance the productivity, efficiency and quality of port services.

Inland terminals can extend the gravitational area of the seaport deep into the hinterland and increase the port's competitiveness by moving its network beyond its borders. The connection with the hinterland increases the overall network efficiency, which is a key factor in reducing "door-to-door" transport costs and thus the total cost of the entire supply chain as a decisive factor. The transition from "port-to-port" service to "door-to-door" service allows ports with strong connections to the hinterland to achieve greater value.

Thus, the attractiveness of the port is related to the attraction of the supply chain, of which it is a part. That supply chain is more efficient and therefore more attractive if the hinterland of the supply chain is more efficient. For this reason, port authorities must promote the development of their port's hinterland. When the hinterland of a port expands, its accessibility increases, strengthening economic activities.

## EXPANSION OF THE PORT GRAVITATIONAL AREA USING THE CONCEPT OF INLAND TERMINALS

If a seaport is connected to its hinterland through an inland terminal that can accommodate various modes of transport (road, rail and inland waterways), it will enable its users to efficiently dispatch cargo within the desired timeframe, increase response speed to customer demands, reduce cargo

13 D. Langen, L. M. Lugt, „Government Structure of Port Authorities in the Netherlands: Devolution, Port Governance and Port Performance“, *Journal of Transportation Economics*, 17:109–137, 2007.

14 A. Ballis, J. Golias, „Comparative Evaluation of Existing and Innovative Rail–Road Freight Transport Terminals“, *Journal of Transportation Research: Part A*, 36:593–611, 2002.

15 A. K. Ng, G. C. Gujar, „Government Policy, Efficiency and Competitiveness: The Case Study of Ports in India“, *Journal of Transport Policy*, 16:232–239, 2009.

16 V. Roso, K. Lumsden, „A Review of Dry Ports“, *Journal of Maritime Economics and Logistics*, 12:196–213, 2010.

17 A. Beresford, S. Petit, Q. Xu, S. Williams, „A Study of Dry Port Development in China“, *Journal of Maritime Economic and Logistics*, 14:73–98, 2012.

dwelling time in the port and attract additional cargo due to available space in the container yard. This will also reduce transportation time to the end user and in the end enhance the productivity, efficiency and quality of port services.

The emergence of inland terminals as extensions of seaports enhances the connection between seaports and their hinterlands by creating transportation networks that provide high accessibility to the hinterland, thus expanding the port's gravitational area.

Inland terminals can extend the gravitational area of the seaport deep into the hinterland and increase the port's competitiveness by moving its network beyond its borders. The connection with the hinterland increases the overall network efficiency, which is a key factor in reducing "door-to-door" transport costs and thus the total cost of the entire supply chain as a decisive factor. The transition from "port-to-port" service to "door-to-door" service allows ports with strong connections to the hinterland to achieve greater value<sup>18</sup>.

### EXPANSION OF THE PORT'S GRAVITATIONAL AREA THROUGH THE CONCEPT OF INLAND TERMINALS

Connecting the port and hinterland through inland terminals reduces transportation costs, surpasses competition and helps seaports provide efficient services to their users. The existence of inland terminals enhances the connection between the port and its hinterland by shifting the vertical coordination between transport modes, increasing container traffic density along the supply chain and improving the interregional intermodal network. Modal transition through inland terminals contributes to a cooperative transport network that has a significant impact on ecological, social and economic benefits, reducing traffic congestion to enhance the competitiveness of the supply chain.

The appropriate location of the hinterland in relation to the port reduces transportation costs and increases the trade of locally produced goods in the global market. The role of the seaport in the hinterland includes other activities such as verifying transportation documentation, providing tailored services and ensuring storage space for containers, which positively impacts the efficiency of port operations.

From the perspective of the port's life cycle, the

ability of inland terminals to act as an extension of port operations inland is crucial for increasing port productivity by enhancing traffic through the port and reducing unit transport costs. This represents the quality of the seaport for users, enhances the reputation of the seaport and ensures long-term reliability in cargo flow for the port.

### POSSIBILITY OF EXPANDING PORT CAPACITIES THROUGH THE CONCEPT OF INLAND TERMINALS

Inland terminals provide space and facilities to take on certain functions of the port inland (in the hinterland). As a result, the seaports gain additional space and provide extra facilities for operations through them. In other words, the connection between seaports and inland terminals increases the capacity of these ports and reduces their congestion and limitations for further expansion.

The growing flow of containers in any port leads to congestion in technological processes within the ports (at the port's entrances/exits, berths and container yards), significantly increasing the dwelling time of containers and ultimately causing delays in the arrival of ships at the ports and the delivery of cargo. The use of inland terminals to perform logistics functions and provide customs services and other value-added services helps seaports mitigate the drawbacks of spatial constraints. Therefore, the spatial capacity provided by the inland terminal attracts users with minimal impact on the cost of handling and the transportation of goods, as well as the time of delivery. It also provides them with additional space for port operations.

The facilities, equipment and services of inland terminals facilitate the distribution of containers, documentation verification, provide value-added services and enable effective management of containers outside the port, in the same manner as in the seaport.

### CONDITIONS AND PERSPECTIVES FOR SUCCESSFUL INTEGRATION OF INLAND TERMINAL SYSTEMS

Congestion, fuel consumption, environmental pollution and unladen journeys encourage the consideration of inland terminal systems as the next step in regional freight transport planning. More environmentally friendly modes of transport are used to connect ports with their hinterlands, specifically with inland terminals, thus reducing the trend of

<sup>18</sup> J. Hintjens, „A conceptual framework for cooperation in hinterland development between neighbouring seaport authorities“, *Maritime Policy & Management*, 45(6): 819-836, 2018.

transporting goods by road, which impacts the reduction of environmental pollution and lowers external transport costs.

External costs are those that relate to society as a whole. These include congestion, pollution, accidents and infrastructure wear and tear.

Inland terminal, as an intermodal terminal, facilitates the transition to sustainable transport modes such as rail and inland waterways, alleviating road traffic and reducing congestion, thus decreasing emissions and promoting more efficient land use.

Therefore, the process of planning, constructing and managing an inland terminal is a process of multiple integration:

- Integration into the logistics chain encompasses the spatial and functional dimensions of an inland terminal, with a particular emphasis on its role in alleviating pressure on the connected seaport. Effective alleviation of the capacity of a seaport or transportation link capacity can only be expected if complete integration between the seaport and the inland terminal is achieved.
- Integration into the strategies of individual companies encompasses the economic dimension of inland terminals, with a particular emphasis on entrepreneurial control of the logistics chain by the main economic actors. The connection between inland terminals and seaports can be organized in various ways, but the closer the connections, the better the chances for implementing coordinated cooperation and integrating the inland terminal as an integral part of the port.
- Integration into regional and interregional structures encompasses the management dimension of inland terminals, with a particular emphasis on mediating between the various interests of local stakeholders, including residents and organized interest groups. This type of management and coordination is primarily organized by the state or public administration. In addition, managing relationships between companies, networks and business associations is an increasingly important task<sup>19</sup>.

If a combination of all three factors is achieved, there is a strong chance that the concept of an inland terminal can be successfully implemented in collaboration with the appropriate seaport. Regarding the complexity of integration requirements, it should

be emphasized that the management dimension is crucial for the concept of an inland terminal. Consequently, appropriate structures and institutions must be established because coordination of interests, decisions and actions typically does not function in an uncoordinated self-organization<sup>20</sup>.

## POSSIBILITIES FOR THE IMPLEMENTATION OF AN INLAND TERMINAL SYSTEM IN THE REPUBLIC OF CROATIA

It is well known that the Republic of Croatia is situated in a favorable geostrategic position, although it has not yet managed to fully utilize its full potential.

In 2023, a revision of the TEN-T network was conducted. The European transport network generally consists of nine corridors and Croatia is currently only on two corridors. However, with the newly adopted amendments, it should be included in four corridors, namely:

- Mediterranean Corridor;
- Rhine – Danube Corridor;
- Baltic – Adriatic Corridor;
- Western Balkans – Eastern Mediterranean Corridor;

With these amendments to the TEN-T Regulation, 450 km of new railway lines (e.g., the Istrian and Podravina railway sections), 430 km of roads (e.g., Zagvozd - Imotski - DG), 8 new ports (Korčula, Stari Grad, Hvar, Supetar, Preko, Rogač, Rab and Cres in addition to the already existing ports of Pula, Rijeka, Zadar, Šibenik, Ploče, Dubrovnik and Split) and 5 new urban nodes (Osijek, Varaždin, Zagreb, Rijeka and Split) will be included. This makes Croatia the country with the largest proportional change to the TEN-T network in Europe.

The Rijeka Gateway project is one of the most comprehensive transportation projects in the Republic of Croatia.

The Rijeka Gateway project is managed by a consortium of bidders (APM TERMINALS / ENNA LOGIC), which includes Maersk, the world's leading provider of logistics services in container cargo transportation. An investment of over 400 million euros is planned for the Rijeka Gateway project, which includes the development of a new terminal, the construction of storage facilities and the acquisition of state-of-the-art cargo handling equipment. This project aims to

19 J. Hintjens, „A conceptual framework for cooperation in hinterland development between neighbouring seaport authorities“, *Maritime Policy & Management*, 45(6): 819–836, 2018.

20 M. Kühn, K. Seidel, J. Tholen, G. Warsewa, „Governance and Conflict Resolution in Dryport Planning. A pilot study by the Institute of Labour and Economy (iaw) of the University of Bremen“, 2012.

improve the quality of cargo dispatch to the hinterland and will eventually employ approximately 300 people. It is predicted that the traffic of the container terminal in the first phase will amount to approximately 650,000 TEU, while in the second phase, the traffic will amount to over 1,000,000 TEU. Considering that the "Brajdica" container terminal is currently operated under the concession of Jadranska vrata, with a traffic of approximately 390,000 TEU, Croatia ranks on the map of key logistics destinations in Southeast Europe with a total of two container terminals.

Large investments in port infrastructure and the expansion of container terminal capacities will attract container ship operators. However, for Croatia to be fully integrated into key commodity flows in Europe and the world, it is essential to dispatch all cargo arriving by ship at the Port of Rijeka to their final destinations as quickly and cost-effectively as possible.

All of the above is unimaginable without a quality connection to the hinterland and the development of a system of inland terminals in Croatia, as well as without better development of intermodal transport (railway networks) and the construction of quality and modern logistics facilities (inland terminals) designed for the type of cargo that will be processed at the terminal.

Of course, the key is to determine a quality location for the infrastructure that will enable the provision of quality cargo services, efficient transportation services and a reduction in overall transportation costs. The number and location of logistics facilities (inland terminals) in the transportation network directly impact the final product price. To ensure that inland terminals efficiently carry out their tasks in the qualitative and quantitative selection process of specific locations, the following conditions must be met:

- **Position:** The position in the transportation network is crucial for attracting potential users and the location should be at the center of the main cargo flow.
- **Area:** The required area of the inland terminal, according to standard practice, is determined by specific needs and technological requirements.
- **Connection:** Connecting to the public road network, road and rail corridors and other infrastructure should be achieved in an adequate manner. When it comes to road transport, the ideal situation is when this connection can be made via a dedicated junction with the highway; in the worst case, this connection must be made through a high-ranking road. To ensure good connectivity with the railway network, the location of the cargo transport center should be close to the main

railway lines. If natural conditions allow, a connection should also be established with inland waterways and seaports through inland terminals that can accommodate container and Ro-Ro cargo.

- **Alignment:** The alignment of the economy and strategic transport management significantly impacts the formation of transportation and logistics service prices. Forecasting market supply and demand allows logistics service providers to adapt more easily to potential market changes. Strategic transport management encompasses long-term plans for managing transportation (such as building transport infrastructure, providing incentives for environmentally friendly vehicles, etc.), which allows logistics service providers to plan investments more easily in specific business sectors.
- **Proximity:** The proximity to users or consumers directly affects the potential number of services provided and, consequently, the profit generated. Therefore, it is important to position the cargo transport center in a location with a large number of potential users and clearly define its function.
- **Availability and flexibility:** The availability and flexibility of the workforce are important for the quality and efficiency of service delivery, which maximizes productivity.

The development of intermodality and the positioning of inland terminals according to defined conditions will attract additional cargo volumes, efficient distribution of goods, relief of supply chain activities and a reduction in overall transportation costs. This will position Croatia as a strategic entry/exit point for Central and Southeastern Europe, with the Port of Rijeka serving as the main transportation hub.

If not addressed, the total cargo volume expected for both container terminals will not be processed efficiently. This will place the entire transport burden on road transport, leading to congestion on access roads near the port, overcrowding of highways, state and county roads, increased emissions of exhaust gases, and, ultimately, higher overall costs. This would result in Croatia once again being overlooked as a key logistics hub for Central and Southeastern Europe.

## CONCLUSION

It can be assumed that future port container terminals will be constructed in locations near the intersections of the most important maritime routes, taking into account weather conditions, water depth, expansion potential, various legal requirements and the availability of a skilled workforce.

In addition, the quality of hinterland connectivity will play a significant role in the positioning of container terminals, particularly the proximity to existing railway corridors and/or inland waterways. This will enable faster cargo dispatch to the hinterland and reduce environmental impact by using less polluting transport modes. Similarly, in the interior, inland terminals will be constructed near these corridors, designed as local and regional cargo transport centers. These terminals will serve to consolidate cargo for further shipment via maritime routes and act as hubs for local and regional distribution.

In this way, the development of inland terminals will become a crucial link in the maritime and global logistics chain, as well as in the just-in-time system.

It can be concluded that for the implementation, quality operation and development of port hinterlands, cooperation and collaboration among all stakeholders is essential. This includes not only the maritime ports and shipping companies but also the managers of port and inland terminals, road and rail operators, customs authorities and the national, regional and local governments where the construction of inland terminals is planned.

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03

# WHAT INDUSTRY THINKS ABOUT LOGISTICS INFRASTRUCTURE?

We have discussed about the current and very important issue of logistics infrastructure in the Republic of Croatia with Srebrenka Saks, Country Manager at DHL Express Croatia

## Do you think that the logistics infrastructure in Croatia is at a satisfactory level?

The logistics infrastructure in Croatia has made progress in recent years, but it still faces challenges. The country has a strategic position along key trade routes and access to the Adriatic Sea, which is beneficial for maritime logistics.

However, issues such as the maintenance of roads and railways, capacity limitations and intermodal connectivity can affect efficiency. While large cities have decent infrastructure, rural regions may not be as well-equipped. Continuous investment in transportation networks, modern facilities and technology is essential for improving logistics capabilities and meeting growing demands. In general, while there are advantages, there is still room for improvement to achieve a fully satisfactory level.

## When comparing with the level of logistics infrastructure in Western countries, how do the shortcomings manifest?

When comparing Croatia's logistics infrastructure with that of Western countries, several shortcomings are revealed. Although there are major highways, many rural roads, especially railway lines, require upgrades, which affects the speed and reliability of transportation. Efficient transitions between different modes of transportation (e.g., from road to rail) are limited in Croatia, while Western countries have well-integrated systems that facilitate smooth transfers. Although Croatia has key ports, they lack the facilities that can be found in larger Western ports, which can hinder the handling of bigger ships and larger volumes of cargo. The adoption of advanced logistics technologies and smart solutions is slower in Croatia, impacting efficiency and transparency in supply chain management



compared to more developed markets. Overall investments in logistics infrastructure are generally lower in Croatia, which affects the development of modern warehouses, distribution centers and logistics parks. These factors combined can result in higher costs and longer delivery times compared to Western partners, highlighting the need for continuous development and modernization of logistics infrastructure in Croatia.

### Does Croatia lack specific strategies and certain forms, such as leasing or renting space, for carrying out logistics activities?

There is always room for improvement when it comes to specific strategies regarding logistics activities. Although there are national transport and logistics strategies, they lack specific, effective plans focused on modern logistics practices and property development. The availability of specialized logistics spaces is restricted, especially in areas outside major urban centers. This can restrict companies looking to expand or optimize their operations. There is a demand for more varied models that meet different business needs, such as short-term rentals or flexible lease agreements that can adapt to fluctuating market requirements. Increased incentives for private investments in logistics facilities could help stimulate the market.

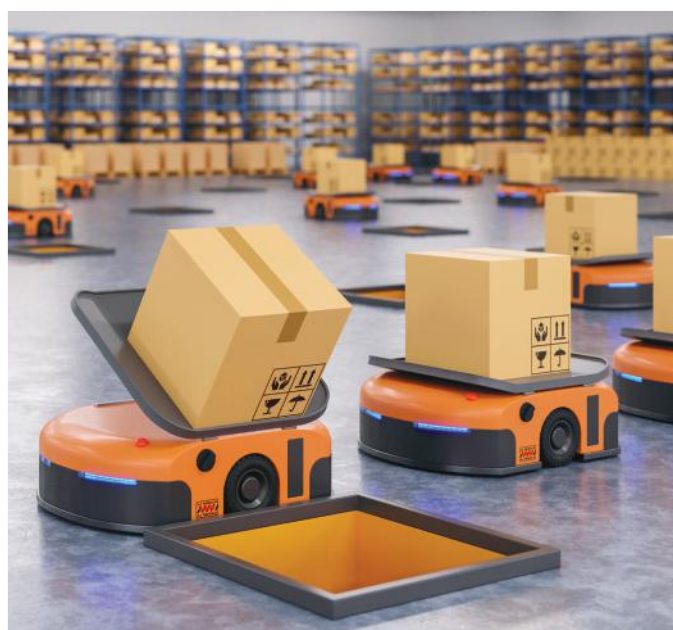
### Do you believe that the state-level strategies and incentives supporting the construction of sustainable infrastructure and environmentally friendly practices are sufficient?

They have certainly made some progress, but it is not enough to fully address the challenges and potentials in this area. Croatia has frameworks for sustainable development, including environmental protection laws and EU directives. Although there

are initiatives to promote green technologies and sustainable practices, the levels of investment are not adequate compared to the level of needs, particularly in transport and logistics. There are incentives for companies to adopt sustainable practices, such as EU financing programs. However, they are not widely accessible or well-advertised, which restricts their effectiveness. Greater efforts are needed to raise awareness among companies and local authorities about the benefits of sustainable practices and the support available. There is a lack of a long-term vision and strategy aligned with the broader EU sustainability goals that would ensure that the infrastructure development is both environmentally and economically sustainable. In general, while positive steps are being taken, enhancing the comprehensiveness and effectiveness of state-level strategies and incentives is crucial for promoting sustainable infrastructure and environmentally friendly business practices in Croatia.

In terms of procedural simplicity for infrastructure development, could it be organized differently? For example, in Slovenia, the incentives, administration and strategies for developing industrial and logistics zones are more encouraging.

There is always room for improvement and increased efficiency. Simplifying and shortening the process of issuing building permits can encourage investment. Transparency and access to the







necessary information and requirements for infrastructure projects can enhance clarity and efficiency. Providing clear, standardized guidelines and timelines for the approval process can help reduce uncertainty for companies looking to invest in logistics and industrial zones. Collaboration between the government and the private sector in the planning and implementation of infrastructure projects can lead to more

innovative solutions and faster execution. Involving local communities and stakeholders early in the planning process can help identify issues and simplify approvals, as seen in Slovenia. By adopting some of these approaches, Croatia could create a more favorable environment for infrastructure development. This can support economic growth and competitiveness in logistics and industry.

# 04 10TH INTERNATIONAL CONFERENCE – ERGONOMICS 2024



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**ERGONOMICS 2024** is an international conference in the “Ergonomics” series organised by the Croatian Ergonomics Society since 2001 and co-organised by the University of Zagreb Faculty of Transport and Traffic Sciences, University of Zagreb Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb Faculty of Graphic Arts and University of Zagreb Faculty of Textile Technology. The Conference traditionally gathers enthusiasts, experts and scientists from around the world to exchange the newest ideas and research in all fields of ergonomics.

The 10th International Ergonomics Conference – ERGONOMICS 2024 will take place from 5 to 6 December 2024 at Hotel International, in Zagreb, Croatia. The fact that the conference is in December when the world-famous Zagreb Advent season is back in full glory, makes the conference even more special.



## Who we are?

Croatian Ergonomics Society (CrES) was established at the founding Assembly on 20 May 1974 in Zagreb. It is one of the oldest societies in Croatia that is interdisciplinary and brings together people from diverse scientific groups. Also, CrES has a good relationship and collaboration with ergonomics professionals and societies from neighbouring countries. CrES is a member of the IEA (International Ergonomics Association) and of FEES (Federation of the European Ergonomics Societies).

## Why is this conference special?

The Conference ERGONOMICS 2024 will be the jubilee 10th conference, as well as the celebration of 50 years of CrES.

Over the years, the conference in the series "Ergonomics" has brought together respected professionals and researchers from Croatia and from all over the world.

## What topics are included?

Group of topics (not limited to) where the participant can participate according to their interest are:

- Aesthetics and Ergonomics
- Biomechanics and Modelling in Ergonomics
- Cognitive Ergonomics
- Education and Training in Work Safety and Ergonomics
- Ergonomics for People with Disabilities and Aging Population
- Ergonomics in Product and Process Design
- Ergonomic Regulations, Standards and Guidelines
- Healthcare Ergonomics
- Physical Ergonomics and Human Factors
- Human Comfort
- Safety and Risk Ergonomics
- Psychoacoustic Ergonomics
- Social and Occupational Ergonomics
- Traffic and Transport Ergonomics
- Consumer Ergonomics
- Packaging and Ergonomics.



*Ergonomics encompasses a broad range of disciplines; the presented topics are just a portion of those addressed at the conference.*

### Visibility and acknowledgement of the conference

Furthermore, ERGONOMICS 2024 is endorsed by the International Ergonomics Association (IEA), Federation of the European Ergonomics Societies (FEES), – Acoustical Society of Croatia (ASC) and The Centre for Registration of European Ergonomists (CREE). These endorsements emphasise the importance of the conference as well as the role of the Croatian Ergonomics Society in ergonomics in the world.

Other ergonomics societies have recognised the significance of the conference ERGONOMICS 2024, therefore this conference is supported by the Polish Ergonomics Society, Ergonomics & Workplace Management Society, Chinese Association of Ergonomics Societies, Ergonomics Society of Taiwan, Hong Kong Ergonomics Society and Chinese Ergonomics Society.

The Ministry of Labour, Pension System, Family and Social Policy as well as the Croatian Academy of

Engineering are also supporting the conference ERGONOMICS 2024.

### Conference highlight

Proceedings indexed in Scopus with full texts of all accepted and reviewed papers will be published by Springer titled “Proceedings of the 10th International Ergonomics Conference – ERGONOMICS 2024”.

The best high-quality papers from the conference will be selected for publication in the following journals: Interdisciplinary Description of Complex Systems, Technical Journal, Traffic & Transportation and Sigurnost (Safety).

For more info about the conference, you can visit our web site <https://h-e-d.hr/conferences.htm>.

“Join us to gain insights into state-of-the-art research with leading experts in ergonomics. Do not miss this opportunity to expand your knowledge and make international connections with experts from various disciplines!”



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