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Elaboration of Criteria for Development of Sustainable Motorways of the Sea Services

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ABSTRACT

The maritime transport system in the Adriatic region has been developed thanks to the individual activities of ports, as well as specific strategies for the development of the countries that gravitate towards that region. Regarding its potential, this system is not sufficiently developed and there are no clear criteria for evaluating the potential for success of the future Motorways of the Sea systems and services. The solution to this problem is in the scientific point of view that should contribute to the development of the Motorways of the Sea with its systematic approach and clearly defined criteria of implementation of specific models and common activities. With this scientific article and conducted research, we tried to cover the greater part of the whole transport chain (from the departure point to the destination) which is present in the Adriatic region. It is crucial that we take into consideration the fact that it wasn't possible to gather and analyze the data for every land direction (highways and railways) because we analyzed the infrastructure of the whole region. Thus, the research in this article is directed to the ports and their entries, where the success factor of the port is determined by the success of the direction and the Motorways of the Sea service. In order to accurately determine each of the defined success factors, it was necessary to identify all the subelements which comprise them. The research results point out the complexity of developing new or improving the existing MoS services at higher levels (administrative, infrastructural, organizational, etc.).

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1 Introduction

Motorways of the Sea (MoS) is a concept that combines each way of transport making it into logistic service "from door to door". Such type of service, as well as transport in general, is not related to limited areas (countries) and borders should not be an obstacle but a generator of the development. At the same time, borders are the most common obstacle when MoS systems are developed separately in each country.

Development of the maritime system should be based on a systematic approach, clearly defined criteria and implementation steps, and also joint action and activities. Given that there are no clear criteria that determine the potential for success of current and future services, they need to be defined and implemented in future development strategies and action plans.

Strategic documents of European transport policy emphasize the key role of logistics in securing sustainable and competitive mobility in Europe and its contribution to achieving other goals such as cleaner environment, the security of energy supply, road safety, etc. Transport logistics include planning, organization, management, control and enforcement of transport operation throughout the entire transport process.

National transport systems at the region level (North America, Asia, European Union) are not equally developed. European Union member countries have undoubtedly reached a higher level of port, terminal and intermodal transport systems at all, but road transport is still dominant in all countries. One of the reasons is the insufficient involvement of the participants, i.e. insufficient co-operation and/or joint performance in any business area. Furthermore, there is a low level of cooperation between

scientific institutions that should be the generator of development strategies. The lack of IT systems that would promote and encourage the use of intermodal routes and services, and logistically facilitate their administration, provides road carriers with a traditional and simple, but environmentally unacceptable way of transporting goods and passengers. However, the goal is not to exclude or struggle road transport, but to make intermodal transport (sea, rail, inland waterways) a logical choice by making it simpler and more competitive (financial and organizational) by implementing series of measures. A particular problem is the lack of a systematic approach to quality indicators in intermodal transport, which is only partially developed in several ports and the lack of a common and systematic approach to the promotion of intermodal transport.

From the scientific literature relevant for the present scientific problem, following authors and articles can be stressed as relevant: Baird, A.: *EU Motorways of the Sea policy* [1] from 2005, where the author presents the European Commission's measures in the effort to develop the maritime transport system and this activity which are being undertaken. The same author in *The Economics of Motorways of the Sea* [2] from 2008 shows the relevant elements of the system and the economic aspect and advantages of land transport. Žgaljić, D., Perkušić, Z., Schiozzi, D. in the article *The significance of multimodal, intermodal and combined transport in the development of Maritime Traffic Maps* [3] from 2015 explain in detail the ways of transport organization with the aim of laying the foundations for further exploration. D. Tsamboulas, P. Moraiti, E. Vlahogianni in the article *Assessing the Effect of Infrastructure and Service Attributes on the Motorways of the Sea Realization* [4] present the Bayesian network as a relevant model for evaluating different scenarios in the function of traffic development. Poletan Jugović, T., Šimić Hlača, M., Žgaljić, D. in the article *Competitive Sustainability of a Transport Route in the Transport Service Market* [5] define the parts of the sustainability of the traffic direction while Jugović, A., Žgaljić, D., Poletan Jugović, T. in the article *Model of incentives for the development of intermodal*

transport of the Adriatic region in the function of sustainable development [6] define the concrete activities necessary for the development of sustainable MoS services. A significant contribution was given by Dundović, Č., Jugović, A., Žgaljić, D. in the analysis of Croatian ports in relation to the Motorways of the Sea implementation, where the port systems of the Republic of Croatia with the potential of MoS development have been analyzed in detail.

2 Analysis of the success factors of maritime traffic systems

The conducted research attempted to cover as much of the entire transport chain (from the departure point to the destination) that takes place in the Adriatic region. Since it is an analysis of the infrastructure of the whole region, it is not possible to collect and analyze data for all land routes (roads and railways). Therefore, research is focused on ports and their approaches. When comparing the potential systems of Motorways of the Sea, the land and sea part of the road is considered to be flawlessly functioning, that is, it is possible to assign factor 1. In this case, the success factor of the port determines the success of the route and the Motorways of the Sea system itself.

Scheme 1 is:

A – the success factor of road or rail transport from the departure point to the port A

B – the success factor of port A

C – the success factor of the Motorway of the Sea

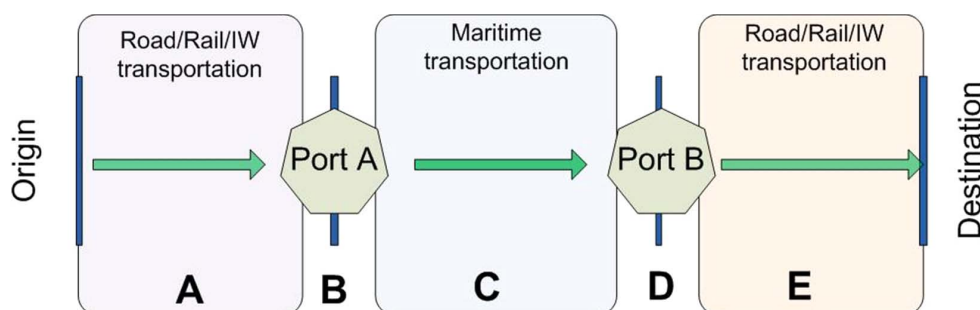
D – the success factor of port B

E – the success factor of road or rail transport from port B to destination

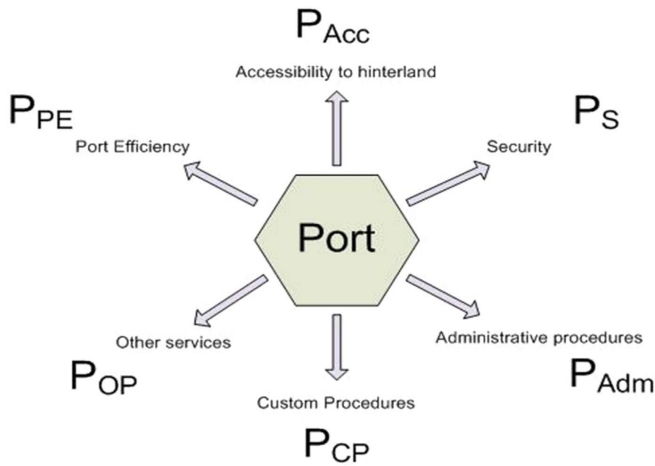
The number of success factors from the departure point to the destination gives the overall factor of the success of the Motorway of the Sea system

$$K = \sum_{i \in I} F_i \quad I = \{A, B, C, D, E\}$$

K = the overall success factor of the Motorway of the Sea system



Scheme 1 Elements of success factors of total service "from door to door"



Scheme 2 Elements of port efficiency factors

Source: Authors

Legend:

- P_{PE} – the success factor of port efficiency
- P_{Acc} – the success factor of the port’s accessibility
- P_S – the success factor of security
- P_{Adm} – the success factor of administrative procedures
- P_{CP} – the success factor of customs procedures
- P_{OP} – the success factor of other services

In order to gain the efficiency of the port, it is necessary to divide the port system to the specified characteristics and processes.

The success factor of the port is equal to the sum of all the mentioned factors ($P_{PE} + P_{Acc} + P_S + P_{Adm} + P_{CP} + P_{OP}$)

$$B \text{ or } D = f_b(P_{PE}, P_{Acc}, P_S, P_{Adm}, P_{CP}, P_{OP})$$

In order to determine each of these success factors, it is necessary to identify all the subelements that make it. With that aim, the questionnaire was divided into 7 chapters. The questionnaire is distributed to all ports in the Adriatic, European and world experts in the field of transport and maritime transport, European Commission staff responsible for the development of short sea shipping, maritime transport and TEN-T corridors, all Short Sea Shipping Promotion Centers (SPCs) in Europe and, through them, all European ports, with the aim of collecting correct data, but also the relevance of each of the individual subelements that make up the success factor. Based on the collected data on the conditions of the ports’ infrastructure and administrative processes, ports can be compared individually, but also according to the models (scenarios) for the implementation of a sustainable Motorway of the Sea system. In addition, the questionnaire requires each expert to identify the factor of the relevance of this subdivision in terms of the development

and implementation of the Motorway of the Sea system. The obtained relevance is used to precisely determine the importance of criteria in the process of multi-criteria decision making.

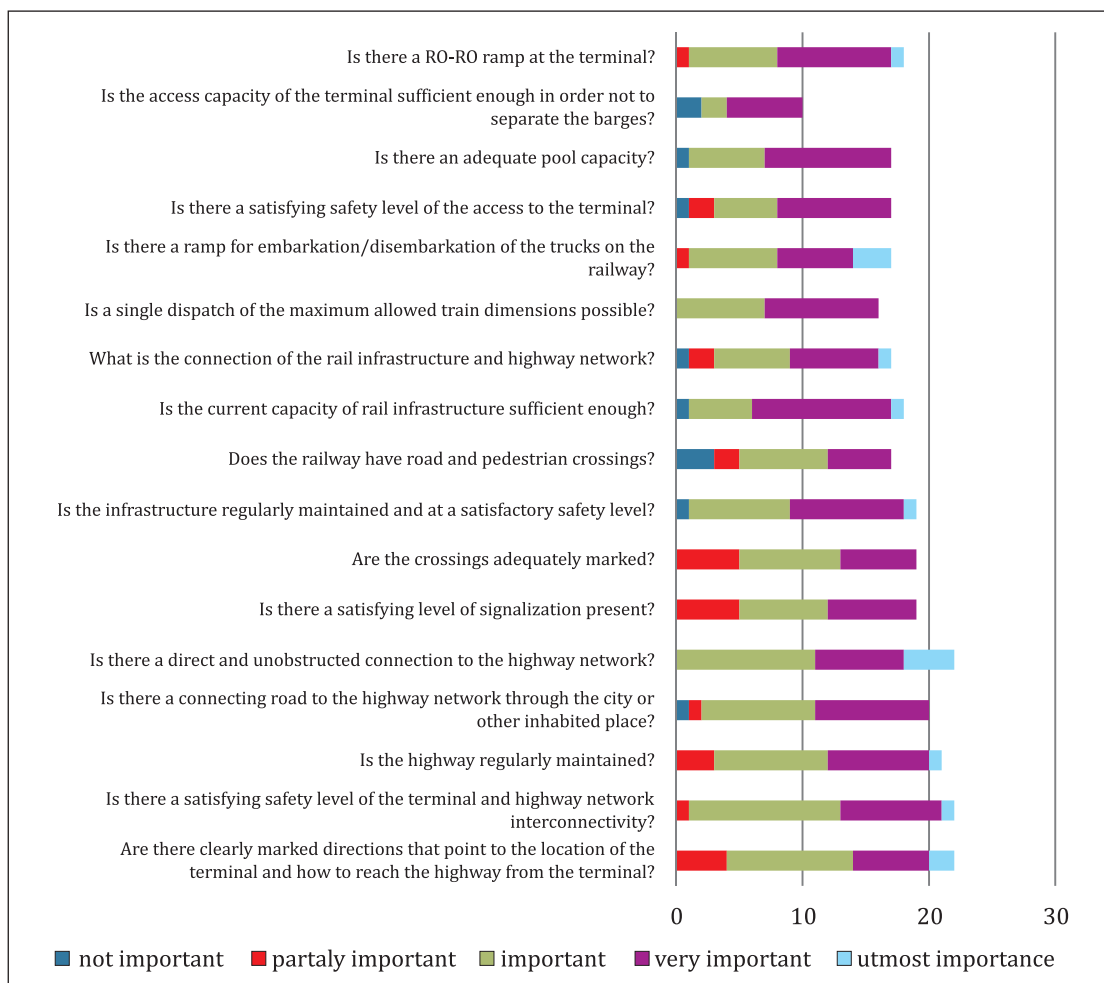
Experts were asked to determine the relevance of each of the subelements rated 1 to 5, where:

- 1 – is not important,
- 2 – partially important,
- 3 – important,
- 4 – very important, and
- 5 – of the utmost importance.

2.1 Port availability

After analyzing the answers presented in Graph 1, it can be concluded that the safety of access roads to the terminal is very important in the context of ensuring and maintaining service performance. It is interesting to note that the respondents gave huge importance to security from the point of entry/exit from the terminal. When asked “Are there clearly marked directions that point to the location of the terminal and how to reach the highway from the terminal?”, most responded with the high value “very important” and “of the utmost importance”. Such an answer is understandable as truck drivers arriving or leaving the terminal are a very important part of the reliability and performance of the entire service. Incorrectly marked roads will result in problems with the operation of the service. In this context, the relationship of other responses is also interesting. Respondents have given less importance to the conditions of the roads themselves or the road safety (though it is still an element of importance) as these are both elements that experienced professional drivers can easily depreciate and do not pose a problem that affects the functioning of the service. At the same time, insufficient marking approaches the terminal, or exit from the terminal and the connection to the highway can easily cause problems and consequently delays and dissatisfaction.

The high importance assigned to the undisturbed connection of the terminals with the highway network emphasizes that this is one of the key elements in ensuring the success of the service. If the terminal does not have direct access to the highway, it is already connected by a simple road, but it is equally bad if the urban area or less populated area passes. In both cases, negative effects on the environment (stress, accident, exhaust gases, etc.) are increasing. However, this also represents a potential problem in the operation of the service due to the increased traffic congestion at the entrance or exit of the terminal, which also results in stress and driver dissatisfaction. As a result, there are problems with the operation of the service in terms of delays, unreliability, and increased costs due to delays. It can be concluded that it is not essential whether the connection between the terminal passes into a populated or urban area, but the best



Graph 1 Analysis of the relevance of the port availability subelements

Source: Authors

solution is the direct connection between the highway and the terminal.

Regarding the safety of rail transport, responses emphasize the importance of safety in the operation of the service. A security failure can result in accidents that result in longer delays or in more severe cases of time-band closing. In both cases, the reliability of the service is hardly compromised, which is one of the characteristics and comparative advantage of Motorways of the Sea. It is interesting the relation between the questions “Are the crossings adequately marked?” and “Does the railway have road and pedestrian crossings?”, which clearly indicates that it is not necessary to have an isolated track from the traffic network (without road and pedestrian crossings), but it is possible by appropriate marking, i.e. by providing security conditions (signaling, bumper, etc.), to ensure the smooth functioning of the service. This is a very important answer in the context of infrastructure planning due to the significant difference in the cost of building a tunnel or a road viaduct, or a pedestrian pathway. In this way, it is possible to significantly reduce the costs of building transport infrastructure.

The high importance given in all responses related to the capacity of the railway connection with the terminal and the railway system at the terminal confirms one of the basic assumptions of Motorways of the Sea, namely that maritime transport must be a smooth high-capacity service. Capacity, in this case, refers to all system elements (ship, terminal, rail, road transport, etc.). Rail capacity has two basic elements – the transport capacity from the terminal to the destination (in terms of the rail as a basic infrastructure with all its elements of wagon and locomotive), and the capacity at the terminal related to the capacity of the track and the transshipment equipment in terms of loading or unloading of containers on wagons. Lack of any element in this complex system results in reduced capacity and consequently limitations of service of Motorway of the Sea. Every infrastructure upgrade of the railway system is very expensive and it is necessary to carefully plan the launch of the service in relation to the maximum infrastructure capacity.

The RO-LA ramp is also of great importance, enabling direct manipulation of vehicles from RO-RO technology,

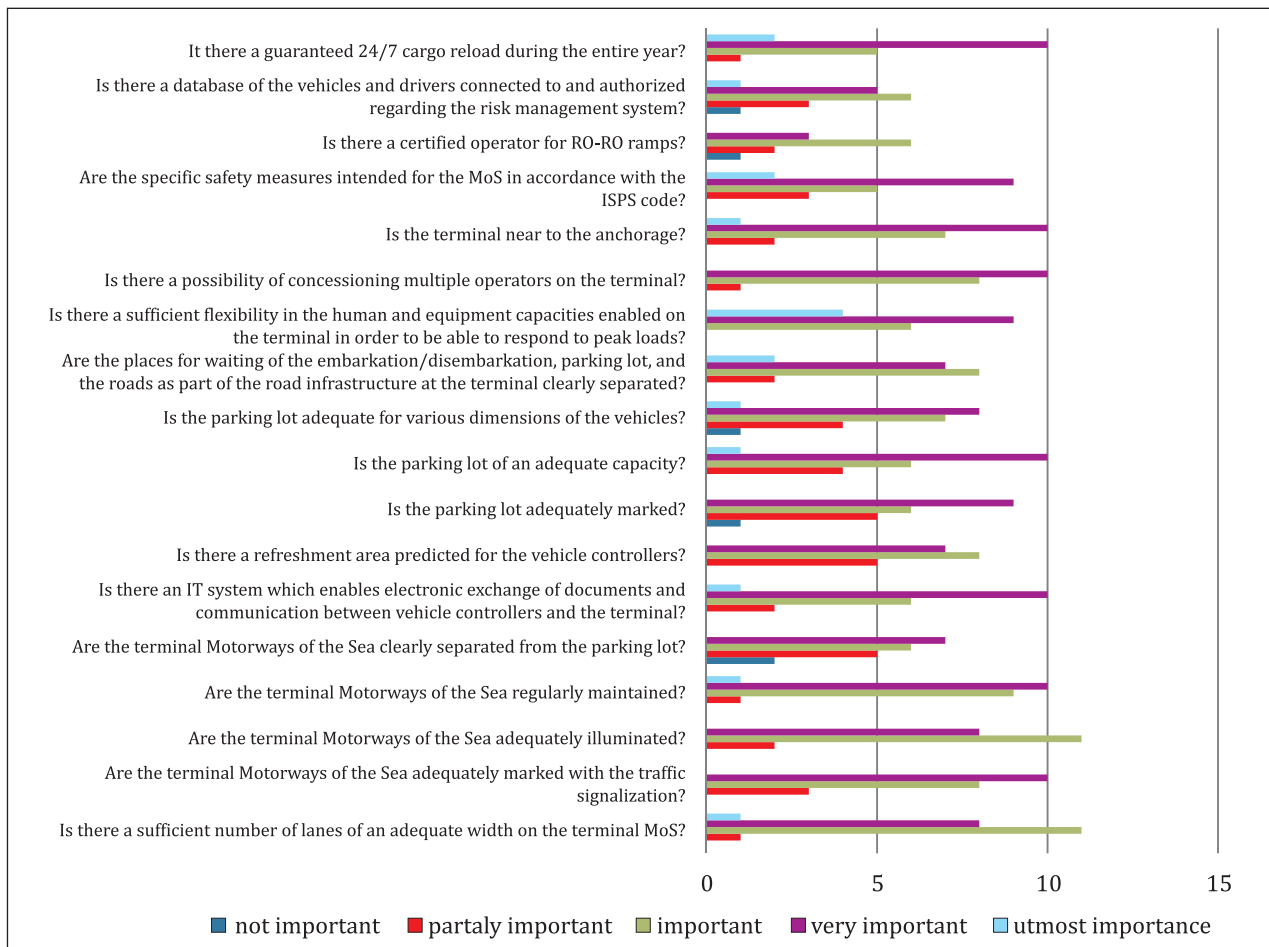
and the organization and inclusion of railways in the entire chain. Such a system is most effective for society and space. Given the high importance of such solutions, the response can be drawn from the aspirations of the respondent to transport the larger quantity by sea, rail or inland waterways. However, the efficiency and cost-effectiveness of such systems are questionable in the short run, given the time this additional manipulation of the ship-rail is taking away.

The responses emphasize the importance of the terminal capacity for the possibility of receiving ships at least at the same time. Answers are logical because any additional manipulation, in the case of distances greater than the ship, takes time and increases the cost. Direct manipulation is ideal, if possible. In that sense, responses suggest terminal capacity large enough to enable this. From this, it can be concluded that the planning of the service should take into account the spatial constraints and the cost that is consequently connected either to the additional manipulation or to the later extension of the terminal capacity. A key element in the RO-RO technology, totally irrelevant to container manipulation, but inevitable in train or truck motion, is the existence of RO-LA ramps. It is therefore un-

derstandable the high importance of its existence. When designing a terminal or service, consider the relatively low cost of the RO-RO ramp and analyze its positioning as an element that allows additional terminal services.

2.2 Infrastructure and activities on the land side of the terminal

When analyzing the response of determining the relevance of subelements related to infrastructure and activities on the land side of the terminal (Graph 2), a large percentage of importance was given to the appropriate road capacity at the terminal. This is a very important element in the whole chain given that the terminal is one of the critical hubs. Specifically, the terminal must be able to simultaneously accept all cargo on arrival, cargo on departure, trucks, and rail that have shipped and dragged cargo and internal port machinery. The terminal must have a capacity of each of these elements sufficient to allow smooth simultaneous manipulation. The road part is critical in that it is most often that a single container is shipped, which means that a large number of trucks must be han-



Graph 2 Analysis of the relevance of infrastructure subelements on the land side of the terminal

dled and manipulated at the same time at the terminal. For this reason, a large number of adequate width strips are necessary. However, width is also important because trucks are driven by people of different abilities and character, and the greater width addresses the potential problem of patching in full capacity conditions.

Related to the previous answer on the number of lanes of appropriate widths, a large percentage of the importance of answering the question of proper marking of roads at the terminal is logical. Clear and understandable marking of internal roads at the terminal is necessary in order to easily and efficiently organize terminal traffic. The lack of proper signaling cancels the high capacity of roads. In this case, the problem of frequent interference with the synchronized operation of the terminal is possible due to the errors of the terminal truck driver and entry into space not intended for them. Proper and logical signaling does not require major investment, but 100% eliminates the potential problem.

Given that the terminal is open for 24 hours, adequate lighting to allow the normal functioning of traffic at the terminal is necessary. In this sense, the importance of the answers given by the respondents is understandable. This is one of the basic requirements for the smooth operation of the terminal. The lack of adequate lighting in night conditions directly creates terminal limitations in terms of smooth operation capacity.

Proper maintenance of internal roads at the terminal is one of the elements that define the total capacity. Specifically, poor maintenance slows down traffic and creates dissatisfaction with trucking companies, which are in large number in the context of Motorway of the Sea service. Understandably, the respondents placed huge importance on this element, intending to strive for maximum capacity and the smooth functioning of the terminal as one of the key and critical points in the overall chain. There is an interesting analysis of the issue of the clear separation of terminal roads from the parking space. 35% of the respondents gave high importance, but at the same time, 30 respondents answered with normal/usual importance. From this, it can be concluded that it is important to clearly mark the parking space at the terminal, but also that experience has shown that truck drivers are professionals who can logically recognize the parking space on which they do not disturb traffic flow and operation at the terminal.

Insufficient parking space directly affects the organization of service and creates long delays and unreliability of service. This is one of the critical elements, which is very difficult to resolve quickly, given that in the Motorway of the Sea system, a large number of truckers are often involved, requiring a large space for stopping and parking. Any follow-up intervention in terms of capacity increase, which comes after capacity is identified as a problem, takes too long and during this time period and all services lose out due to unreliability, delays, and problems in the organization. For this reason, a large percentage of the importance placed by the respondents is understandable. The existence of waiting and parking spaces of sufficient capacity and

roads of appropriate characteristics means nothing if the signaling and organization do not allow their full utilization and smooth operation. The absence of a clear, efficient and optimized internal organization of the functioning of road traffic, as only one part of the total port system, undoubtedly makes a decrease in total capacity of the terminal, its inefficiency and, consequently, to problems in organizing each individual service. The result is unreliable services and an inability to compete on the market.

Given a large number of truck drivers who arrive at the terminal, the huge importance given to the accompanying infrastructure and content for drivers is understood to relate to the basic conditions of physiological needs. The overall result in the efficiency of the terminal or service will not increase but will reflect the dissatisfaction of drivers, which are very important in the overall chain.

Most respondents placed great importance on the fact that services operate 24 hours a day and any deviation from this rule results in delays and unreliability of services. This is unacceptable in competition. Since ships carry the largest number of containers or vehicles in the system, the terminal organization involves operating at intervals from full capacity to reduced traffic, depending on the arrival and departure of ships. In these conditions, it is not possible to organize the work of the terminals in shifts with always the same number of people and mechanization as this will result in loading difficulties and unnecessary increase in costs in the case of reduced traffic. Respondents clearly recognized and identified the great importance of the possibility of organizing workers and mechanization during periods of full capacity, when failure to do so would result in a deadlock and consequently inefficient and unreliable services and terminals. This is an indispensable criterion for ensuring maximum service capacity.

Respondents recognized the need for specific safety protocols when it is about ships in the Motorways of the Sea service. There are two ways to define this. First is the increased potential for danger given a large number of containers and vehicles and the high risk of safety. But on the other hand, these are ships that are in line service and often come to the port and some simplifications can be made. Furthermore, these are the vehicles and drivers that most frequently and regularly arrive at the terminal, and it is, therefore, reasonable to allow them a simpler procedure after a security check, with the aim of increasing the reliability and efficiency of the services and terminals.

2.3 Infrastructure and activities on the sea side of the terminal

VTMIS is primarily intended for navigation safety but also a very useful tool to speed up procedures and to ensure the reliability of the maritime part of the MoS service. Namely, using AIS technology through VTMIS very precisely monitors the ship and enables the preparation of all involved services for ship reception. This optimizes the workforce, mechanization and working hours of all

services (captaincy, customs, police, etc.). VTMISS provides information about the ship, cargo and crew electronically. This is the first step in computerizing all elements of the service. Computerization, that is, providing accurate cargo information in real time, with the exchange of all supporting documents throughout the chain, is a comparative advantage that ensures service is more attractive than its competitors. In addition, it enables the clear implementation and control of the quality system and the exact identification of weaknesses in the chain. It is therefore logical that the respondents recognized the high importance of using this system as shown in Graph 3.

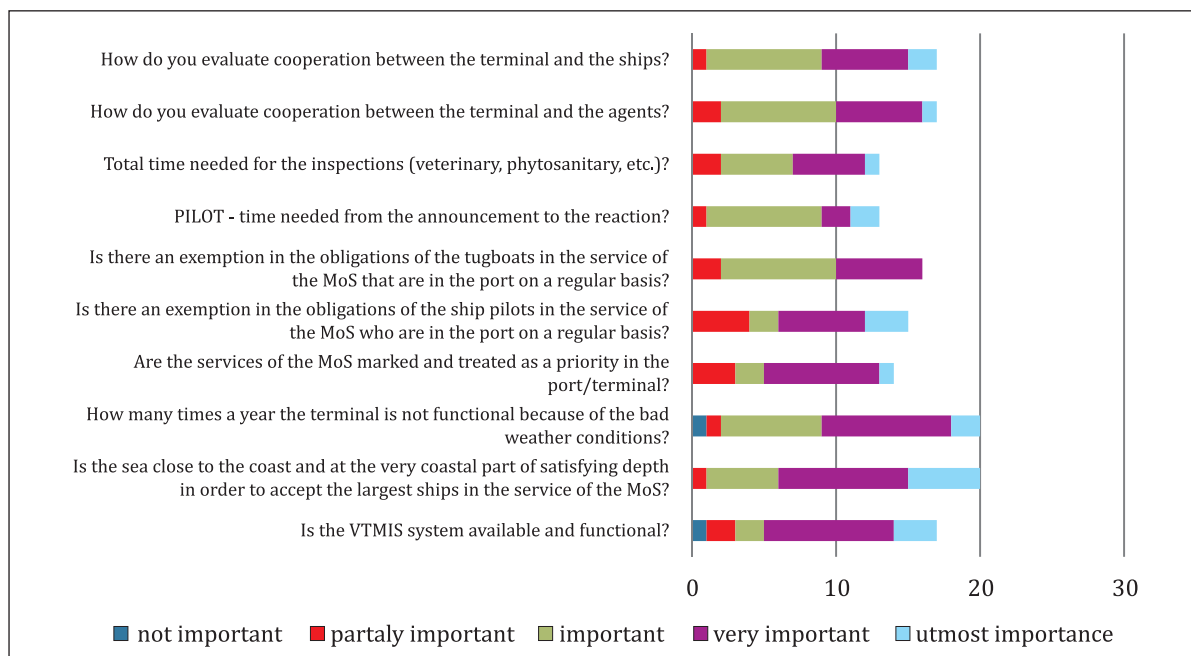
One of the key elements that can permanently limit the capacity of terminals and services, which may later result in the inability to monitor developments related to competing services, is the depth of the sea at the terminal. Namely, the increase in the capacity of ships (TEU), and therefore its dimensions (length, width, and draft) is linear and it is expected that this trend will continue. In view of this, terminals that today have restrictions on the draft of the ship will not be able to accept new ships in the near future. The inability to accommodate all ships under full load limits them in relation to competition, and given the high daily cost of the ship, compels shippers to avoid this terminal. Infrastructure investments are very large, very often not reasonable and not even possible to increase the depth of the terminal, and this element must be taken into account when planning the service. In consideration of this, the high importance given to the question by the respondents is understandable. Moreover, 70% of the respondents gave the answer "very important" or "extremely important" and thus

defined the depth crucial for the development and operation of the terminal today and in the future.

If the strategic determinant of the terminal is to function and develop for MoS services, then the first of the preconditions for a MoS service is satisfied. Then such services have the advantage and thus assume that they can be developed at full capacity. This element ensures the highest level of service reliability, at least when it comes to the marine part. In view of this, and analyzing the answers, it is noted that the respondents did not give the highest possible importance. The reason is that for terminals that are not limited by the capacity of a good organization of the terminal, optimizing all its processes, it can completely eliminate possible downtime of the terminal. In this way, there is no difference in the operation of multipurpose terminals and dedicated terminals for MoS services.

Considering that the traffic in the world is running constantly 365 days a year, it is impermissible to delay the functioning of the terminal as one of the hubs of the transport system. Any terminal restriction due to weathering is also a service limitation. Consequently, such limitations reduce the reliability of the service as one of the key features of MoS service and thus eliminate their advantage over the road. For this reason, it is clear the high importance identified by the respondents.

The exemption from the obligation to use the pilot also affects the cost of service. Price is ultimately one of the key elements that determine the market's direction and whether or not a service will be successful. Therefore, any reduction in price increases the competitiveness of service



Graph 3 Analysis of the relevance of the infrastructure subelements on the sea side of the terminal

and the chances for success. At the same time, reliability is also a key element of shipping services. Pilot use is a safety element and any exemption from pilot use must be such that it does not in any way affect safety. Any possible failure and accident would do great harm and significantly reduce the element of service reliability in the market. If the characteristics of the terminal are such that it is obligatory to use the tugboats when manipulating the ship, it is an element that increases the price. Analyzing the answers, it is noted that a smaller number of respondents placed high importance on this element. So it is questionable whether this element is of high importance.

There is an interesting analysis of the response related to reaction time and the work of the services. High importance was assigned in both cases, but with little difference. In response to the reaction time of the pilot, the majority of respondents raised the usual importance. Understandable, given that terminal is using the VTMIS system and can precisely determine the time of arrival of a ship at the terminal, and ordering pilots may be sufficient in advance to avoid waiting. In this way, there is no influence of the reaction time on the operation of the terminal or the reliability of the service.

At the same time, a large number of respondents emphasized the importance of questions connected to the working hours of the inspection services. It is clear that this element is of high importance and that any unreasonably long work of inspection services creates a deadlock and directly affects the extension of service time and its reliability.

2.4 Interacting with the ship

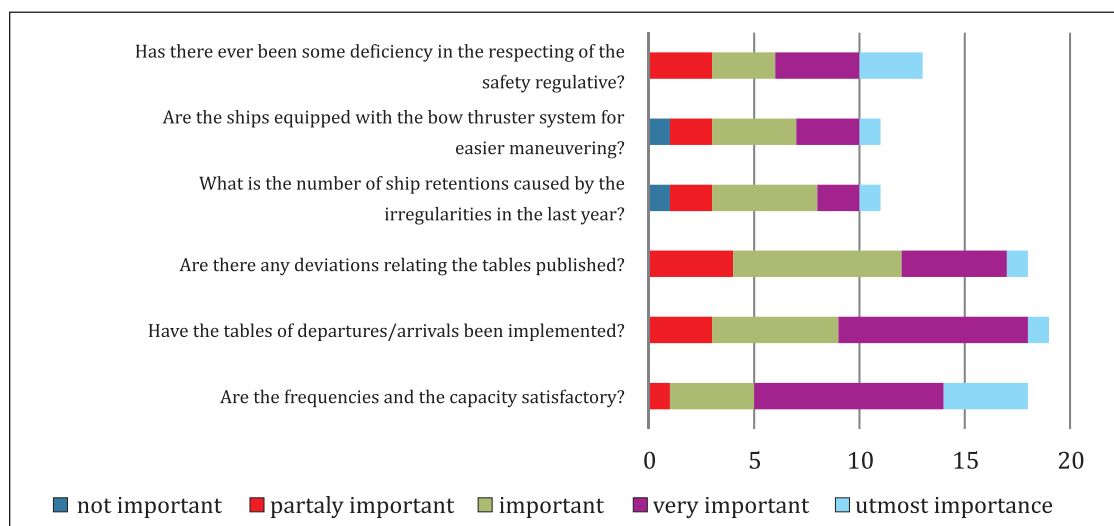
Regularity and reliability are key elements of a MoS service. This is also evident from the answers in Graph 4, given that 77% of the respondents answered “very impor-

tant” or more, of which 22% said, “of huge importance”. MoS services are regular line services, and it is clear that departure/arrival time must be pre-determined and accessible to all. Moreover, it is in the interest of shipping companies, service organizers, and everyone involved in the chain to make this information as widely disseminated and promoted as possible.

The answer to this question about reliability is consequently related to the previous one, which defined that a useful announcement of the time of departure/arrival of a ship. With this announcement, all logistics operators who organize related services (by rail, truck, etc.) plan their services and offer and contract them on the market. So once the departure/arrival times of a ship are announced, they enter the service calculation, become a connection in the chain, and the service must then function according to that schedule. Any deviation from mentioned results in a deadlock, delays and ultimately disrupts the reliability of the service, one of the main features on which the whole concept of MoS is based.

The quite low importance identified by the respondents can be attributed to the fact that most of the respondents are terminal operators and port authorities, and that from their point of view the functioning of the terminal delays does not result in extremely large problems. These are terminals that are not at the maximum of their capacities, their operation is relatively optimized, and any delays are announced and the terminals are being prepared to receive and manipulate and do this without any deadlock. However, the delay is further transmitted to the rail and/or road and the overall functioning of the service.

Safety is of the utmost importance. This is a prerequisite for the reliability of the service and deviation is not tolerated. Since these are regular liner services, it is an often case that after a detailed security check according to



Graph 4 Analysis of the response relevance of subelements of the ship interaction

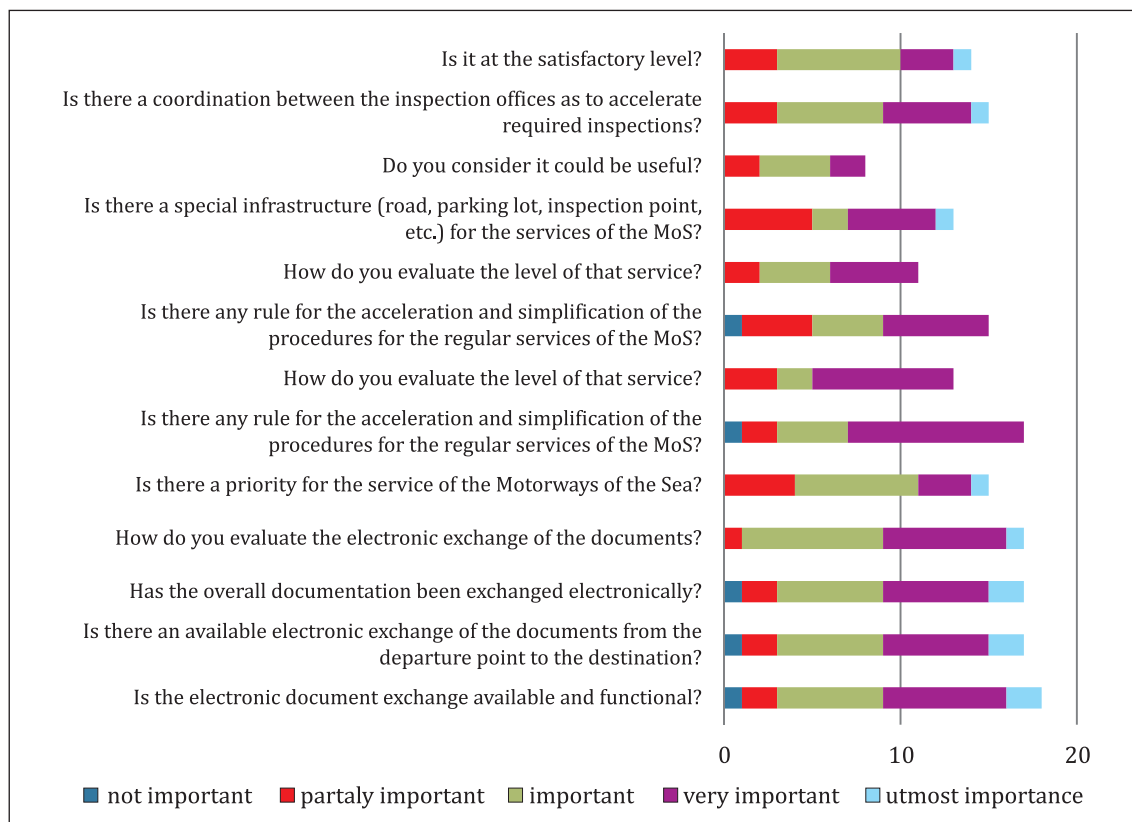
the default protocol, a simplified port manipulation procedure is established, which enables less transit time, high reliability and lower cost of services. Then any security breach will be severely punished and the mentioned advantage will disappear. Therefore, the logical and understandable answer of the respondents is that the security element is of the highest possible importance.

2.5 Exchange of information and documents

Respondents rated the use of electronic document exchange between all participants in the service chain as highly relevant, as can be seen from Graph 5. Understandably, electronic document exchange significantly speeds up and facilitates document administration. Electronic document exchange alone does not speed up the transport process but raises reliability and transparency. Also, electronic document exchange enables the submission of the necessary documentation before the arrival of the ship and can be precisely prepared beforehand (manipulation). This optimizes the transport process, shortens transit time and increases reliability. When it comes to exchanging documents between only two ports as a maritime part of the total MoS chain, the respondents gave the usual level of importance. From the above, it can be concluded that electronic document exchange is very important when it comes to the over-

all chain, especially in terms of preparation, optimization, and reliability. However, when it comes only to the physical reception of a ship in port and transshipment by the time the cargo is placed at the terminal, the electronic exchange of all documents is not crucial. And the notice coming from the AIS system (VTMIS) is enough to arrange for proper mooring of the ship on time and without deadlock. Simply announcing the amount of cargo (containers, trucks, etc.) and how they continue their journey is enough to arrange disembarkation. In the continuation of manipulation, inspection, loading onto a truck, rail or so, electronic document exchange is an indispensable part.

Respondents highly emphasized the importance of simplifying the inspection process for goods by all relevant departments. Considering that these are regular line services, most often involving well-known carriers and customers, it is possible to carry out a process of simplifying the inspection of cargo, means of transport and people after a security check. In this way, it speeds up the transport process, shortens the transit time and ensures the reliability of the service as one of the main features of the MoS system. It is important that the simplification process is public, clear and equal to all, and that there are periodic reviews to confirm status. Highly placed on the quality level of this service, respondents clearly emphasize the importance of transparency. The simplified terminal



Graph 5 Analysis of the relevance of the information and document sharing subelements

inspection process is only one of the elements that contribute to the reliability of the shipping service. Namely, reliability is very important, it has an advantage over competing services, it is long and difficult to build, and once broken it often damages all services that use the terminal.

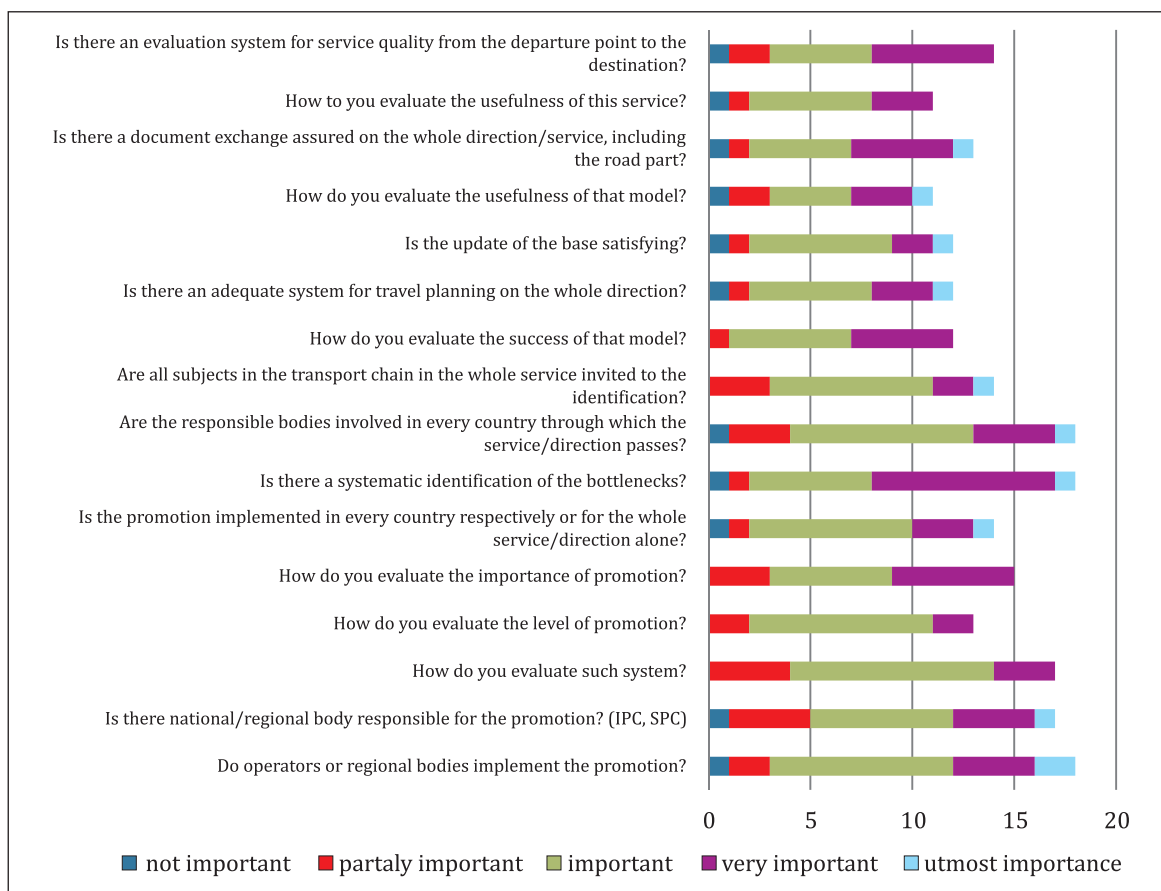
Respondents stressed high importance on the coordinated work of all inspections. Given that cargo, people and means of transport at the terminal are subject to inspection by several services (captaincy, police, customs, etc.), their coordinated work is essential to optimize the inspection process. This is a very important element that affects the total shipping time and price. Any additional manipulation, just like waiting, creates a cost to be charged to the goods. Therefore, there is a direct impact on the reliability and competitiveness of the service.

2.6 Promoting and organizing services from the departure point to the destination

The analysis of the responses in the section related to the promotion through the promotional centers gives a very interesting conclusion. Respondents generally give the usual importance of publicity, but with a tendency for

high importance. It seems to be concluded that the promotion is not important when it comes to the development and sustainability of the shipping service. The answers are logical given that there is only one promotional center in the Adriatic area and there is not enough experience of the respondents. It should be emphasized that it is common practice for transport organizers to conduct the promotion themselves, but 33% of the respondents in the first question answered that promotion through a regional body is of high importance. It can be concluded that publicity is important, but that organization at the level of the region or corridor is also necessary. In the second question, which defines the importance of having a separate regional promotional body, respondents place the usual importance, but only 65% of the respondents answered this question at all. Interestingly, of these, 30% respond with a high level of importance. It is concluded that there is a general opinion on the importance of promotion on a regional basis. However, there is not enough experience and knowledge to define exactly whether an organization is necessary through a single center or in a joint way.

A common and systematic method of identifying and solving problems in the organization and maintenance of



Graph 6 Analysis of the relevance of the subelements of the promotion and organization of the service from the departure point to the destination

service is identified as very important as shown in Graph 6. The bottleneck is an obstacle to smooth transportation, no matter if it is administrative, operational, legal, local, national, regional or a similar problem. This is a bottom-up approach that identifies problems in a very simple way. Namely, all subjects in the transport chain, but also in the entire transport system, have been given a simple web form through which they briefly describe the problem. Problems are collectively collected, filtered and presented to a joint processing committee. It is necessary to organize interdepartmental commissions (police, customs, captains, etc.) at the level of each country, which periodically organizes meetings as needed, depending on the intensity of bottlenecks. Each country has a national commission and one representative in a regional (or corridor) commission. The work of both commissions must be coordinated, as most regional problems must be dealt with operationally by representatives of national commissions. This approach ensures constant progress and improvement of the service and ultimately its sustainability.

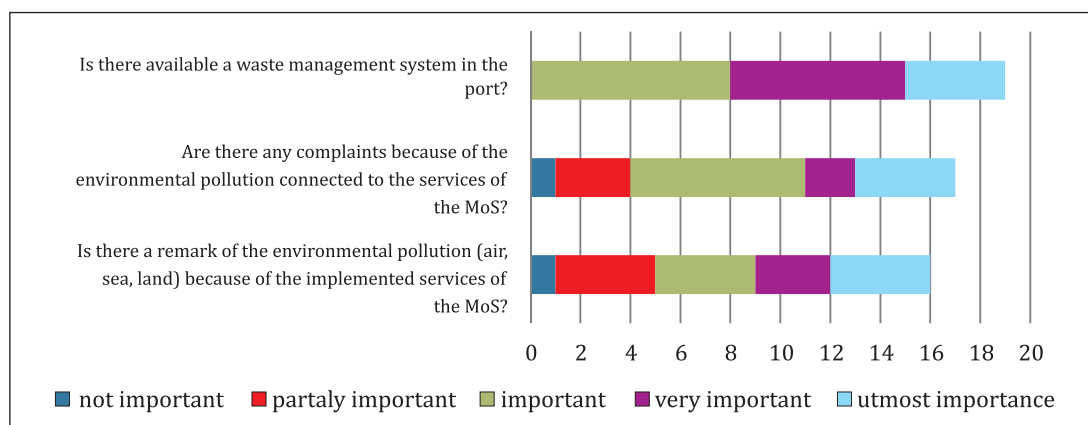
Respondents recognize the high importance of having a unique and accessible on-line service that can comparatively analyze possible routes and modalities of transportation. Such a system provides complete information on possible routes, models, duration of transport, price and necessary documents to encourage the maximum utilization of intermodal capacities. This encourages the strengthening of these "alternative" modes of transport, and thus their competitiveness. Thus, by entering the departure point and desired destination, the user is offered an overview of possible transportation routes in all combinations of transport modes. Intermodal transport combinations come first, with a focus on shipping routes, but the application also presents classic (road) modes. It is clear to the user to analyze the advantages and disadvantages of both modes of transport. The persistence of the comparative advantages of shipping routes, such as reliability and price, is very important in this case. Graph 6 shows that respondents identified a very important refresh of the database. Namely, if the schedule

of departures and arrivals of any service (ship, railway) is updated in real time, this system makes no sense because the data is incorrect. The application provides all the necessary logistical information (contacts of carriers, freight forwarders, terminals, opening hours of all entities, capacities, required documents, etc.). This is the complete information required when planning transportation and given the benefits of shipping in terms of reliability and cost, this is a very valuable promotional tool. This is why respondents identified this service as very important.

Respondents placed a high level of importance on the introduction and maintenance of quality assurance systems in maritime transport services. It is imperative to identify all participants and processes in the service flow from the point of departure to the destination. Limit values should be assigned to each of them, depending on their role (response time, the time needed to carry out an activity, price, speed, description of activities, etc.) and an automatic monitoring system for their values. In this way, it is possible to easily and precisely identify the connection in the chain that is responsible for the delay, deadlock, insufficient quality level or so. Such a system enables the transport organizer to offer the customer a quality guaranteed service. This is the reliability that is necessary with the shipping service.

2.7 Ecology

Motorways of the Sea were created in response to the environmental demands and the desire to shift as much cargo as possible from the road to more environmentally friendly modes of transport. It is on this philosophy that a MoS system is built and it is clear that ecology is an important feature of these services. In this regard, it is understandable that the respondents' opinion is that environmental protection is of high importance. Even 69% of respondents say that transportation through the MoS service should not be connected to environmental pollution. Of that percentage, even 36% say this is the highest possible level. Understandably, it would be because of that



Graph 7 Analysis of relevance responses of ecology subelements

loss of seaports as an ecological mode of transport would be lost. The analysis and graphical representation are in Graph 7.

The answer to the question regarding the systematic disposal of waste at the port is in line with the previous question. All respondents emphasized that the operation of the MoS service should not have any negative impact on the environment. These include terminals that must ensure that sewage and oily water and garbage are received.

The selected criteria are the result of the conclusions drawn from research and surveys for the purpose of defining models, measures, and activities for the implementation of a sustainable MoS system. The following groups of criteria were selected with associated criteria:

- **infrastructure criteria groups:**
 - subelement group port availability with subelement:
 - direct connection to railway infrastructure,
 - direct connection to the highway network,
 - safety factor on railway infrastructure,
 - road safety factor,
 - maintenance of railway infrastructure,
 - maintenance of road infrastructure,
 - the capacity of the railway infrastructure,
 - the capacity of road infrastructure;
 - a group of subelements infrastructure and activities on the land side of the terminal and subelements:
 - condition and capacity of road infrastructure for external vehicles,
 - condition and capacity of road infrastructure for internal vehicles,
 - the capacity of parking space,
 - existence of *Terminal Operating System*,
 - port equipment for handling containers and vehicles;
 - group of subelements infrastructure and activities on the sea side of the terminal with subelements:
 - depth of the sea,
 - priority in receiving for ships in regular service,
 - exemption from pilot use,
 - exemption from the use of tugboats;
- **the group of criteria for interaction with different modes of transport:**
 - subelements group of ship service interactions with subelements:
 - SSS service number,
 - number of permanent representations of shipping companies;
 - subelements group of rail transport interactions with subelements:
 - number of block train services,
 - number of operators in the country;
 - interaction with road transport,
 - subelements group exchange of information and documents from the subelements:
 - the existence of a port communication service,
 - the existence of status of prioritization;
- **the group of administrative-political criteria:**
 - a service promotion system,
 - IT support of the service,
 - systematic identification of service bottlenecks,
 - quality management system,
 - subelements group joint management of the port system with subelements:
 - the complexity of work organization and functioning,
 - the advantage of increased capacity;
 - political decision making.

3 Conclusion

By analysis of the available literature, scientific articles, discussions with businessmen (ports, carriers, transport organizers), it can be concluded that there is no single and comprehensive list of criteria that the Motorways of the Sea system must satisfy in order to ensure its efficiency and sustainability. The authors of the questionnaire tried to cover as much of the entire transport chain (from the departure point to destination) that takes place in the Adriatic region. Since this is an analysis of the infrastructure of the whole region, it is not possible to collect and analyze data for all land routes (road and rail). The questionnaire was distributed to all ports in the Adriatic, experts in Europe and the world in the field of transport and shipping, European Commission staff responsible for the development of short sea shipping, shipping routes and TEN-T corridors, all Short Sea Shipping Promotional Centers (SPCs) in Europe, and, through them, to all European ports. The purpose of the questionnaire is to collect accurate data, as well as the relevance of each individual subelements, which is a success factor in order to determine the true value of each subelement. Based on the analysis of the responses collected, the available literature and interviews with experts, relevant criteria for evaluating the development and sustainability of the Motorways of the Sea system have been identified.

The performance groups of criteria by which the proposed models for the implementation of the MoS system can be evaluated are infrastructure, interaction with different modes of transport, and administrative-political.

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