

The Determinants of the Development of the Sea-Land Transport Chains in the Second Decade of the 21st Century

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The intersectoral integration which meets the requirements of the transport sector clients is one of the most important trends observed in the modern transport system. At the quantitative level sea transport, which is the main component of the sea-land transport chains, accounts for handling of 80% of the world trade and at its value level it accounts for 70% of the world trade¹. The article aims at identifying, systematizing and analysing the most important determinants of the development of the sea-land transport chains in the second decade of the 21st century.

Keywords: sea-land transport chains, determinants of development.

1. THE PRIMARY IDEAS IN RELATION TO THE SEA-LAND TRANSPORT CHAINS

What should be regarded as a 'transport chain' is "a technically, technologically, organizationally and commercially coordinated rational sequence of actions in the processes of transport, handling and storage with the objective of moving goods which are necessary for the economy to be operational"². The idea of transport chain was popularised as a result of the increase in the importance of additional logistic services in the primary processes of moving merchandise.

In the reference books on economics and transport arrangement involvement of at least two sectors of transport in the accomplishment of a particular process of freight transport is defined as 'multimodal transport'³. At the same time in the Polish academic record on this subject field the

idea of multimodal transport is interchangeably mistaken for intermodal or combined transport.

A sea-land transport chain is established for fulfilling transport needs which require involvement of at least two sectors of transport, one of which is always sea transport, in the process of moving merchandise between the consignor and the consignee.

Several sea-land transport chains, which compete for transport handling of particular merchandise, can also be an alternative to direct road and rail transport or rail and road chains.

One of the most important issues in relation to the sea-land transport chains are the reasons for the development of this form of intersectoral transport processes. These determinants can be examined at three levels:

- general - connected, in general, with the need for integration in transport and development of the multimodal transport chains,
- detailed - related to the sea-land multimodal transport chains regarded as a specific form of integration in transport, which involves sea transport combined with the land transport sectors,
- practical - related to particular scenarios of the sea-land multimodal transport chains.

¹ Measured in transport activity.

² J. Neider, D. Marciniak – Neider, *Transport intermodalny*, PWE Warsaw 1997, p. 22.

³ J. Wronka, *Nowy etap rozwoju transportu kombinowanego w Polsce?* [in:] *Transport intermodalny w Polsce, Uwarunkowania i perspektywy rozwoju*, edited by E. Załoga, *Zeszyty Naukowe Uniwersytetu Szczecińskiego* issue no. 778, *Problemy transportu i logistyki* issue no. 22/2013, p. 24.

2. THE GENERAL DETERMINANTS OF THE DEVELOPMENT OF THE INTEGRATION PROCESSES IN TRANSPORT

With regard to the first level of integration in transport, it occurs more and more often that the cargo administrators (shippers) address the need for a comprehensive coordination of actions in relation to the entire transport process, relating to the primary actions performed in the complex transport processes (loading, unloading, temporary storage), and additional actions which increase the so-called added value of transported merchandise. It is a fundamental change in comparison to the previous practice of signing numerous partial contracts with the contractors providing services at particular stages of the transport process. What is characteristic of these actions is that they encompass individual components of the transport process aiming at their integration which performs the task of ensuring maximum efficiency of the actions taking place in the entire transport chain⁴.

The general determinants of the development of the integration processes in transport include:

- spatial determinants,
- economic determinants,
- temporal determinants,
- administrative determinants,
- other.

The spatial determinants which have their impact on the structure development of the participants in the intersectoral transport chains should distinguish the location of:

- main industrial centres,
- arable land,
- settlement centres,
- tourist centres.

The first two factors are related to the location of the supply zone for the markets in specific raw materials and industrial articles (related to the traditional industry branches such as mining or ferrous metallurgy and modern food-processing industry) as well as agricultural produce. The following two out of the above mentioned factors are related to the location of the demand zone for the markets in industrial and agricultural products.

It is worth pointing out the changes occurring in the particular parts of the world related to the importance of the individual sectors of economy (services, industry and agriculture) in relation to producing a GDP as well as changes within the framework of particular sectors.

The spatial determinants can also include natural environment obstacles which, on the one hand, eliminate some forms of intersectoral cooperation in transport, but, on the other hand, provide a good, or sometimes dominant, position of other forms of integration (e.g. sea-land transport chains in the case of insular states and numerous intercontinental transport operations).

The next group of development determinants of the integration processes in transport is of economic nature. It includes:

- level of economic development,
- level of national wealth,
- taxes, fees and remunerations,
- transport market circumstances
- objective and subjective structure of the international trade exchange.

It is a very complex group of factors. However, they are interrelated in a significant way. The level of economic development in the particular countries influence their inhabitants' wealth and the objective structure of demand they create in which the higher the income the bigger demand for processed goods (Engel's law). It also influences the objective structure of industrial production, as the level of economic development increases the role of modern industry branches increases. The amount of taxes, fees and remuneration has their impact on competitiveness of the domestic industrial and agricultural production on the international markets. However, the circumstances, in connection with the individual sectoral transport markets, influence the sectoral structure of transport chains, including the level of liberalization of the supply zone for these markets, the amount of fees charged for the access to the transport infrastructure, the size and ownership structure of the enterprises which take part in the international trade exchange, etc. A very important group of the determinants of the development of integration processes in transport is related to the changes in participation of particular merchandise groups in international trade as well as consequent changes occurring in the subjective area where this trade is handled.

⁴ S. Szwankowski, Współzależność funkcjonowania składników lądowo – morskich łańcuchów transportowych, Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk 1994, p. 11 et seq.

The group of economic determinants is connected with the determinants which influence the period of time in which intersectoral transport processes are accomplished. The most important determinants in this group include:

- specific features of particular transport sectors,
- diversified quality of the infrastructure of particular transport sectors,
- tendency to implement innovations,
- economic power of the particular participants in the intersectoral (multimodal) chains.

The particular transport sectors are distinguished by specific features which have a significant impact on the decisions regarding their involvement in the services provided for the international merchandise streams within the framework of intersectoral transport chains. Normally, different authors present such criteria (demands) as velocity, mass volume, safety, cheapness, directness of deliveries, availability, reliability and comprehensiveness of services⁵. For the transport systems in particular countries it is also possible to identify differences in the level of development of the transport infrastructure of particular transport sectors. Differences are also seen in the tendency to implement organizational and technological innovations within the framework of particular sectoral systems.

The factor, which has its significant impact on the development of intersectoral integration in transport, is also the power of individual partners involved in this form of chain⁶.

⁵ cf. D. Rucińska, A. Ruciński, O. Wyszomirski, Zarządzanie marketingowe na rynku usług transportowych, Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk 2004, p. 94 and W. Grzywacz, J. Burniewicz, *Ekonomika transportu*, WKŁ, Warsaw 1989, p. 157.

⁶ A good example is a phenomenon of the so-called 'slow steaming' introduced by the shipowners during the latest global economy crisis, which resulted in a fall of demand for international transport operations and consequently in an excess supply of the unused transport capacity. Aside from the temporal and partial withdrawal of the fleet from operation, introduction of slow steaming, that is reduction in the speed of vessels, was a response to the circumstances made by the container shipowners. For the shipowners these actions resulted in savings on account of the lower costs for vessel fuel, but the rest of the participants of the chain had to adjust to the changes imposed by the shipowners.

The group of development determinants of the administrative integration processes in transport is also complex. It includes:

- liberalization of the economic flows on the international scale.
- procedures and customs, veterinary and phytosanitary requirements, etc.,
- requirements in relation to safety,
- environment requirements.

This group of actions should be examined from the vantage point of the advanced processes of trade flow liberalization on the international scale, continued processes of the international economic integration as well as their consequences (elimination of obstacles in the international trade, consolidation of veterinary and phytosanitary standards, etc.). More and more important are also the requirements related to safety and to what influence economic activities, including transport, have on the natural environment which not only is taken into account in the national regulations, but also in the solutions developed at the international level (global and within the framework of integration bodies).

Within the remaining determinants of the development of the integration processes in transport it is worth pointing out the social determinants which are for the most part related to the environmental issues that were previously mentioned in the text. The ever increasing awareness and sensitivity of the society to the issue of negative influence of economic activity, including transport, on the natural environment is a stimulus for the development of solutions which generate lower external costs for transport processes. Although the volume of academic record is enormous, the principle of charging causers of external costs with the costs they generate (and therefore boosting competition within the framework of transport system with social aspects) has not been introduced yet.

3. THE DETAILED DETERMINANTS OF THE SEA-LAND MULTIMODAL TRANSPORT CHAINS DEVELOPMENT

In case of the second identified level the most important determinants of the development of the sea-land transport chains include:

- development of maritime trade which stimulates the necessity of utilizing various means of transport and therefore influences

the development of different forms and technologies of intersectoral transport,

- EU policy which on the one hand provides favourable conditions for the development of the intersectoral transport chains, but on the other hand worsens their competitiveness.

Maritime trade is still dominant in handling the international trade exchange. It was also observable at the beginning of the second decade of the 21st century. In 2012 it transported over 9.17 billion tonnes of merchandise with 60% of the global sea transport operations for the developing countries and 35% for the developed ones. The external and internal relations of the Asian countries played the biggest part in this exchange, which was in compliance with the general tendencies in the world trade. The turnover in this respect was mainly generated by the growing national demand on the Chinese market as well as strengthening and intensification of the trade exchange by and between Asian countries and other regions of the world.

In the quantitative terms of the maritime transport structure the biggest part was played by liquid bulk cargo such as crude oil or gas (30%) as well as dry bulk cargo including iron ore, coal, bauxite, phosphate (30%). In comparison to other merchandise groups the transport of dry bulk cargo was growing much faster (+7.2% in 2012). It was mainly a result of the increased demand for iron ore and coal in Asia. In comparison to the transport operations performed at the beginning of the 80's in the 20th century transport of primary dry bulk cargo, including coal, ore, bauxite, phosphate and corn increased fivefold (approximately) and for the rest of dry bulk cargo it was a twofold increase. In that period of time transport of crude oil and gas increased only by 50%, which resulted from a considerable increase in their prices and other factors. Container transport, which accounted for 16% of the global maritime transport in 2013, enjoyed the unparalleled increase in comparison to other merchandise groups. According to the UNCTAD research containerisation became the most important drive for the globalisation development (to a bigger extent than liberalization of the world trade). In 2012 600 million TEUs were handled in the seaports. The dominant role in container handling was played by the Chinese

ports whose share was over 25%. A considerable growth was also observed in the African ports⁷.

Sea transport has played a key role in handling the international EU trade exchange and accounted for 90% of the total turnover (in terms of transport activity volume). Approximately 37% of merchandise was handled by maritime transport (short sea shipping) within the EU trade. By comparison, road transport, which accounts for the biggest part of the EU internal trade, handled 46% of merchandise. In total, the EU countries have 70,000 km of the coastline and 22 out of 27 EU countries are seaboard countries. In the coastal regions 40% of the total EU GDP was produced.⁸ 60-70% of the EU economic and industrial centres are situated within the distance of 150 - 200 km away from the shore. As a result, most of the merchandise transported in Europe is in the area of short sea shipping.⁹

Sea transport contributes significantly to the improvement of social and economic as well as spatial cohesion of the EU. Even the most exterior territories of the EU which have access to the sea transport routes (including the insular land) can enhance cooperation with other regions of this body thanks to sea transport¹⁰. As a result, sea transport contributes to the accomplishment of one of the most important objectives of the EU strategy called Europe 2020. The so-called maritime industries, including maritime navigation, seaports and operations which are related to them, contribute to the establishment of permanent employment in the European economy. However, some inconsistencies can be observed in the EU policy with regard to sea transport which is part of the sea-land transport chains.

Until the beginning of the second decade of the 21st century the EU transport policy promoted sea transport in connection with rail transport as a more beneficial alternative to the rapidly developing direct road transport (from the social

⁷ Based on UNCTAD Review of Maritime Transport 2006–2013.

⁸ M. Grzybowski, Udział portów zachodniopomorskich w koncepcji autostrad morskich, Europa Bałtycka, przeszłość, terażniejszość, nowe wyzwania, XXV Sejmik Morski, Zeszyty Naukowe issue no. 589, Ekonomiczne Problemy Usług no. 49, Wydawnictwo Naukowe Uniwersytetu Szczecińskiego, Szczecin 2010, pp. 141-155.

⁹ European Commission Statistics, [online: http://ec.europa.eu/transport/facts-fundings/statistics/pocketbook-2013_en.htm].

¹⁰ Author 2011, p. 114.

and ecological point of view). This promotion was supported with specific legislative and financial instruments. The policy suggestions in relation to the sea-land transport chains are included in the White Paper which was published in September 2001¹¹ in which a great deal of emphasis is put on integration of the transport sectors, development of intermodality and a concern for the sustainable development of transport. One of the most important priorities of the EU policy in that period was seeking a change of the unfavourable sectoral arrangement in transport by means of advocating the idea of the so-called maritime highways with the main objective of moving merchandise from land to sea¹².

In March 2011 another White Paper was published. It defined the strategic objectives and primary instruments/initiatives of the long-term EU transport policy until 2050¹³. In contrast to the White Paper of 2001 the paper of 2011 does not include such clear preferences for the transport sectors which are an alternative to road transport. The very transport policy has undergone an evolution which is shown in its departure from seeking sustainable development of transport by advocating the so-called modal shift policy defined in the White Paper of 2001. Now, the primary objective is to search for an optimal solution in the entire operational field of all transport sectors, including multisectoral transport operations (co-modality)¹⁴.

Apart from the transport policy another area of the EU policies within the framework of proposals aiming at developing sea transport (including sea-land transport chains) are formulated is the EU maritime policy.

At the turn of the first and second decade of the 21st century a bigger and bigger influence of other policies, with the environmental policy in particular, on the EU transport policy trends can be observed. One of the disadvantageous regulations (within the framework of EU policies) with regard

to sea transport is the EU directive of 2010 which, since then, has imposed reduction in the amount of sulphur in fuel used by the vessels at berth down to the level of 0.1%. Another initiative of similar impact is an intended incorporation of sea transport into the European Union Emissions Trading System. According to the EU Commission sea and air transport generates approximately 25% of the CO₂ emissions¹⁵. The first stage of incorporating sea transport into the emissions trading system will be establishment by a system for monitoring, reporting and verifying greenhouse gases emitted by ships. With regard to the seaports in 2006 the EU Commission published a recommendation which encourages them to construct facilities which supply electric energy to the ships at berth in the ports. First, these facilities should be constructed on the terminals located in the close vicinity to the populated areas, especially in these locations where the emission and noise norms are violated.^{16 17}

4. THE PRACTICAL DETERMINANTS OF THE DEVELOPMENT OF SPECIFIC SCENARIOS FOR THE SEA-LAND MULTIMODAL TRANSPORT CHAINS

In this subsection the essential determinants of effective competition among specific scenarios for the sea-land transport chains are presented. These determinants include:

- level of adjustment of the port infrastructure parameters as well as access to the particular seaports from sea to the varying parameters of sea ships,
- quality of the infrastructure which provides access to the ports from land,
- cost of intersectoral transport process
- changes in the supply zone for the sea transport market,
- discriminatory policy of the EU and navigation enterprises,
- level of PCS solutions implementation

¹¹ White Paper submitted by the Commission on 12 September 2001: "European transport policy for 2010: time to decide", COM(2001) 370 final.

¹² cf. J. Neubert, Motorways of the Sea-Ziele, Planung und bisherige Realisierung, "Hansa" 2007, issue no. 4, pp. 3-39.

¹³ White Paper Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system, Brussels, 28.3.2011 COM(2011) 144 final.

¹⁴ cf. J. Łacny, Komodalność jako nowy trend w transporcie ładunków, Logistyka issue no. 2/2009.

¹⁵ EU action against climate change, Emission Trading System (ETS), Office for Official Publications of the European Communities, Brussels 2009.

¹⁶ Directive 2005/33/EC Of The European Parliament And Of The Council of 6 July 2005 amending Directive 1999/32/EC, (Official Journal of the EU, L 191 of 22/7/2005).

¹⁷ Commission Recommendation of 8 May 2006 on the promotion of shore-side electricity for use by ships at berth in Community ports, 2006/339/EC, (Official Journal of the EU 125, of 12/05/2006).

The analysis of the sea ship construction market indicates that for the most part the newly constructed ships are bigger than their predecessors. One exception is the fleet of tankers which, for many years, had been mainly constructed as VLCC and ULCC tankers. Then smaller vessels were built. The main reason for improving ship parameters is seeking reduction in transport unit costs, fuel consumption, emission of CO₂ and other toxic substances which result from fuel burning.

intersectoral transport. A well developed infrastructure of access to the seaports from land conditions creation of cheap and fast connections between a particular seaport and its economic hinterland, and therefore it influences total transport costs and the period of time in which merchandise in the sea-land relation is handled.¹⁸ A seaport which has access to the dense network of effective land connections with the hinterland wins a merchandise battle with a port which provides services of similar quality, but which is deprived of

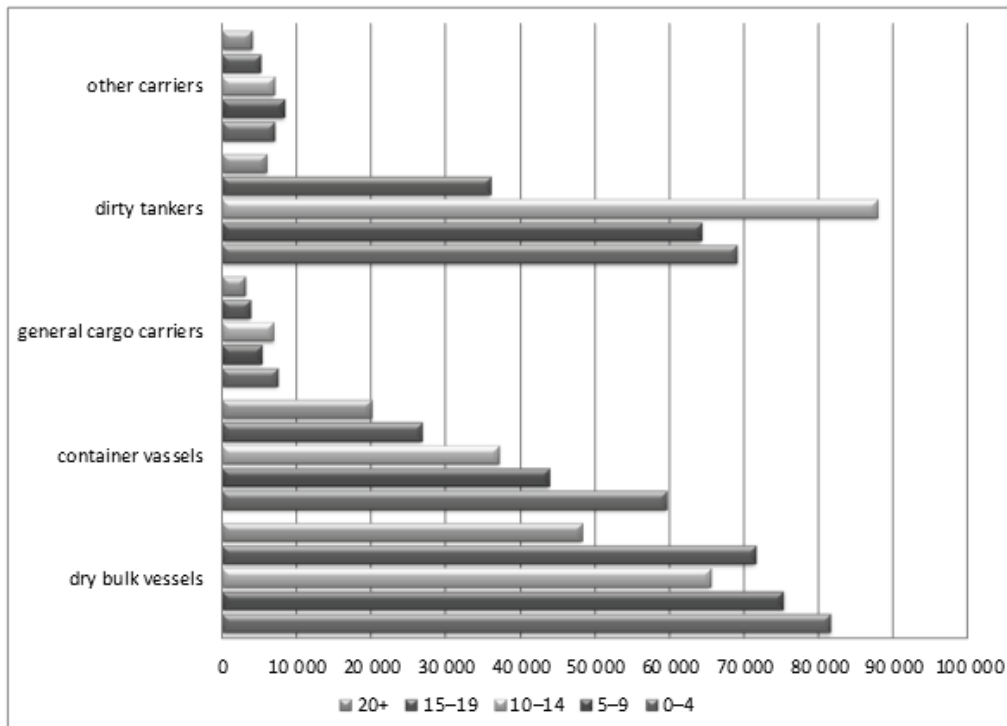


Fig. 1. Average size of ships in 2013 in relation to their lifetime.

Resources: Own work based on: Review of Maritime Transport 2013, UNCTAD, 2013.

A continued increase in the size of ships which are ready for use is expected in the years to come. In order to maintain their position in the market the seaports have to adjust their port infrastructure and infrastructure of access to the ports from sea as well as their handling potential to the varying quantitative structure of maritime navigation. The navigation market has started suffering from shortage of small ships of up to several thousand DWT, which additionally influences the increase in containerised cargo. Small batches of merchandise such as corn and coke, which to date have been regarded as unsuitable for containerisation, are more and more often transported in cargo units.

A physical access to the seaport hinterland pertains to the issue of delivery efficiency, both in terms of particular transport sectors and

such connections¹⁹. At the same time what is worth pointing out is that very often it is not the physical distance which is a decisive factor in choosing a specific sea-land transport chain course by the organizer of a multimodal transport operation. It is the time length that is of key importance. Competitiveness of an intersectoral transport chain, whose primary integrating link is the seaports, depends considerably on the fulfilment of a cohesive policy for the port infrastructure development as well as infrastructure of port

¹⁸ A. Bursztynski, Dostępność komunikacyjna portów Gdańska i Gdyni w aspekcie rozbudowy sieci drogowej zaplecza portowego, *Logistyka* 5/2011, pp. 1011-1012.

¹⁹ A. Koźlak, Dostępność portów morskich od strony zaplecza jako czynnik ich konkurencyjności, "Logistyka" 2009, issue no. 6.

access from sea with the linear infrastructure which first and foremost connects seaports with the hinterland by way of road, rail and inland waterways.

Very important factors, which are decisive for a specific sea-land transport chain which goes into effective competition with alternative chains, should include a total cost data of the intersectoral transport process.

In case of general unit load cargo this can be transport processes in which, aside from land transport processes, only one maritime transport process is performed ("hub - hub" relation) or transport processes with a bigger number of maritime transport processes ("hub - hub" and "hub - feeder port" relations). In case of places where merchandise is forwarded / received, situated on the economic hinterland of the regional seaports application of a specific kind of sea-land chain means a choice between a lower total cost ("hub - feeder port - overland transport to the economic hinterland" relation) and a shorter period of time for the accomplishment of an intersectoral transport process ("hub - direct overland transport to the economic hinterland of a feeder port" relation)²⁰.

What should be pointed out in the EU policy is some of the sea-land chains being discriminated in favour of some other ones. A good example is the sea-land chains going across the Baltic or the North Sea ports which since 2015 have been discriminated in favour of the analogous sea-land chains going across the Mediterranean or Black Sea ports. It is to do with the situation in which the Baltic Sea and North Sea are subject to very rigorous regulations in relation to the amount of sulphur in vessel fuel, (it has been 0.1% since 2015) while at the same time implementation of analogous restrictions for the above mentioned seas of the south is delayed (they will be introduced in 2020).

The policy of navigation enterprises also has a significant influence on the development of specific solutions with regard to the sea-land transport chains. For example, the freight for transport from Asia to the ports of North Europe and the freight for transport to the Mediterranean ports are the same. As a result, only just under 30% of the European handling is performed by the Mediterranean ports, including Marseille, Valencia

or Genoa²¹. The policy of container lines can be diverse even within one coast. A good example is the policy operated towards the container terminals in the ports of Szczecin and Tri-City. Although the distance from Hamburg to the port of Szczecin is shorter than to the remaining Polish ports (roughly half this length) the fees for transporting a container to Szczecin are higher.

One of the most important trends in relation to the changes in the supply zone for the navigation services market includes tendencies to integrate horizontally (for the most part). This trend, for example, can be observed in the container market. Since 2002 the number of navigation enterprises which provide services for the container lines decreased by almost 30%. 70% of the container fleet in use belongs to ten biggest shipowners including Maersk Line, Mediterranean Shg Co, CMA CGM Group, Evergreen Line, COSCO Container L., Hapag-Lloyd, Hanjin Shipping, APL, CSCL and MOL. Over 30% of the container (TEU) fleet is owned by one container operator which is APM-Maersk.

Horizontal integration is also a response to the very difficult circumstances of the navigation services market, which results from the slowdown in the development of the world economy. The objective of ship-owners who form powerful alliances is to offer more regular and customized services to the customers, reduce the number of "empty places" on ships and, incidentally, avoid competition. The fight for the container market, which is being continued between Asia and Europe, is especially tough. In the middle of 2013 it was publicly announced that the three biggest carriers, i.e Maersk Line (ML), Mediterranean Shipping Company (MSC) and CMA CGM, were forming an alliance. They signed heads of terms for an agreement on formation of an operational alliance for providing transport services on the intercontinental connections (the so called P3). Ultimately, they did not enter into the agreement, because the Chinese Ministry of Trade, who did not agree to have the P3 alliance operating on the territory of their state, thwarted it²².

²¹ Almost half the number of containers transported in the Milan - Far East relation is handled by the North European ports; as cited in J. Solana, A. Saz, Mediterranean eyes future as trade hub between Europe and Far East, Taipei Times, 22/05/2011.

²² Prior to that the Federal Maritime Commission and EU Commission gave their permission for them to operate.

²⁰ cf. Author 2013, p. 79.

Information systems became a necessary component for proper management of organizations and complex transport processes which, without a doubt, include sea-land processes. Normally, the exchange of information includes numerous business entities such as customers, freight forwarders, maritime offices, ship-owners, customs offices, port enterprises, agencies, insurers, banks and many other ones²³.

Implementation of the Port Community Systems is regarded as especially important to the competitiveness of particular sea-land transport chains. The idea of PSC is based on establishment of one system which engages all the participants of the sea-land operations and inspection teams who communicate with each other in a more effective way²⁴.

competitiveness of the entire sea-land transport chains.²⁵

5. RESUME

The determinants of the development of the sea-land transport chains in the second decade of the 21st century can be examined at three levels: (1) general, (2) detailed and (3) practical. The approach presented by the author of the article takes into consideration the general determinants of the intersectoral integration processes in transport and the ones which specifically relate to the sea-land chains regarded as a specific form of integration in transport which involves sea transport combined with land transport sectors. The second of the identified levels presents these determinants which can be decisive in terms of

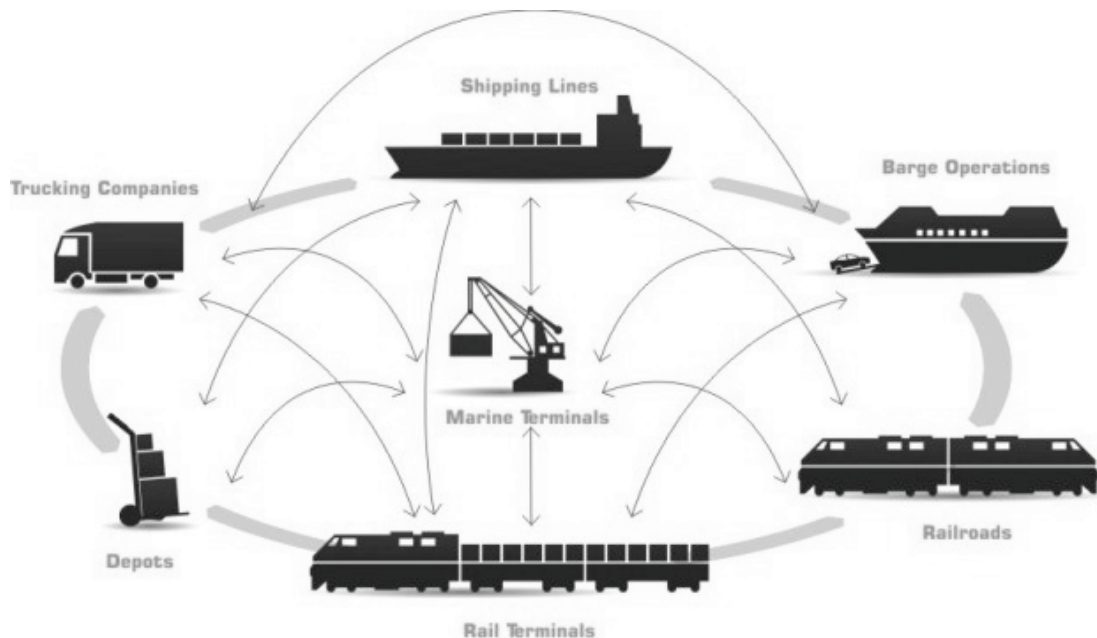


Fig. 2. Port Community System.
Source: www.actual.hr (10.10.2014).

The Port Community Systems which have been operational in West Europe for over 30 years were a logical development of consequent actions for the improvement of merchandise and information flow in the area of seaports, which contributed to the increase in handling capacity and

efficient competition which takes place between particular scenarios of sea-land transport chains and other sea-land chains.

This article does not aspire to explore the topic in full. However, the author hopes that the three-level approach presented in his article will contribute to further research into the determinants of the development of sea-land transport chains.

²³ P. Adamczewski, Zintegrowane pakiety informatyczne wspomagające zarządzanie przedsiębiorstwem. *Logistyka* 1996, issue no. 1.

²⁴ Raport, Nowe technologie w gospodarce morskiej, *Namiary na Morze i Handel*, issue no. 5/2014.

²⁵ cf. M. Brzozowski, *Informacje przychodzą same*, *Namiary na Morze i Handel*, issue no. 5/2014.

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