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Container transport flows as a prerequisite for determination of inland terminal location

Tomislav Rožić[1], Marjana Petrović[2], Dario Ogrizović[3]

[1] University of Zagreb, Faculty of Transport and Traffic Sciences, Vukelićeva 4, 10000 Zagreb, Croatia
[2] University of Zagreb, Faculty of Transport and Traffic Sciences, Vukelićeva 4, 10000 Zagreb, Croatia
[3] University of Rijeka, Faculty of Maritime Studies Rijeka, Studentska ulica 2, 51000 Rijeka, Croatia

ABSTRACT

Container cargo flows in the Republic of Croatia have been insufficiently explored, as well as the quantity and destination of containerized cargo flows between the port of Rijeka and its hinterland. This paper defines containerized cargo flows between the port of Rijeka and its hinterland destinations by road and rail transport means. Based on the analysis of container cargo flows the potential location for inland terminal construction is defined in terms of shifting of container flows from road to rail.

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1. Introduction

Continuous international trade growth and container market enlargement entails problems in the ports storage efficiency and traffic congestions. Transportation systems, particularly maritime transport, are faced with the growing demand to increase capacity and decrease transportation cost toward final destinations. All participants related to the global supply chain make efforts to improve ports transport connectivity with their hinterland in order to transport containers to the end users in the shortest time possible, relieving container storage space in ports. The linkage between the ports and their hinterland results in relieving container storage space in ports. Storage space relieving without excessive investments in infrastructure is possible by implementation of inland terminals, where all operations with containers can be performed just like in the port, providing quality transport to end users. Proper inland terminal location enables less congestion, reduces air pollution by using intermodal transport and reduces overall transportation costs.

Defining of the location of inland terminal affects the function of the terminal together with other factors related to the attractiveness of the terminal. The competitive advantage of inland terminal location should be the possibility of attracting additional cargo flows. This paper will discuss the effect of containerized cargo flows on determination of the inland terminal location, for which the container cargo flows between the port of Rijeka and its hinterland have to be analyzed. The analysis of containerized cargo flows will serve as the basis for the proposal of potential inland terminal locations.

2. Inland terminal classification

Ports and maritime carriers are trying to implement integration with the inland (hinterland), based on suitable road and rail networks [32]. Inland terminals are observed as extended gates of seaports, through which transport of goods can be customized to the port conditions [33]. There is no single definition classifying the inland objects. In available literature inland objects, as important network objects, can be defined as dry ports, inland terminals, inland ports, inland hubs, logistic inland centres and freight villages [17].

The diversity of terminology appears in different geographical environments, offering a variety of services and functions, and includes different subjects. The classification of inland objects depends on the parameters which classify them [15]. These parameters are transport functions (road, road / rail, road / inland waterways / road / rail / inland waterway terminal), size parameter and logistics functions (only customs operations, basic warehouse jobs, wide range of services, manufacturing activities, ac-

tivities of retail sale and wholesale) [20]. They are distinguished according to the distance from the ports (short, middle and long distance) and to ownership structure (owned by ports, rail operators, certain regions, public-private ownership).

The most used terms for describing inland objects are inland terminals, dry ports and inland ports. The mentioned terms are used for defining inland objects where it is possible to conduct different kinds of manipulation with the cargo and activities related to the value-added services.

Among other terms, the term "dry port" is used for defining an inland object when it is important to show that some object reached a certain level of sophistication regarding the offered services [16] [27] [30].

The term "inland ports" represents inland objects of different types and various sizes that offer a wide range of logistic services and have different forms of ownership. Inland ports are usually located near production regions. These types of terminals are mostly used in the USA. They are much larger in comparison with the ones in Europe, storage capacities are much higher and the volume of containers often exceeds several hundreds of thousands. In the USA 89% of containers are domestic containers that do not require performing any kind of custom duties.

The term "Inland terminal" is a suitable way to define a prospective inland object in Croatia, because it represents a modern intermodal terminal offering the basic functions of intermodal terminals (cargo handling for different modes of transport) together with a wide range of logistics services (functions). Logistics functions within the inland terminal depend on different participants in the ownership structure, which have been integrated in the establishment, development and inland terminal operation. This type of terminal consists of three basic components: intermodal terminal, logistic activities and transportation corridor that has high capacity towards the port. Some of the mentioned inland objects are simple terminals, but others can represent complex objects that include logistic zones and different management structures.

3. Definition of the research problem

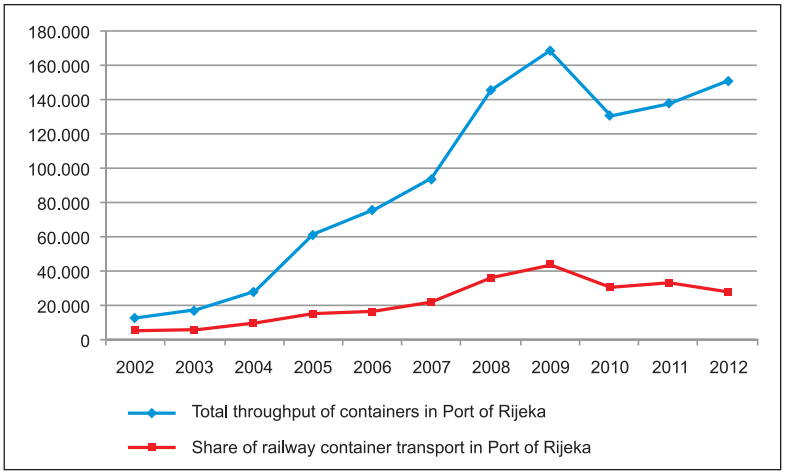
The Port of Rijeka logistics infrastructure in Croatia has been gaining greater local, regional and global significance, because the Port of Rijeka is the largest and most important port in Croatia, and it is also the end point for very important branch B on the Pan-European Corridor V.

The Adriatic Gate Container Terminal "AGCT" is the concessionaire of container terminal Brajdica, constituted in 2001 as a subsidiary of the Port of Rijeka. From 2011, AGCT has collaborated with the International Container Terminal Services Inc. (ICTSI), the international corporation that operates with 21 container terminals across the globe. AGCT operates in a successful public-private partnership, in which ICTSI has the ownership share of 51% and the Port of Rijeka accounts for 49%. The ICTSI is making AGCT into the strongest port for container traffic in the Central and South Eastern Europe market. In the first 20 years of concessions AGCT planned to invest 70 million euro in container terminal Brajdica in order to enlarge the annual turnover of container terminal to 245,000 container units (TEU) by the year 2015. The Port of Rijeka and AGCT total turnover in 2012 was 4.5 million tons of cargo and container terminal turnover was 128,680 TEU.

An additional problem of the Port of Rijeka is very limited space for possible expansion and certainly not enough space for the amount of container cargo that is planned in the next decade. The inland terminal implementation will enable enough space and organization possibility for additional logistic services with enhanced storage capacity.

The railway infrastructure satisfied temporary demands for container transport in spite of delivery overtime and cargo volume on some sections are limiting the role of the Port. Transit railway time is up to one day between the Port of Rijeka and Zagreb in comparison to 4 hours by truck.

The road infrastructure in Croatia is of high quality, enabling fast and easy container transport to final destination in any part of the country in favourable climate condi-



Graph 1 Review of total throughput of containers and share of railway container transport in the Port of Rijeka

tions. The government still supports road traffic, investing most resources in its development and reconstruction.

The Republic of Croatia has the ability to use inland waterways in container transport, but inland waterways have not been properly treated. Inland waterways in the Republic of Croatia are a part of the European traffic system. Via the rivers Danube, Drava and Sava, Croatia is connected with the western, middle and eastern part of Europe, by rail and road transport with the Adriatic and thus with the rest of the world. Modernization of inland waterways offers rerouting of cargo flows on the rivers which contribute to savings in both internal and external costs.

The intermodal transport strategy as the most acceptable ecological and economical way of traffic has not been clearly defined. Another transportation problem is railway underdevelopment, because only 18% of container cargo is transported by train from the Port of Rijeka (see Graph 1). In this paper the container flows in Croatia will be analysed. This analysis will include container cargo flows between the port of Rijeka and its hinterland by road and rail transport. Detail analysis will serve as the basis for determining the potential location of inland terminal.

By data in Graph 1 the growth index for the total throughput of containers and transport by rail in the Port of Rijeka can be performed. The total container throughput growth index in the period from 2002-2012 was 1.23, while the growth index for transport by rail in the port of Rijeka amounts to 1.15.

3.1 Literature review

At the beginning of the 1980s the importance of inland objects started to be explored when Munford [18] in his paper stated the problem of growing congestion at the ports gateways and for the first time in the academic literature mentioned the term dry port and cited this term as a solution to the problem of congestion. A UN text from 1982 [36] declared dry ports as inland terminals to which the shipping company issued its marine bill of lading for the import cargo and took responsibility for the conditions and costs of freight transport.

In their paper, Van Klink and Van der Berg [38] defined the port hinterland as an internal region that serves the port at a lower cost than other ports in the region. Van Klink, Van der Berg and McCalla [38, 14] discussed the possibility of expanding the port operations and reducing the transportation costs by using inland intermodal transport. The port hinterland expanding possibility using the traditional rail or inland waterways was considered.

Roso [31, 32, 33] made significant contribution to the research in the field of inland objects with her papers, through which she has defined the concept of dry ports and set its definition. She also defined the division of dry ports into those with small distance, middle distance and large distance from the port, and demonstrated the ability of reducing the environmental pollution by implementing dry ports and benefits for all participants in the transport process from the use of dry ports.

Authors Rodrigue and Notteboom [21, 25, 28, 29] preferred the term inland port (in the USA) which represents the internal node of different types and sizes. The same authors defined the ownership structure and the basic functions of inland ports, and stated that the term inland terminal depends on the ownership structure, geographic location and functions of inland terminal. They compare the European and North American inland ports and their role in the supply chain.

Monios [16] defined the impact of inland ports on the development of hinterland expanding on the principle of the Spanish ports and discussed the term "dry port".

According to some authors, the best approach to determine the location of an inland terminal is the application of network models and the use of multi-criteria analysis [34].

Racunica and Wynter [22] made the optimization model that has been developed to address the problem of increasing the share of rail in intermodal transport through the use of hub-and-spoke type networks for freight rail.

Janic developed a model for calculating full (internal and external) costs of intermodal and road freight transport networks in Europe, in which he presented the impact of distance and the amount of transported cargo on the total cost [7].

The paper by the authors Sörensen, Vanovermeire and Busschaert [34] made integration of a fast heuristic procedure to approximate the total cost given the set of open terminals.

Ghodratnama, Tavakkoli-Moghaddam and Baboli [5] made a mathematical model in which the location of hubs is fixed and their capacity is determined based on the facilities and factories allocated to it.

Macharis and Bontekoning [13] have distinguished three different approaches to determine the optimal location of transhipment terminals.

Kayikci [8] developed a conceptual model based on a combination of the AHP and ANN methods in order to select the most appropriate location for intermodal terminals.

Feng and Huang [3] made multi-objective mathematical model for optimizing multimodal intercity logistics flows. This model is used for Taiwan to resolve least cost routing of shipments and to find optimal locations of railway terminals.

Chang et al. [2] made an optimization model to minimize internal transportation costs and the external costs from air pollutants and greenhouse gases by shifting container cargoes from road to short sea shipping (SSS).

Lv R.-S. and Li C. [12] analyzed the location selection of Tianjin Port's dry ports. To determine the priorities on location selection of the dry ports, ANP method has been used. Dry port location is selected based on the systematically analyzed factors and an evaluation model was built.

Wang and Wang [39] used Fuzzy Clustering Analysis to select and classify the alternatives of dry ports in the Economic Zone on the Western Side of the Taiwan Straits.

4. Paper methodology

Determining the location of inland terminal is a dynamic and complex task. In order to determine the location of an inland terminal it is necessary to define its function, that is, it is necessary to know if the terminal will be used to unburden the port or, furthermore, whether it will have a role of a local and regional distribution centre. Examples of this kind of terminal can be found in Germany, Holland and Belgium. Therefore, it is important to know if Croatia needs that kind of terminal, and if it does what is its primary function. Determining the inland terminal function is not subject of this paper, but that topic will become interesting for many researchers because of the port of Rijeka strengthening since the Croatian accession to EU.

The location of inland terminal depends on many factors that affect the attractiveness of inland terminal. The most important factors that can define the function and attractiveness of the location of inland terminal are distances from port(s), vicinity of important transportation corridors, frequency of cargo flows, possibility of terminal expanding, vicinity of important industrial, transport and economic centres on local and regional level, presence of qualified workers, price of land, level of multimodality, political structure and others. Each factor has its role in determining the potential location of inland terminal. In this paper the role of cargo flows is emphasized.

The reason for that lies in the fact that container transport has not been clearly defined in Croatia, and the locations to which the port of Rijeka, as the most important port in Croatia realizes communication in the distribution of containers are not defined. Therefore, an analysis of container cargo flows was performed on the basis of the quantity of containers from the locations with which the port of Rijeka is realizing container traffic in the Republic of Croatia, as well as the border crossings through which Croatia has realized container traffic with the neighbouring countries. The same methodology was used for the transportation of containers by road and rail transport.

Table 1 Number of TEU transported by rail from Port of Rijeka to destinations in Croatia and potential locations of inland terminal (Q_j)

Port of Rijeka (TEU)	
Slavonski Brod	873
Zagreb	6,866
Koprivnica	727
Osijek	695
Županja	667
Vinkovci	610
Tovarnik	10,564
Slavonski Šamac	472
Volinja	471
Karlovac	283
Čakovec	256
Virovitica	218
Knin	202
Kutina	154
Solin	46
Varaždin	32
Čačinci	19
Ogulin	17
Nemetin	11
Bregi	7
Drenovci	2

Table 2 Railway distances d_{ij} from Port of Rijeka to destinations with which the Port of Rijeka achieves container transport

Port of Rijeka (km)	
Delnice	60
Ogulin	119
Karlovac	175
Sisak	227
Zagreb	228
Dugo Selo	251
Kutina	309
Volinja	316
Koprivnica	317
Bregi	326
Knin	343
Varaždin	359
Čakovec	370
Virovitica	382
Slavonski Brod	421
Čačinci	429
Solin	441
Split	442
Slavonski Šamac	477
Osijek	502
Nemetin	509
Županja	514
Vinkovci	517
Tovarnik	520
Drenovci	531

4.1. Analysis of the rail container transport in Croatia

In order to establish container cargo flow transported by rail it is necessary to analyse the transport from the Port of Rijeka in the year 2012 (Table 1). According to the conducted analysis it is possible to conclude that the port of Rijeka realizes container rail transport with 21 locations in Croatia. The majority of container transportation is with Tovarnik, border crossing with Serbia and the City of Zagreb. Share of container transportation towards Tovarnik in overall rail container transportation is around 45.5 %, and the share towards the City of Zagreb is 29.6%. Among other locations it is possible to single out Slavonski Brod with the share of 3.8%, and other locations in the eastern part of Croatia. Table 1 shows the locations and the number of transported containers from the port of Ri-

jeka, and Table 2 shows distances by rail between those locations and the port of Rijeka. The transportation cost of container shipping by rail in Croatia amounts to 5.17 kn/km (0.68 €/km).

4.2. Analysis of road container transport

At the moment, there is no official statistics of road container transport from the Port of Rijeka to final destinations. The total number was obtained by analyzing container road transport of the most important logistics operators in Croatia, and the results are shown in Table 3.

Based on the analysis of road container transport it is possible to conclude that the shipment dynamics is a bit different than in railway transport. Almost 79% more containers are transported by road transport than by rail. The reason for that is the limitation of railways, that is, inadequately developed railway infrastructure. At this moment railway has enough capacity for container transportation but the transportation time is much higher in comparison to road.

The container transport by road is carried out between the port of Rijeka and four other locations. Nearly 60% of overall container transport is carried out on the Rijeka – Zagreb link, Rijeka – Bajakovo link participating with 20%, while the border crossings with Bosnia and Herzegovina, Županja and Stara Gradiška, account for 10% each. It is therefore possible to conclude that the port of Rijeka is achieving the highest volume of overall container transportation with the neighbouring countries. In domestic container transport the highest share has the Rijeka – Zagreb link.

It should be noted that in contrast to rail traffic the transportation costs in road container transport are not in proportion with the generated kilometres (Table 4).

Table 3 Total number of TEU transported from the Port of Rijeka to the known destinations in Croatia by road

	Port of Rijeka (TEU)
Zagreb	63,893
Bajakovo (B)	21,298
Županja (Z)	10,649
Stara Gradiška (SG)	10,649

5. Determination of inland terminal location based on modal shift of overall container flow to railway transport

Based on container transport analysis it is possible to conduct another analysis, the one regarding transportation cost savings for shipping of all the containers towards potential locations of inland terminals by rail.

Inland terminal in this case represents a maritime port. All port activities are performed in the inland terminal. Overall container cargo is shipped towards inland terminal by rail where all further operations are performed.

By following proposition, the transportation cost savings will be accomplished if all containers are first shipped from maritime port toward inland terminal by rail, and then from inland terminal towards final destinations by road, rail and/or inland waterways.

Railway network is graph (V, L), where railway stations and terminals form the set of nodes V. Lines connect nodes form the set of arches L.

Proposition 1 (Train transporting) If inland terminal is located in the *i*-th graph node, then the annual transport cost savings of container transport by rail after inland terminal construction are equal to:

$$P_V(i) = p \sum_{j \in V} (d_{1j} - d_{ij} - d_{1j}) Q_j, \quad (1)$$

where:

Q_j = annual container throughput in *j*-th diagram point known by rail data;

d_{1j} = distance from Port to the j-th user;

i = node index in which the inland terminal will be located,
- index *i* may indicate an existing node,
- index *i* can be a place on communication which is more general case
- index *i* can be out of communication which is a difficult problem and had to be solved by seeking extreme functions of two variables;

d_{ij} = distance of user positioned in the *j*-th node to the *i*-th location;

p = 5.17 kn/km (0.68 €/km) – transport cost per container transported by train per kilometre.

In this paper index *i* can signify the existing node, but it can be a place on communication which is a more general case. Index *i* can be out of communication which is a difficult problem and had to be solved by seeking extreme functions of two variables.

According to Table 1 and Proposition 1 the overall annual transportation cost saving, if the containers are shipped by rail, after the construction of the terminal can be calculated and this is shown in Table 5. The negative as-

Table 4 Interval transport cost for every potential location

	Road transport cost per interval from potential location to end user										
Interval	<50 km	50 – 100 km	100 – 150 km	150 – 200 km	200 – 250 km	250 – 300 km	300 – 350 km	350 – 400 km	400 – 500 km	500 – 600 km	> 600 km
Prize €	131.5	154.8	195.3	245.9	292.4	372.5	453.7	505.1	602.4	684.5	759.3

pect of the saving is expected by shipping empty containers back towards the port.

Table 5 Total annual transport cost savings $P_v(i)$ from (1) of container transport by rail after inland terminal construction (in euro)

Location	Annual transport cost savings of container transport by rail (euro)
Delnice	0
Ogulin	0
Karlovac	-20,190.21
Zagreb	-59,780.16
Dugo Selo	-306,443.58
Sisak	-780,622.382
Kutina	-1,028,389.19
Bregi	-2,032,161.70
Koprivnica	-2,198,688.08
Slavonski Brod	-2,427,483.71
Virovitica	-2,729,961.36
Volinja	-2,779,081.80
Čačinci	-3,326,126.98
Varaždin	-3,498,670.97
Slavonski Šamac	-3,584,193.66
Čakovec	-3,839,621.59
Tovarnik	-3,951,481.34
Županja	-4,224,779.78
Osijek	-4,234,615.03
Vinkovci	-4,319,677.86
Nemetin	-4,502,090.42
Drenovci	-4,599,470.09
Knin	-6,992,365.14
Solin	-10,078,457.90
Split	-10,082,991.10

Locations Bajakovo and Stara Gradiška are not included in the total annual cost savings in case of railway transport, since there is no railway link between Rijeka and those places.

The best place for the construction of the inland terminal is near the City of Delnice, according to total annual transportation cost savings. The suggested location is suitable for the construction of inland terminal from the aspect of the port of Rijeka container storage. If inland terminal function is not just the storage of containers then it is necessary to conduct more detailed analysis in order to determine the inland terminal location.

For conducting a detailed analysis of cost savings if containers are shipped from the port of Rijeka towards the potential locations of inland terminal it is necessary to take into account the following: transportation cost if containers are shipped from inland terminal towards final destinations by road, possibility of using inland waterways, land price for construction of inland terminal and vicinity of strong economic and transport centre of Croatia – Zagreb. By conducting this kind of analysis it is possible to determine the inland terminal location that would enable container shipment towards final destination by inland waterways.

6. Conclusion

More significant global economies require global logistics network with the aim of making a cost-effective and customer-friendly supply chain. Inland terminals are important nodes in the global logistics system, which provides logistics services in logistics supply chain for their customers. The inland terminals provide effective business to ports, expansion of gravity zone and competitiveness increase in relation to the ports in the region but also in the supply chain.

The accession of Croatia to EU leads to transport market liberalization, which will in the future imply the development of current logistics operators, as well as arrival of new ones, and the result of enhanced competition is the reduction of transport costs.

This paper provides an overview of the current situation in the Croatian container transport. The constructed model proposed the location of the City of Delnice for the construction of the Port of Rijeka inland terminal in order to reduce the overall transportation costs. The function of the mentioned inland terminal would be a storage place for container from the port of Rijeka. Further research of inland terminal in Croatia should go towards the definition of inland terminal function, that is, it is necessary to determine if Croatia needs that type of terminal and if its function will be the storage place for containers or whether it will attract additional cargo flows and speed up distribution of cargo towards final destinations.

Further research in the Republic of Croatia should go towards container transport development by inland waterways, which would achieve and enhance the reduction in the total transport costs. More importantly, Croatia would become the only country in the region which would provide cargo transport by all transport modes.

References

[1] Bontekoning, Y.M., Macharis, C., Trip, J.J., 2004, Is a new applied transportation research field emerging? A review of intermodal rail–truck freight transport literature, Transportation Research Part A 38, pp. 1–34.

[2] Chang, Y.T., Lee, P.T.W., Kim, H.J., Shin, S.H., 2010, Optimization model for transportation of container cargoes considering short sea shipping and external cost: South Korean case. Transportation Research Record: Journal of Transportation Research Board 2166, pp. 99–108.

[3] Feng, C.M., Huang, H.H., 2005, The economic evaluation of intercity intermodal logistics. Journal of the Eastern Asia Society for Transportation Studies 6, pp. 2921–2936.

[4] Geramianfar, R., Pakzada, M., Golhashem, H, Moghaddam , R.T., 2013, A multi-objective hub covering location problem under congestion using simulated annealing algorithm, Uncertain Supply Chain Management 1, pp. 153–164.

[5] Ghodratnama, A., Tavakkoli-Moghaddam, R., Baboli, A., 2012, Comparing Two Proposed Meta-Heuristics to Solve a New P-Hub Location-Allocation Problem, 2012 IEEE International Conference on Industrial Engineering and Engineering Management, Hong Kong.

[6] Iannone, F., 2012, The private and social cost efficiency of port hinterland container distribution through a regional logistics system, Transportation Research Part A 46, pp. 1424–1448.

[7] Janic, M., 2007, Modelling the full costs of an intermodal and road freight transport network, Transportation Research Part D 12, pp. 33–44.

[8] Kayikci, Y., A, 2010, Conceptual model for intermodal freight logistics center location decisions, Proceding Social and Behavioral Sciences 2, pp. 6297–6311.

[9] Koi, Yu A. Ng, Gujar, G.C., 2009, The spatial characteristics of inland transport hubs: evidences from Southern India, Journal of Transport Geography 17, pp. 346–356.

[10] Koi, Yu A. Ng, Padilha, F., A., Pallis, A., 2013, Institutions, bureaucratic and logistical roles of dry ports: the Brazilian experiences, Journal of Transport Geography 27, pp. 46–55.

[11] Li, Y., Liu, X., Chen, Y., 2011, Selection of logistics center location using Axiomatic Fuzzy Set and TOPSIS methodology in logistics management, Expert Systems with Applications 38, pp. 7901–7908.

[12] Lv, R.S., Li, C., 2009, Analysis on Location Selection of Dry Ports Based on ANP, Industrial Engineering and Engineering Management, 2009. IE&EM '09. 16th International Conference on, Bejing, pp. 638–641.

[13] Macharis, C, Bontekoning, Y.M., 2004, Opportunities for or in intermodal freight transport research: a review. European Journal of Operational Research 153(2), pp. 400–416.

[14] McCalla, R. J., 1999, Global change, local pain: intermodal seaport terminals and their service areas, Journal of Transport Geography, 7, pp. 247–254.

[15] Mlinarić, T.J., Rogić, K., Rožić, T., 2011, Methodology for Determining Dry Port System Transport Network – Case Study Port of Rijeka, DAAAM International Scientific Book 2011, ISBN: 978-3-901509-84-1, pp. 133–146.

[16] Monios J., Wilmsmeier G., 2013, The role of intermodal transport in port regionalization, Transport Policy 30, pp. 161–172.

[17] Monios, J., 2011, The role of inland terminal development in the hinterland access strategies of Spanish ports, Research in Transportation Economics 33, pp. 59–66.

[18] Munford, C., 1980, Buenos Aires – congestion and the dry port solution, Cargo Systems International: The Journal of ICHCA, Vol. 7, Issue 10

[19] Murillo, D.G.C., Liedtke, G., 2013, A model for the formation of colloidal structures in freight transportation: The case of hinterland terminals, Transportation Research Part E 49, pp. 55–70.

[20] Notteboom, T., Rodrigue J.P., 2005, Port regionalization: towards a new phase in port development, Maritime Policy and Management, 32, pp. 297–313.

[21] Notteboom, T., Rodrigue, J.P, 2009, Inland Terminals within North American and European Supply Chains, Transport and Communications Bulletin for Asia and the Pacific, United Nations, Economic and Social Commission for Asia and the Pacific, No. 78, pp. 1–57.

[22] Racunica, I., Wynter, L., 2005, Optimal location of intermodal freight hubs, Transportation Research Part B 39, pp. 453–477.

[23] Ravibabu, M. A., 2013, Nested logistic model of mode choice for inland movement of export shipments: A case study of containerized export cargo from India, Research in Transportation Economics 38, pp. 91–101.

[24] Ricci, A., Black, I., 2005, The social costs of intermodal freight transport, Research in Transportation Economics 14, pp. 245–285.

[25] Rodrigue, J.P., 2008, The Thruport Concept and Transmodal Rail Freight Distribution in North America, Journal of Transport Geography, Vol. 16, No. 4, pp. 233–246.

[26] Rodrigue, J.P., Comtois, C., Slack, B., 2013, The Geography of Transport System, ISBN 978-0-415-82254-1, Routledge, New York

[27] Rodrigue, J.P., De Brie, J., Fremont, A., 2010, Functions and actors of inland ports: European and North American dynamics, Journal of Transport Geography, 18, pp. 519–529.

[28] Rodrigue, J.P., Notteboom, T., 2009, The terminalization of supply chains: reassessing port-hinterland logistical relationships, Maritime Policy and Management, 36(2), pp. 165–183.

[29] Rodrigue, J.P., Notteboom, T., 2010, Comparative North American and European Gateway Logistics: The Regionalism of Freight Distribution, Journal of Transport Geography, 18(4), pp. 497–507.

[30] Rogić, K., Rožić, T., Kolarić, G., 2013, Functionality of distribution logistics centers as inland port terminals (dry port terminals) – Case study City of Zagreb, PLANNING AND DEVELOPMENT OF SUSTAINABLE TRANSPORT SYSTEM 83-95 (ISBN: 978-953-243-064-6)

[31] Roso, V., 2009, The dry port concept – applications in Sweden, Proceedings of Logistics Research Network, Plymouth: International Logistics and Supply Chain Management,

[32] Roso, V., 2009, The Dry Port Concept, Thesis for the degree of doctor of philosophy, Department of Technology Management and Economics, Chalmers University of Technology, Göteborg

[33] Roso, V., Woxenius, J., Lumsden, K., 2009, The dry port concept: connecting container seaports with the hinterland, Journal of Transport Geography, 27, pp. 338–345.

[34] Sörensen, K., Vanovermeire, C., Busschaert, S., 2012, Efficient metaheuristics to solve the intermodal terminal location problem, Computers & Operations Research 39, pp. 2079–2090.

[35] Sterzik, S., Kopfer, H.A., 2013, Tabu Search Heuristic for the Inland Container Transportation Problem Computers & Operations Research 40, pp. 953–962.

[36] United Nations Conference on a convention on International Multimodal Transport of Goods, Geneva, 1980.

[37] Van den Berg, R., De Langen, P.W., 2011, Hinterland strategies of port authorities: A case study of the port of Barcelona, Research in Transportation Economics 33, pp. 6–14.

[38] Van Klink, H.A., Van den Berg, R., 1998, Gateways and intermodalism, Journal of Transport Geography 6, pp. 1–9.

[39] Wang, Y., Wang, J., 2010, The Optimal Location of Dry Port: A Case Study of the Hinterland of Western Side of the Taiwan Straits Port Group, Industrial Engineering and Engineering Management (IE&EM), 2010 IEEE 17Th International Conference on, Xiamen, pp. 1864–1868.

[40] Wilmsmeier, G., Monios, J., Lambert, B., 2011, The directional development of intermodal freight corridors in relation to inland terminals, Journal of Transport Geography 19, pp. 1379–1386.

[41] Zhang, M, Wiegmans, B, Tavasszy, L., 2013, Optimization of multimodal networks including environmental costs: A model and findings for transport policy, Computers in Industry 64, pp. 136–145.

[42] Zhang, Z.M., 2008, Applying fuzzy Clustering to location planning of dry port, Journal of Shanghai maritime university, Vol. 29, No. 4, pp. 34–38.