

ANALYSIS OF CROATIAN PORTS IN RESPECT TO MOTORWAYS OF THE SEA IMPLEMENTATION

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ABSTRACT

The European Commission introduced the concept of Motorways of the Sea (MoS) in its 2001 White Paper on European Transport Policy for 2010 (revised in 2006). Motorways of the Sea refers to the development of key sea routes between EU Member States (and possibly neighbouring third countries) that will offer high quality regular services in combination with other transport modes. Croatian port system is consisting of six equally treated ports, all public ports: Rijeka, Zadar, Šibenik, Split, Ploče and Dubrovnik. Standard quality criteria have been developed by the European Commission to assess projects for Motorways of the Sea. Port system is identified as one of the key elements for efficient development of functional MoS concept. Regarding Croatian transport system, at the moment when no MoS is existing, and based on available and reliable fact, efficiency in port and port infrastructure is the only element which can be analysed and is analysed within this article. This paper will give an overview of multicriterial analysis of present port system and infrastructure all Croatian ports as a prerequisite for sustainable development of MoS.

KEY WORDS

Motorways of the Sea. sea ports. port system. multi criteria. European Union. Croatia.

1. INTRODUCTION

The subject of this article is to determine the potential and to analyse Croatian port's system in respect to development of Motorways of the Sea system in Croatia. The Adriatic Sea region is the most endangered region in the Mediterranean Sea — a highly sensitive marine area facing serious environmental challenges that is home to some of the most significant treasures of world heritage. It is expected to be placed on the International Maritime Organization (IMO) list of particularly sensitive sea areas. The Adriatic region is of great significance to the economy of the region, particularly for the tourism and recreation sector, as well as a major transport hub for energy resources, and one of Europe's most highly developed industrial areas.

Recent traffic demand is stressing the capacity of road transportation and has significant impact on the environment. As congestion begins to be particularly worrisome in some border zone, new transport solutions have to be found. The lack of available land and population protest against new roads construction added to road huge cost and funding constraints enhances the development of maritime solutions such as short sea shipping and motorways of the sea.

The European Commission introduced the concept of Motorways of the Sea (MoS) in its 2001 White Paper on European Transport

Policy for 2010¹ (revised in 2006). Motorways of the sea appear to be quite attractive solutions to traffic problems. It is a new concept, building on successful short sea shipping experiences, to shift cargo traffic from the heavily loaded road network to environmentally-friendly waterways. Through the establishment of frequent and high quality maritime-based logistics services between Member States, motorways of the sea will become veritable alternatives to congested roads. As a frequent and regular service, offering a door-to-door solution to customers, it may substantially contribute to bypass road congestion. This mode isn't land consuming and is environmentally friendly. For the carrier, it can guarantee transit time and avoid delays due to traffic congestion, it is reliable and enable door-to-door solutions. It can be cheaper than road transport.

The article will result with comparison of all ports, giving an objective overview on pre-requests and potential of Motorways of the Sea implementation in Croatia.

2. PAST RESEARCH

A limited scientific database on MoS research and implementation is available. Most of it is concerning European Commission and its trying to implement MoS in European transport system. In its Transport White Paper of September 2001, the Commission proposed the development of "Motorways of the Sea" as a "real competitive alternative to land transport." To help these lines develop, the White Paper states that European funds should be made available. These "motorways of the sea" should be part of the Trans-European network (TEN-T)².

Four corridors have been designated for the setting up of projects of European interest

1 http://ec.europa.eu/transport/white_paper/documents/doc/lb_texte_complet_en.pdf

2 http://tentea.ec.europa.eu/en/ten-t_projects/ten-t_projects_by_transport_mode/

Motorway of the Baltic Sea (linking the Baltic Sea Member States with Member States in Central and Western Europe, including the route through the North Sea/Baltic Sea canal);
Motorway of the Sea of western Europe (leading from Portugal and Spain via the Atlantic Arc to the North Sea and the Irish Sea);
Motorway of the Sea of south-east Europe (connecting the Adriatic Sea to the Ionian Sea and the Eastern Mediterranean, including Cyprus);

Motorway of the Sea of south-west Europe (western Mediterranean, connecting Spain, France, Italy and including Malta and linking with the Motorway of the Sea of south-east Europe and including links to the Black Sea).
These corridors provide one essential part of the projects: the "floating infrastructures" of our European seas. However, it is up to industry, Member States and the Community to implement financially and operationally sound projects to use these maritime resources better for new intermodal maritime-based transport systems.

Since 2004, the Commission and Member States initiated coordination activities on MoS. From these activities resulted the first studies on the role of MoS and the first geographic area task forces were set-up. Furthermore, several development projects and studies were carried out by stakeholders with the support of European Institutions and funds such as the EIB, structural funds, Marco Polo and TEN-T. In different geographic areas, MoS calls for proposals have been organised jointly by Member States in order to involve stakeholders, e.g. the joint Call France-Spain in 2009. Unfortunately, large MoS projects have not yet succeeded so far. Until now, four different studies on MoS were carried out, and one MoS Marco Polo project was launched in 2007 under the framework of Marco Polo3. In 2008, 3 MoS TEN-T projects (2008) were selected for funding and are about to be implemented. Under other frameworks, e.g. EIB and structural funds, other MoS or MoS related projects were launched. Still and as the key stakeholders point out, the state of play for the

3 <http://ec.europa.eu/transport/marcopolo/>

ongoing MoS studies and projects: is markedly insufficient, in particular if compared with all the other maritime transport development actions proposed and retained during the same period.

Scientific literature recognises A. Braid “EU Motorways of the Sea policy” and D. Tsamboulas, P. Moraiti, E. Vlahogianni “Assessing the Effect of Infrastructure and Service Attributes on the “Motorways of the Sea” Realization” relevant and important concerning the concept of development and MoS and criteria for its implementation.

MoS implementation in Croatia

In addition to the existing RO-RO lines that connect Croatian and Italian ports, not even one new MoS service has started in Croatia. So far, research and analysis of potential Croatian ports have been implemented only within East Mediterranean MoS Master Plan⁴ which analysed ports of Rijeka, Zadar, Split and Ploče but dealt with partially available data. Based on the results of that project, 9 MoS potential scenarios were identified under which the Croatian ports are represented in all three corridors.

- *MoS potential corridor 3 (Ionian Sea/ West Greece ports cluster & the eastern segment of the North Adriatic ports cluster)*
- *MoS potential corridor 5 (The eastern segment of the North Adriatic ports cluster & the western segment of the North Adriatic ports cluster)*
- *MoS potential corridor 7 (The eastern segment of the North Adriatic ports cluster & the central segment of the North Adriatic ports cluster & the northern segment of the South Adriatic - Balkan ports cluster)*

3. RELEVANT CRITERIA FOR IMPLEMENTATION OF MOS CONCEPT

There is no official list of criteria relevant to the development of the MoS concept issued by the

⁴ TEN-T project: 2005-GR-90701-S East Mediterranean Motorways of the Sea Master Plan, <http://www.eastmed-mos.eu/>

European Commission or any other national legislation.

According to Braid⁵ development of MoS between two areas depends on following elements⁶.

- a.) Price – The rate charged for the sea crossing, when combined with the cost of road transport at the beginning and end of the journey, would need to be competitive with the current total door-door transport charge;
- b.) Departure/arrival schedule – A minimum requirement is a daily sailing in each direction. The ship should sail at the same time each day, and arrive at the time scheduled. Shippers preferred a late evening departure time, offering the potential for next day (i.e. Day B) or Day C delivery of goods;
- c.) Reliability – The ship must be able to adhere to the departure/arrival schedule consistently. Frequent disruption of the schedule by bad weather or any other reason would be unacceptable;
- d.) Transit time – The SSS option should enable users to maintain existing byroad door-door transit times, which range from 24-48 hours;
- e.) Efficiency in port – Speed of loading/unloading, cargo security, absence of bureaucracy, low charges, 24-hour working, and fast access to the road network, were all seen as further essential service attributes;
- f.) On-board facilities – Drivers accompanying trailers required restaurant, shower and cabin facilities, with the cabin included in the price.

⁵ Braid, A.: EU MOTORWAYS OF THE SEA POLICY, European Conference on Sustainable Goods and Passenger Transport, Kristiansand, 2005

⁶ European Marine Motorways Study (EC 4th Framework Programme)

Standard quality criteria have been developed by the European Commission to assess projects for Motorways of the Sea, and include⁷:

- quality of port services;
- quality of hinterland connections and services (port accessibility);
- overall information systems and monitoring in the supply chain;
- characteristics of the shipping services (e.g. frequency, regularity, safety, security);
- TEN-T dimension (integration of the project into the overall network development).

From both mentioned criteria, port system is identified as one of the key elements for efficient development of functional MoS concept. Regarding Croatian transport system, at the moment when no MoS is existing, and based on available and reliable fact, efficiency in port and port infrastructure is the only element which can be analysed and is analysed within this article.

When analysing potential of MoS service, Tsamboulas, Moraiti i Vlahogianni⁸ highlight that freight transportation is a competitive industry with costs and time being as two main decision-making criteria for choice of mode. Transportation companies compete on cost and on the level of service been offered, operating under certain standards and regulations. In addition, the optimum quality of service and infrastructure in ports and their connections to the hinterland, the service provided by shipping lines, road and rail hauliers and forwarders are prerequisites for the successful implementation of MoS. Thus, an adequate functional port system is of utmost importance when analysing potential of MoS.

According to their model, the following attributes, which all are a part of port system, are assumed to determine the operation of a MoS supply chain:

- Port Efficiency

- Accessibility to hinterland
- Security
- Administrative procedures
- Custom Procedures
- Other services

Within their model, the authors present the above parameters together with their respective indicators and units of measurement (qualitative). These are assumed to constitute the attributes related to infrastructure and services for two ports (A and B) and their hinterland access and maritime links.

Within this analysis, Croatian ports system will be analysed according to those attributes, considered only port A, as presented in table 1.

⁷ European Commission, Report on the Motorways of the Sea – State of play and consultation, Commission staff working document, SEC(2007) 1367, Brussels, 2007.

⁸ D.Tsamboulas, P.Moraiti, E.Vlahogianni: Assessing the Effect of Infrastructure and Service Attributes on the “Motorways of the Sea” Realization

Table 1. Attributes for Specific Characteristics of European Intermodal Supply Chains

Attributes	Indicator	Value
Port Efficiency	Port A Productivity (total throughput)	1 (minimum) to 5 (maximum)
	Port A Labor Productivity	1 (minimum) to 5 (maximum)
	Port A Dedicated Berth	yes/no
	Port A Operating Hours	1= 24 hours 0=less than 24 hours
Accessibility	Section to port A Demand/Capacity	1 (minimum) to 5 (maximum)
	Section to Port A Distance to main transit axis	km
	terminal/port efficiency for section A	1 (minimum) to 5 (maximum)
	Section A interoperability	yes/no
Security	Port A degree of surveillance of transportation means	low/medium/high
Administrative Procedures	Port A One-stop shop service, Electronic Data identification	yes/no/partial
Custom Procedures	Port A Harmonization	yes/no/partial
	Port A standardization	yes/no/partial
Other Services	rail Port A	non-existent/ low/medium/high
	maritime connections	non-existent/ low/medium/high

4. ANALYSIS OF MAIN CROATIAN SEA PORTS

Former political and economic circumstances were favourable to the creation of a considerable number of ports and small harbours on the Croatian coast. Of some 350 ports and small harbours on the coast and islands, six can take large ocean going ships, all of them located along the mainland coast. Among them are the following seaports (from north to south): Rijeka, Zadar, Šibenik, Split, Ploče and Dubrovnik, which are considered to be the main Croatian public ports. The above-mentioned seaports are variously positioned in relation to the macroregional and geographical status in general, which determines also their operational focus and position with respect to

the targeted areas on the mainland. Rijeka is on the Northern Adriatic; Zadar, Šibenik and Split on the Central Adriatic; and Ploče and Dubrovnik on the South Adriatic. The Port of Rijeka accounts for the major portion of port business among Croatian seaports, generally generating more than 60% of total port traffic in Croatia.

4.1. Port of Rijeka

Within the port area of the Port of Rijeka 5 locations can be distinguished. Central location is basin Rijeka which includes the Port of Rijeka, Sušak and Brajda and it is a constituent part of urban core of the city of Rijeka. Remote parts of the Port of Rijeka are basin Bakar, basin Omišalj-Krk and basin Raša.

Table 2. Characteristics of port of Rijeka concerning MoS

Services in the port of Rijeka		
	Indices	Values
Port Operations	Annual non-operating time (hours)	24/7/365
Anchoring services	Anchoring available	YES
	Pilot mandatory	YES for ship > 500 GT
	Tugboat assistance - requirements	Up to Pilot
Security services	Access monitoring system – brief description	Safety of port (control of cars/persons), environmental according to the international rules
	Other security systems – brief description	Radiation monitors, x-ray system
Goods handling support services	Customs services – operation hours	24/7/365
	Electronic documents management systems – brief description	Terminal Operating System (TOS)
Railway services	Port shunting company	Croatia Railways
Technical specifications of the Rijeka Container/RO-RO pear		
Features of Terminal	Linear length of quay (m)	300 m + 330 m (from 2013)
	Berths and relative lengths (m)	164 + 300 m + 330 m (from 2013)
	Draught (m)	11,8 m
	Maximum ship length (m)	310 m
	Capacity of yard (n° lorries)	5.000 TEUs (10.000 TEUs from 2013)
	Size of yard (km ²)	0,136 (0,243 from 2013)
Terminal equipment	Number of dedicated entrance gate	1
	Size of parking areas (km ²)	-
	Lighting for night-time operations	YES
	Customs warehouse (m ²)	1.000
	Quay and storage area (m ²)	60.000 (110.000 from 2013)
	Car capacity	N/A
	Trailer capacity	N/A
	Trailer handling services	N/A
	Passenger terminal – brief description	Quay length 300 m Draught 7,5 m Terminal building
Offices, phones, faxes, internet	YES	
Connections of port of Rijeka		
Port infrastructure connections	Number of access to motorways	2
	Direct access to railway line	YES
	Number of road tracks	4

In the Table 2, available data that will be used for evaluation process based on the previously mentioned model are presented. Table shows that the Port of Rijeka is a functional port which operates 24 hours a day and it fulfills all the security standards. However, unfortunately it has limited capacity for parking lots and maintaining of the vehicles which presents one of the preconditions for the MoS service.

4.2. Port of Zadar

The port of Zadar is directly linked to the Zagreb- Split highway and to the central Croatia by two railways. Port system is consisting of three terminals:

- Passenger Port – operating for island, coastal, international ferry traffic and Ro-Ro traffic,

- Cargo Port Gaženica – cargo port for liquid, bulk and general cargo, and
- New Passenger Port Gaženica – currently under construction and will operate for island, coastal, international, ferry traffic, passenger traffic mega cruisers and Ro-Ro traffic.

Table 3 represents characteristics of the Port of Zadar concerning the developmental potential of the MoS service. At this point, Port of Zadar has limited capacities for acceptance of larger freight volumes. However, a direct link with the highway and railway presents a great potential.

Table 3. Characteristics of port of Zadar concerning MoS

Services in the port of Zadar		
	Indices	Values
Port Operations	Annual non-operating time (hours)	24/7/365
Anchoring services	Anchoring available	YES
	Pilot mandatory	YES
	Tugboat assistance - requirements	YES
Security services	Access monitoring system – brief description	Main Gateway with two ramps (port entrance and port exit), video control, lighting, fences
	Other security systems – brief description	NO
Goods handling support services	Customs services – operation hours	24/7/365
	Electronic documents management systems – brief description	NO
Railway services	Port shunting company	Croatian Railways
Technical specifications of RO-RO pear		
Features of Terminal	Linear length of quay (m)	150
	Berths and relative lengths (m)	150
	Draught (m)	8,7-10,2
	Maximum ship length (m)	150
	Capacity of yard (n° lorries)	150
	Size of yard (km ²)	100.000
Terminal equipment	Number of dedicated entrance gate	2
	Size of parking areas (km ²)	-
	Lighting for night-time operations	Available
	Customs warehouse (m ²)	2.720
	Quay and storage area (m ²)	Opened warehouse: 150.000 m ² Closed warehouse: 30.600 m ² Conditioned warehouse +0 °C: 3.400 m ²
	Car capacity	700
	Trailer capacity	150
	Trailer handling services	2
	Passenger terminal – brief description	Berths: 60-200 m Width: no restrictions Depth: 5-8 m
Offices, phones, faxes, internet	YES	
Connections of port of Zadar		
Port infrastructure connections	Number of access to motorways	2
	Direct access to railway line	YES
	Number of road tracks	4

4.3. Port of Šibenik

Port of Šibenik is linked to hinterland by the railway but does not have direct access to the highway. Road connection to the highway can be considered as a bottleneck.

The port consists of the following terminals:

- Passenger terminal (Vrulje),
- Terminal for transshipment of phosphate (Dobrika),
- Bulk and general cargo terminal (Rogač),
- Timber terminal.

Table 4. Characteristics of port of Šibenik concerning MoS

Services in the port of Šibenik		
	Indices	Values
Port Operations	Annual non-operating time (hours)	24/7/365
Anchoring services	Anchoring available	YES
	Pilot mandatory	YES
	Tugboat assistance - requirements	YES
Security services	Access monitoring system – brief description	NO, security guard on entry
	Other security systems – brief description	24 h surveillance, operation officer: 7.00 – 20.00
Goods handling support services	Customs services – operation hours	24/7/365
	Electronic documents management systems – brief description	NO
Railway services	Port shunting company	Croatian Railways
Technical specifications of port of Šibenik		
Features of Terminal	Linear length of quay (m)	1.564 m (+ 600m under construction)
	Berths and relative lengths (m)	1.564 m (+ 600m under construction)
	Draught (m)	5,20 – 10,0 m
	Maximum ship length (m)	260 m
	Capacity of yard (n° lorries)	8
	Size of yard (km ²)	0,050
Terminal equipment	Number of dedicated entrance gate	2
	Size of parking areas (km ²)	0,010
	Lighting for night-time operations	YES
	Customs warehouse (m ²)	5.000
	Quay and storage area (m ²)	32.000
	Car capacity	200
	Trailer capacity	N/A
	Trailer handling services	N/A
	Passenger terminal – brief description	Under construction: Berth No. 1: 191 m Berth No. 2: 133 m Berth No. 3: 50 m Berth No. 4: 114 m
Offices, phones, faxes, internet	YES	
Connections of port of Šibenik		
Port infrastructure connections	Number of access to motorways	1 (limited)
	Direct access to railway line	YES
	Number of road tracks	2

Table 4 represents characteristics of the Port of Šibenik taking into account developmental potential of the MoS service. Port of Šibenik, in comparison to the other Croatian ports has little capacity for acceptance and maintaining of the vehicles and has no direct connection to the highway which presents a large disadvantage in planning the MoS system.

4.4. Port of Split

The port of Split has two locations: passenger port in centre of city (Gradska luka) and cargo terminal in north suburb (Sjeverna luka). No direct access to highway but road connection. The both locations have rail infrastructure which connects port to the hinterland and Croatian railway system.

Table 5. Characteristics of port of Split (Gradska luka) concerning MoS

Services in the port of Split		
	Indices	Values
Port Operations	Annual non-operating time (hours)	24/7/365
Anchoring services	Anchoring available	YES
	Pilot mandatory	YES
	Tugboat assistance - requirements	YES
Security services	Access monitoring system – brief description	Video cameras (21) used by port authority and maritime police. On border crossing there are 2 entrances with cameras, controlled by the maritime police
	Other security systems – brief description	Metal-detectors and x ray for luggage, used by police and custom
Goods handling support services	Customs services – operation hours	24/7/365
	Electronic documents management systems – brief description	NO
Railway services	Port shunting company	NO
Technical specifications of port of Split – Gradska luka		
Features of Terminal	Linear length of quay (m)	-
	Berths and relative lengths (m)	28 (63 m-173 m)
	Draught (m)	7,9
	Maximum ship length (m)	250 or more
	Capacity of yard (n° lorries)	175 total for all queues
	Size of yard (km ²)	0,084654
Terminal equipment	Number of dedicated entrance gate	-
	Size of parking areas (km ²)	-
	Lighting for night-time operations	YES
	Customs warehouse (m ²)	-
	Quay and storage area (m ²)	2,807 (length of the quay)
	Car capacity	-
	Trailer capacity	-
	Trailer handling services	NO
	Passenger terminal – brief description	Agencies, shop, coffee shop, forwarding, custom, maritime police,
Offices, phones, faxes, internet	YES	
Connections of port of Split		
Port infrastructure connections	Number of access to motorways	1 (limited)
	Direct access to railway line	NO
	Number of road tracks	2

Regarding the vehicle maintaining, the capacity of the terminal City Port in Split is quite small. The port is situated in the town centre, urban core which represents a

bottleneck in the well functioning system. Furthermore, absence of a direct approach to the highway is also a great disadvantage.

Table 6. Characteristics of port of Split (Sjeverna luka) concerning MoS

Services in the port of Split		
	Indices	Values
Port Operations	Annual non-operating time (hours)	24/7/365
Anchoring services	Anchoring available	YES
	Pilot mandatory	1
	Tugboat assistance - requirements	1 (2)
Security services	Access monitoring system – brief description	Entrance control, video cameras used by port authority and maritime police
	Other security systems – brief description	-
Goods handling support services	Customs services – operation hours	24/7/365
	Electronic documents management systems – brief description	PML file for container ship stowage planning
Railway services	Port shunting company	1
Technical specifications of port of Split – Gradska luka		
Features of Terminal	Linear length of quay (m)	871
	Berths and relative lengths (m)	6 (171m)
	Draught (m)	10,2
	Maximum ship length (m)	200
	Capacity of yard (n° lorries)	150
	Size of yard (km ²)	160.000
Terminal equipment	Number of dedicated entrance gate	2
	Size of parking areas (km ²)	10.000
	Lighting for night-time operations	YES
	Customs warehouse (m ²)	38.000
	Quay and storage area (m ²)	123.000
	Car capacity	-
	Trailer capacity	4
	Trailer handling services	3
	Passenger terminal – brief description	-
Offices, phones, faxes, internet	YES	
Connections of port of Split		
Port infrastructure connections	Number of access to motorways	1 (limited)
	Direct access to railway line	YES
	Number of road tracks	2

North port which is under private concession is completely allocated for the freight transshipment. It fulfills security standards and unlike the City Port, it has a direct railway infrastructure on the terminal. Big bottleneck is a 15 km long city junction road from the port to the highway.

4.5. Port of Ploče

The port of Ploče is second biggest port in Croatia and is located on the Vc branch of a Pan-European corridor which connects the port directly to the road and rail network in Europe.

The port system operates on the following locations:

- Basin Ploče – dry bulk, general cargo, bulk cargo, containers, special cargo, liquid cargo and passenger terminal,

- Basin Metković - cement, dry bulk and general cargo.

Table 7. Characteristics of port of Ploče concerning MoS

Services in the port of Ploče		
	Indices	Values
Port Operations	Annual non-operating time (hours)	36
Anchoring services	Anchoring available	YES
	Pilot mandatory	YES (> 500 GT and for tankers)
	Tugboat assistance - requirements	Liquid cargo – 2 tug boats Other cargoes - according to the Master's decision
Security services	Access monitoring system – brief description	<ul style="list-style-type: none"> • Access Control Contactless smart card ID of personnel and visitors • CCTV system • AIS (Automatic Identification of vessel traffic) • Port Security Watch Guard
	Other security systems – brief description	X-ray scanners and radioactivity detector (installation in progress)
Goods handling support services	Customs services – operation hours	24/7/365
	Electronic documents management systems – brief description	<ul style="list-style-type: none"> • NCTS (Customs) • Container application (port operator company Luka Ploče PLC) • PCS (in progress)
Railway services	Port shunting company	Croatian Railways
Technical specifications of container terminal		
Features of Terminal	Linear length of quay (m)	280
	Berths and relative lengths (m)	280
	Draught (m)	13,8
	Maximum ship length (m)	250
	Capacity of yard (n° lorries)	N/A
	Size of yard (km ²)	0,038
Terminal equipment	Number of dedicated entrance gate	1
	Size of parking areas (km ²)	0,001
	Lighting for night-time operations	YES
	Customs warehouse (m ²)	-
	Quay and storage area (m ²)	0,02
	Car capacity	N/A
	Trailer capacity	N/A
	Trailer handling services	YES
	Passenger terminal – brief description	Two ramps: <ul style="list-style-type: none"> • international traffic vessels (LOA: 120 m, width: 20 m, sea depth: 8 m) • local, internal traffic vessels (LOA: 65 m, width: 14 m, sea depth: 5 m) Administrative buildings and terminal surfaces
Offices, phones, faxes, internet	YES	
Connections of port of Ploče		

Port infrastructure connections	Number of access to motorways	2
	Direct access to railway line	1
	Number of road tracks	4

Advantage of the Port of Ploče is a direct connection to the highway and high security standards. Problem that is identified is limited capacity for the placement of vehicles on the terminal which represents kind of a bottleneck in planning development of the MoS service.

4.6. Port of Dubrovnik

Dubrovnik is a prestigious Mediterranean destination for cruise ships that are in transit. The port consists of the following components:

- Berth Grad - passenger traffic,
- Port of Gruž - passenger traffic; receives up to three mega cruisers from round trips as well as passenger ferries on regular routes between all Croatian major ports and Italian ports of Ancon, Bari and Pescara.

Table 8. Characteristics of port of Dubrovnik concerning MoS

Services in the port of Dubrovnik		
	Indices	Values
Port Operations	Annual non-operating time (hours)	24/7/365
Anchoring services	Anchoring available	YES
	Pilot mandatory	YES
	Tugboat assistance - requirements	Available 24 h on request
Security services	Access monitoring system – brief description	YES
	Other security systems – brief description	Video surveillance ID card control
Goods handling support services	Customs services – operation hours	24/7/365; officer: 7.00-22.00
	Electronic documents management systems – brief description	NO Only the information system that supports the document flow concerning the acceptance of ships in port (reservation, arrival, departure, coordination of port services)
Railway services	Port shunting company	-
Technical specifications of port of Dubrovnik		
Features of Terminal	Linear length of quay (m)	1.350 m
	Berths and relative lengths (m)	1.350 m
	Draught (m)	2,5-11,5 m
	Maximum ship length (m)	Over 300 m
	Capacity of yard (n° lorries)	100
	Size of yard (km ²)	0,6
Terminal equipment	Number of dedicated entrance gate	2
	Size of parking areas (km ²)	1.800
	Lighting for night-time operations	YES
	Customs warehouse (m ²)	20
	Quay and storage area (m ²)	-
	Car capacity	300
	Trailer capacity	100
Trailer handling services	YES	

	Passenger terminal – brief description	Spaces for custom, police, information desk, tourist agencies, multipurpose space
	Offices, phones, faxes, internet	YES
Connections of port of Dubrovnik		
Port infrastructure connections	Number of access to motorways	limited
	Direct access to railway line	-
	Number of road tracks	2

Table 8 represents characteristics of the Port of Dubrovnik taking into consideration developmental potential of the MoS service. Table shows that the Port of Dubrovnik has no direct connection to the highway which certainly represents a major deficiency.

5. EVALUATION OF SCENARIOS OF IMPLEMENTATION OF MOTORWAYS OF THE SEA CONCEPT IN CROATIAN PORTS

Based on the data and presented model from the previous Chapter, analysis of all Croatian ports has been performed. Comparison between the evaluation marks in this manner is quite difficult and ungrateful. MoS services in Croatia do not exist, thus the ports do not have separate terminals used only for this purpose. If these did exist, then a comparison made on concrete examples and experiences could be done. This way, it is possible only to present

an estimation based on the assumption that terminals are being used only for RO-RO transport.

Furthermore, there is a problem of infrastructure evaluation. Momentary infrastructure is very restrictive for larger amounts of RO-RO transport. However, it is necessary to analyse developmental plans, necessary financial means for construction and cost effectiveness. As all Croatian ports have developmental plans and since these are not taken into consideration in this analysis, it is possible that the results of this analysis would be different if the issue was considered from the future perspective. However, realization of these plans is questionable so these are not taken into account.

According to the abovementioned criteria, Croatian ports can be valued as follows:

Table 9. Values of Croatian ports concerning MoS potential

Attributes	Indicator	Rijeka	Zadar	Šibenik	Split	Ploče	Dubrovnik
Port Efficiency	Port A Productivity (total throughput) [1-5]	4	1	2	2	4	1
	Port A Labor Productivity [1-5]	4	4	4	4	4	4
	Port A Dedicated Berth	yes	yes	no	yes	yes	no
	Port A Operating Hours	1	1	1	1	1	1
Accessibility	Section to port A Demand/Capacity [1-5]	5	2	5	4	5	2
	Section to Port A Distance to main transit axis	0-3 km	0 km	8 km	15 km	0 km	100 km
	terminal/port efficiency for section A [1-5]	2	3	2	3	4	1
	Section A interoperability	yes	yes	yes	yes	yes	no
Security	Port A degree of	medium	low	low	low	medium	low

	surveillance of transportation means						
Administrative Procedures	Port A One-stop shop service, Electronic Data identification	partial	no	no	no	partial	no
Custom Procedures	Port A Harmonization	partial	partial	partial	partial	partial	partial
	Port A Standardization	partial	partial	partial	partial	partial	partial
Other Services	rail Port A	medium	non-existent	non-existent	non-existent	non-existent	non-existent
	maritime connections	medium	low	low	low	medium	low

The multi-criteria analysis of all Croatian ports indicates that the port of Rijeka and Ploče are most acceptable in terms of development of MoS. Due to the fact that MoS concept integrates maritime and rail or road transport, port Dubrovnik has worst potential as there is no direct nor close connection with highway and rail. Road infrastructure is the biggest problem of ports of Šibenik, Split and Dubrovnik, as connection to highway is using city roads. At the same time the port of Šibenik do not have dedicated Ro-Ro terminals, which is main prerequisite for the development of highly reliable and just-in-time system as the MoS is. Thus, in other words, ports of Rijeka and Ploče can, due to present system, be consider as most suitable for development of MoS services. These systems have capacity and infrastructure to serve for sea-land transition in the MoS concept.

6. CONCLUSIONS

The European Commission introduced the concept of Motorways of the Sea (MoS) in its 2001 White Paper on European Transport Policy for 2010 (revised in 2006). Motorways of the Sea refers to the development of key sea routes between EU Member States (and possibly neighbouring third countries) that will offer high quality regular services in combination with other transport modes. Motorways of the Sea aim at providing a viable and more efficient alternative to road only transport and will permit the substantial modal shift of freight traffic from congested roads to key combined “land-maritime routes”. This will be achieved through the improvement of existing or the development of new integrated intermodal maritime-based logistics chains with high quality maritime links that

will connect a limited number of strategically located European ports.

With regard that the reliability and high efficiency are main characteristics and comparative advantages of this system, start-up of MoS system requires compliance of all traffic entities. Besides that, infrastructure is basis for building up quality and sustainable service. Croatian hinterland infrastructure is relatively solid and connections to all neighbouring countries and their transport infrastructure are satisfactory.

Analysis of present port system in respect to immediately development of MoS systems and services declares that ports of Rijeka and Ploče are can be consider as most suitable options. MoS services can start trough this ports with relatively small infrastructure investments as all main infrastructure exists. But for further analysis, Master Plans of all ports should be respected and the situation can be much different in coming years. Missing strategy of development and implementation of entire Croatian transport system should define directions of development of all transport sectors including Motorways of the Sea. The strategy should respect present status of port systems presented in this article and feasibility impact of further investments planned by strategy.

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