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SPECIFICS OF THE DANUBE FLEET MANAGEMENT (TRENDS AND PERSPECTIVES FOR DEVELOPMENT)

In the last years the main objective of most of the European strategic documents concerns establishment of sustainable and competitive transport system while promoting the development of secure, safe, reliable, energy effective and environmentally friendly transport modes such as inland waterway transport. The free capacity of European inland waterways provides opportunities for transportation with no traffic jams in the living areas; oversized and bulk cargoes, less green house gas emissions, compared to the road transport. Thanks to the development of the information and communication technologies (ICT) much more innovative vessels, which are economically efficient and environmentally friendly are used. Improving the technical specifications of Danube river fleet is of great importance for the development of the transport sector in the separate countries in the region. This fact is also proved by the growth rate of the inland waterway modal split during the last 5 years in the West-European countries such as Germany (12.6%), France (4.3%), United Kingdom (13.4%), Austria (5.1%), the Netherlands (39.1%) (EUROSTAT, 2016) compared to the road and rail transport.

In this regard the main objective of the current study is to analyze, as an example of Bulgaria, the development trends of Danube river fleet and as a result the specifics of its management will be revealed. The following economic indicators are analyzed: Danube fleet performance, number and capacity of vessels, coefficient of capacity usage and average stay of ships at ports for handling activities. These indicators allow the strengths and weaknesses, as well as the threats and opportunities of river fleet to be assessed and also measures for its development to be proposed.

The proposed model for analysis could be successfully used for studying the specifics of river fleet of other countries with transitional economies.

JEL: R49; O31; Q56

Introduction

Transport is the key factor that makes easier the trade relations among economic entities and in this way helps the economic growth and social welfare to be improved. In the last years the advancing climate changes, the continuous depletion of natural resources and the pollution of environment due to the road freight and passenger carriages force measures to

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be taken for its development. In this regard the European (European Commission, 2006) and national policy (Koralova, 2013) in the field of transport are oriented towards establishment of sustainable and competitive transport system where all passenger and freight transportation services are carried by secure, safe, environmentally friendly and energy efficient transport modes.

Compared to the other transport modes, inland waterway transport satisfies to great extent the main policy objectives as it is characterized by free capacity. This makes possible the optimal usage of river fleet and promoting its development in order a sustainable transport system, social benefits and minimizing of transport costs for stakeholders to be achieved. Compared to the rolling stock of road and rail transport, river fleet has the following advantages (Via Donau, 2004):

- High security and safety of freight carriages – cargoes could be carried over long distances without causing traffic jams in the living areas;
- It is extremely suitable for carriages of oversized and bulk cargoes – the capacity of vessels is 2000 t. while carrying bulk cargoes and 3000 t. for carriages of liquid cargoes, which approximately equals the capacity of 125 wagons of 40 t. or 250 trucks of 20 t. (UNECE, 2011);
- Environmentally friendly – the volume of green house gas emissions of vessels is from 3 to 6 times lower than that of road vehicles (UNECE, 2011);
- The delivery costs and subsequent costs of operation and maintenance of one ton load capacity are much lower than the relevant costs in the other surface transport modes;
- High energy efficiency – the fuel costs per transportation unit are much lower than those in the other surface transport modes.

Despite the aforementioned advantages, the following disadvantages are also typical for the inland waterway transport:

- Dependence on weather and climate conditions resulting in ice formation, high and low waters which lead to transportation seasonality;
- Much lower speed of vessels than that of rolling stock of road, rail and air transport, which result in long delivery time of cargoes to the recipients.
- Necessity of usage of auxiliary transport services when the network of inland waterways is not sufficiently developed or such network is missing on the territory of the relevant country, which results in higher price of the transportation services provided.

Till the moment many studies in the field of river fleet management are conducted but no publications of Bulgarian authors could be noticed. In his publication R. Hekkenberg (2015) examines the possibilities for optimal usage of inland waterway transport on Rhine through implementation of innovative vessels in order the transport costs to be minimized and the volume of green house gas emissions to be reduced. This publication however

analyzes the results of the technical development of river fleet rather than their economic impact.

H. Jessen (2015) proposes specific measures for development of inland waterway transport again on river Rhine, as he emphasizes on the European policy framework and puts the accent on the technical and commercial requirements for effectiveness of river fleet management. This publication again does not examine the future development of inland waterway transport from economic perspective but from legal one.

Another important research that is of great importance for the problem analyzed in the current publication is that of Sv. Mihic, M. Radovanovic and M. Mihajlovic (2011) who studied the Danube river fleet management. Their publication analyses the possibilities for sustainable transport system through promoting transport services on the river Danube. Special attention is paid to the recommendations of the European policy for sustainable development and the data analysis about freight and passenger carriages, as well as to the cargo volumes of separate river ports. There is also a short review of the development of the Danube river fleet but it is not based on economic indicators analysis, concerning the specifics of the fleet which is one of the main objectives of the current study.

The aforementioned papers do not cover the main objective and assignments of the current research.

The main objective of the publication is through analysis of the development trends of Danube river fleet, the specifics of its management to be revealed and measures for its efficient operation and maintenance to be proposed. Trends and perspectives for development of river fleet are studied as an example for Bulgaria and the proposed model could be successfully implemented in other countries with transitional economies.

The river fleet of Republic of Bulgaria is the **object of the analysis**.

In order the main objective of the research to be achieved, the following **assignments are discussed**:

- A review of the European policy in the field of inland waterway transport;
- The application of intelligent transport systems in the Danube fleet management is analyzed;
- The performance of Bulgarian river fleet by carrying capacity, coefficient of loading capacity usage and average stay of vessels at ports is made; The strengths and weaknesses, threats and opportunities for development of the river fleet are summarized;
- Specific measures for development of the river fleet in order its effectiveness to be improved are proposed.

1. European Policy in the Field of Inland Waterway Transport

The European policy in the field of inland waterway transport is oriented towards rising up of an integrated market of river transportation services based on the principles of equity, freedom of navigation and competition. In this regard a harmonized legislation in each member-state must be established, based on the following principles:

- Lack of discrimination among participants in the transportation process based on their nationality;
- Free access of the river operators to the market of transportation services;
- Freedom of pricing and negotiations among the participants in the transportation process;
- Free movement of people and goods within the territory where the market of river transportation services is located.

The main organizations that are of great importance for the establishment and harmonization of the legislation in the field of inland waterway transport are: the Inland Transport Committee at the United Nations Economic Commission for Europe; Directorate General for Transport and Mobility; Danube Commission and the national institutions and organizations of the member-states.

The main objective of the **Inland Transport Committee** (UNECE, ITC, 2005) is to be established and unified the technical specifications and conditions for navigation along the inland waterways, as well as cooperation among countries in the field of inland waterway transportation services to be achieved. The Committee shall perform the functions of an advisory body in the field of amendments of European legislation and economic development of the member-states in order a flexible and balanced transport system to be established, based on the market economy principle. This institution shall promote the interoperability between surface modes of transport (road and rail transport) and inland waterway transport through simplification and harmonization of the administrative procedures and implementing the electronic transfer system in intermodal carriages.

General Directorate for Mobility and Transport (DGMT, 2016) is the main legislative body in the field of transport, whose main obligation is to guarantee the free movement of people and cargoes through the implementation and harmonization of legal acts that allow access to the transport market and prevent unfair competition. Many directives, regulations and communications are brought into use, concerning the conditions for market access; technical specifications of the river fleet; working conditions and required qualification of the personnel; transport infrastructure; border control; fiscal regime; protection of the environment and etc.

The Danube Commission (DC, 2012) is an intergovernmental commission, established as a result of the signing of Belgrade Convention (Convention regarding the regime of navigation on the Danube). The member-states of this convention are Austria, Bulgaria, Hungary, Germany, Moldavia, Russian Federation, Romania, Slovak Republic, Ukraine and Croatia. The main objective of the Commission is to monitor the compliance with the

requirements and conditions of navigation, written in the Belgrade Convention. It helps the Danube countries transpose the main European legal acts in their national legislation. The commission publishes regulations and decisions in three main fields: conditions of navigation on the Danube; regulations for the technical parameters of vessels; protection of the environment. The main activity of the Danube Commission is the focus on the mutual recognition of regulations for navigation on the Danube River and the integration of the river to the European inland waterways.

The International Commission for the Protection of the Danube River (ICPDR, 2016) is an administrative body whose main responsibilities are related to the cooperation with government and non-government organizations, interested in the protection of the Danube River, the reduction of green house gas emissions to the environment and the sustainable development of the ecosystems in the region.

The main institutions that defend the interests of river shipping companies are as follows:

1) **European Barge Union** (EBU, 2016) – this union represents and defends the interests of river shipping companies and the owners of non-propelled vessels to the European and international bodies. The headquarters of the organization is in Rotterdam and Brussels. The association has the functions of a consultative body in the field of dangerous goods carriages in European inland waterways, as well as contracts of towage and pilotage and passenger carriages;
2) **European Skippers Organization** (ESO, 2016) – its main objective is to defend the interests of river shipping companies on European level. Its headquarters is in Brussels.
3) **European Federation of Inland Ports** (EFIP, 2016) – members of this organization are more than 200 port administration from 19 European countries. The federation represents and makes popular the inland ports as important intermodal terminals and defends the interests of port administration to the European institutions. The main objectives of the organization are:
    - To make popular the competitive advantages of inland waterway transport in order more forwarders to be attracted;
    - To strengthen the role of inland waterway transport in the intermodal transportation services;
    - To promote the establishment of single European inland waterway net through the unification of rules of navigation and building up the missing links among inland waterway corridors in Europe.
4) **Inland Navigation Europe** (INE, 2016) – it is an independent non-profit organization that promotes the economic benefits of the transportation services with inland waterway transport. Its main objective is to attract much more customers of the river transportation services and the market share of inland waterway transport to be increased.

The introduction of the European programmes NAIADES (2006) and NAIADES II was an important progress in the promotion of inland waterway transport. In this way the European

Commission strives to enhance the customer interest in inland waterway transport by emphasizing on its advantages and the possibilities a sustainable, environmentally friendly and competitive transport system to be established. These programmes focus on five key areas: crew; infrastructure; market; image and fleet. They include also propositions to the member states for the development of the European inland waterways.

The European policy in the field of inland waterway transport is oriented mainly towards development of the economic and energy effectiveness and environmental friendliness of the river fleet along the inland waterways of Europe. Moreover the application of information and communication technologies and insurance of well-managed transport infrastructure are of great importance for the better positions of this transport mode on the transport market. The established organizations for defending the interests of river shipping companies help the competitive advantages of inland waterway transport to be popularized and its role in the intermodal transportation services to be strengthened. This fact is proved by the development trends in the river fleet along the Rhine River and the Netherlands inland waterways, where the modal split of inland waterway transport during the last 5 years is higher than the share of rail and road transport.

2. Trends in the Development of the Bulgarian River Fleet

River fleet is one of the key elements of the organization and management of inland waterway transport, together with river ports and their superstructure, waterways and locks. It is defined as set of vessels that have the same function, nationality and are assigned to the river shipping companies of the relevant countries (OECD, 2007).

The number of fleet is an indicator that measures the performance and competitiveness of freight transportation services. It consisted of various types of vessels distinguished by technical specifications, carrying capacity, equipment, reliability, safety and security. These parameters of vessels are of great importance for defining the competitive advantages of inland waterway transport compared to the other transport modes. They are necessary also for the competitiveness among operators in inland waterway transport as well as for the competitiveness among relevant transport modes. In this regard the parameters that are of most significance are listed below:

- Displacement;
- Carrying capacity;
- Size and coefficient of loading capacity usage;
- Gross tonnage;
- Vessels type, equipment and age;
- Nationality of the ship;
- Time of the vessels trip (14, 18 or 24 hours per day);

- Information about the crew (number, nationality and qualification of the crew members).

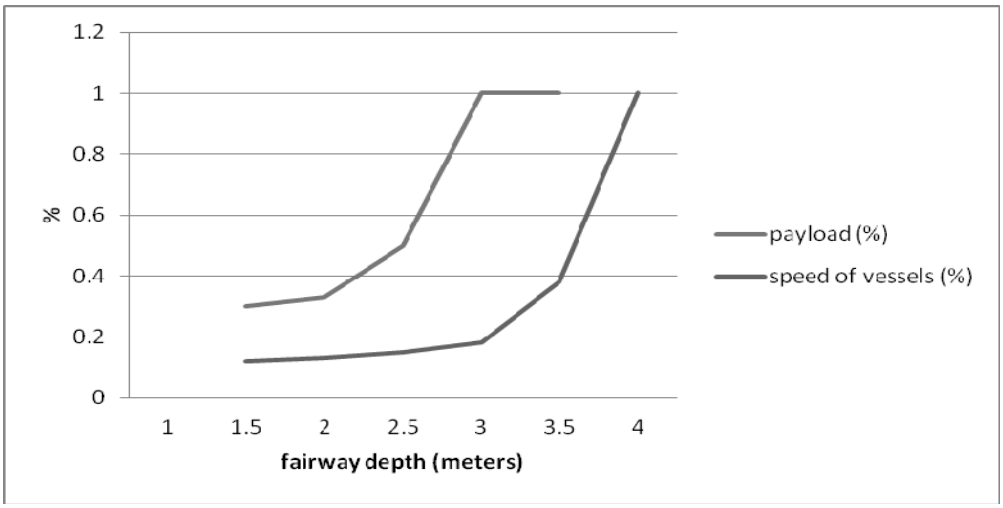
Danube river fleet consists of various types of vessels. What is important when choosing a ship for freight transportation is its physical parameters (length, altitude and latitude), as they depend on the navigation and fairway conditions. The latitude of the vessel is of great importance for passing through the locks, the altitude – for the bridge clearance and the wading depth is determined by the fairway depth in high or low waters. That is why; the Danube river fleet consists only of self-propelled vessels and convoys of pushed barges.

The reasons for this on one hand are the continuous fluctuation of the water levels, and on the other hand – the cargo flow structure. E.g. the unfavorable navigation conditions results in lower wading depth of vessels.

Studying the correlations between technical parameters of vessels and fairway conditions is of great significance for the improvement of river fleet performance. On figures 1 the influence of fairway conditions on the carrying capacity and speed of vessels are displayed. Both indicators impact directly the performance of vessels and indirectly the operational costs. As one can see, in unfavorable navigation conditions, the vessels' carrying capacity and wading depth is increasing with lower pace (e.g. the payload increases with 30% in 1.5 m. fairway depth and with 50% in 2.5 m.). Accordingly, the better the physical characteristics of locks and fairway are, the lower the operational costs will be as a result of the increase of the wading depth of vessels.

Figure 1

Permissible loading capacity and speed of vessels depending on the fairway conditions



Source: Statistical Yearbook of the Danube Commission and author's calculations.

Each improvement of the fairway conditions results in higher speeds of vessels (e.g. when the fairway depth is 2.5 m. the speed of vessels increases with 15% and in 3.5 m. fairway depth, the speed of vessels increases with 38%). The speed increase of ships is a factor that impacts positively the regularity of transportation services and delivery time of cargoes. The higher the values of these quality indicators are the better the competitiveness of river shipping companies is.

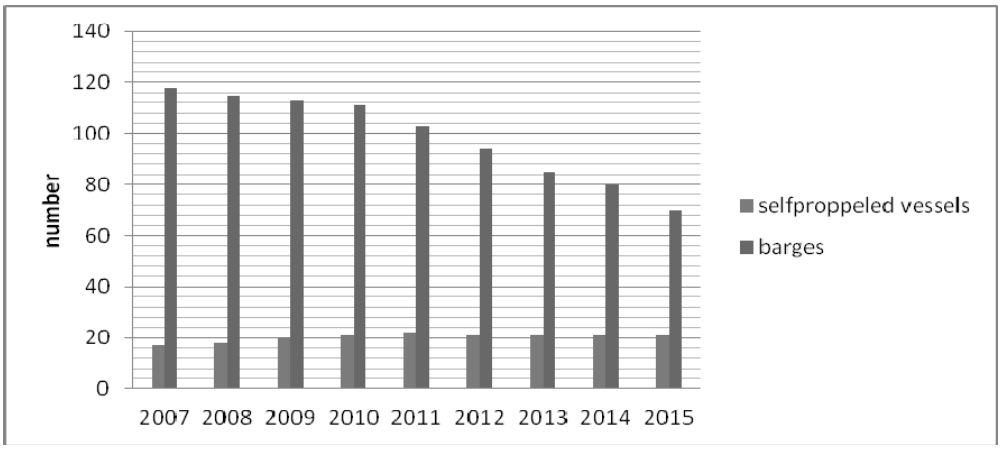
The construction and type of vessels influence the structure and nature of cargo flows.

The usage of convoys of pushed barges is more efficient for transportation of containers, because the payload volume of the vessel could be enhanced. The decks of barges are constructed in a way that allows containers stiffing on three and four layers which leads to better performance and improvement of their loading capacity.

As far as the structure of Bulgarian river fleet is concerned, the convoys of pushed barges predominate. On figure 2 below, the proportion of self-propelled and pushed barges is presented.

Figure 2

Dynamics of the number of vessels by types in the Bulgarian river fleet



Source: National Statistical Institute of Bulgaria, Annual reports of Bulgarian River Shipping Company for the period 2007-2015.

The huge share of convoys of pushed barges (83%) is determined by the favorable conditions of navigation in Lower Danube that allows movement of vessels with high carrying capacity. Some of the vessels of Bulgarian river fleet could be used in river sections where conditions of navigation are unfavorable but others could be used for transportation of various types of cargoes such as bulk and liquid cargoes, oversized constructions, containers and etc.

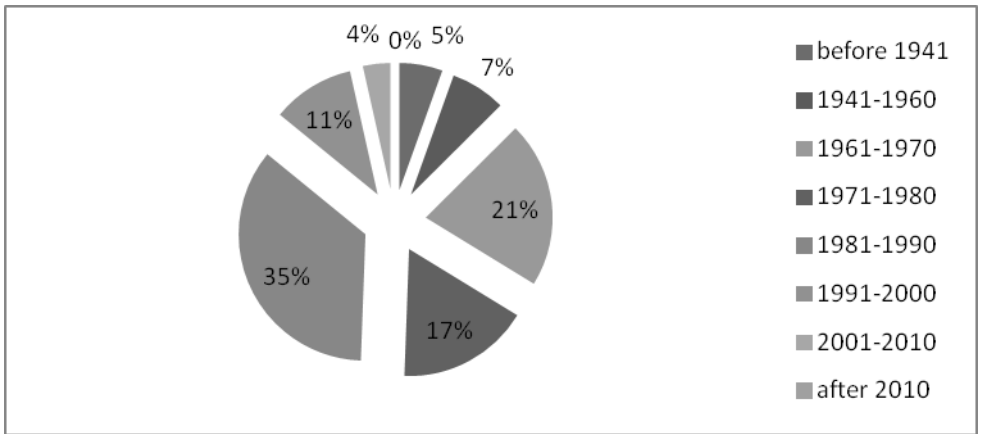
On figure 2 one can see that the number of self-propelled vessels is constant and a slight increase of 23% in 2015 compared to 2007 is observed, while the number of pushed barges is continuously decreasing and a drop of 41% in 2015 compared to 2007 is recorded.

What is typical for Bulgarian river fleet is the long period of their exploitation. This fact has its pros and cons. On one hand, building of river vessels is a long term investment (the amortization period of ships is 20 years), but on the other hand – the market of modern information and communication technologies is developing quite rapidly and it is not possible such technologies to be implemented in ships that has been built during the 80s and 90s years of the last decade. Most of the vessels of Bulgarian river fleet are of age between 40 and 65 years, as most of them are second hand and purchased from river shipping companies, providing transportation services on the river Rhine.

The analysis of age of vessels is of great importance for the energy effectiveness and environmentally friendliness of freight transportation. This fact is determined by the licensing of river shipping companies in order to access the freight transportation market to prove that vessels are seaworthy for safe and secure navigation.

Figure 3

Age of Bulgarian river fleet in 2014



Source: Danube Commission Navigation Statistics, 2013-2014.

As one can seen from the figure above, the biggest share is possessed by the vessels, built in the period 1981-1990 – 35%, which means that their age is approximately 30-35 years. There are vessels that are built 70 years ago – 5%. Next rank self-propelled vessels of age between 40 and 50 years old – 21%. There are no vessels that have been constructed after 2010 and the number of these, aged less than 20 years old is hardly 4%.

One of the reasons for the high share of physically obsolete vessels in the Bulgarian river fleet are as follows: inland waterway transport is determined as capital-intensive as the initial investments for purchasing of rolling stock are significant and in most cases river shipping companies could not take advantage of funding from the state or bank institutions. Credit organizations refuse to assist companies in purchasing new vessels because of the high financial risk and uncertainty, high price of the fixed assets and lack of crediting in such activities. The observed drop of 85.5% of imported and 20% of exported goods in

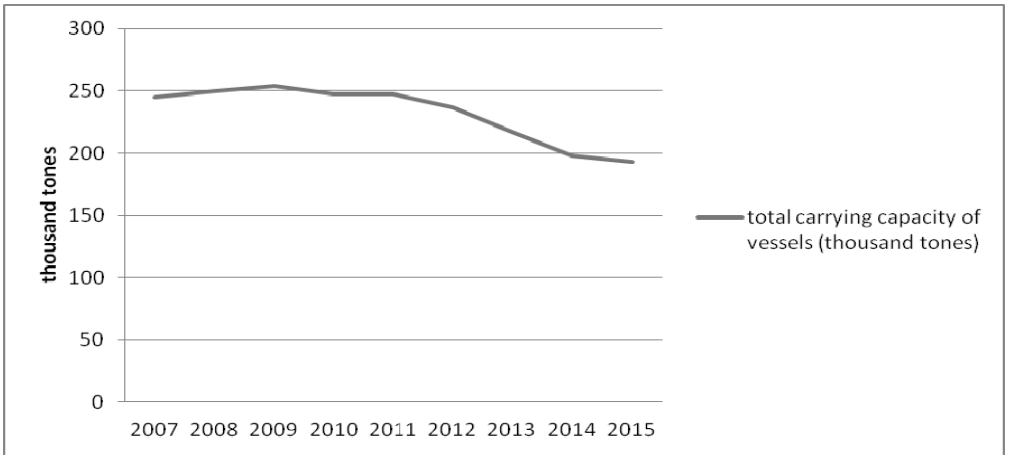
2015 compared to 2007 (see figure 10) force many river shipping companies to decrease the sum of their investments for modernization of fleet.

The main reasons for the current status quo of Bulgarian river fleet are as follows: the restrictive measures of banks in crediting river shipping companies to purchase new ships; the significant decrease in demand of river transportation services during the world economic and financial crisis and uncertainty for the future development of the Bulgarian economy after the post-crisis period.

Liberalization and deregulation of river transportation services market have led to certain changes under which river shipping companies operate. This is also the reason for the decreasing number of vessels at Bulgarian river fleet. Another important factor that influences the Danube river fleet structure is the total carrying capacity of vessels.

Figure 4

Dynamics in the carrying capacity of Bulgarian river fleet



Source: National Statistical Institute of Bulgaria.

A continuous trend of decrease in total carrying capacity of Bulgarian river fleet is observed on figure 4 and in 2015 a drop of 21% compared to 2007 is reported. This decrease dues to the changes in the cargo flows structure and turnover (e.g. the transportation of small batch cargo loads is not efficient for river freight carriages).

By increasing and/or decreasing the number of vessels their carrying capacity accordingly increases and/or decreases. The explanation of this conclusion is related to the constant cargo flows which are oriented towards the East (Ukraine, Russia) and West destinations (Serbia, Croatia, Hungary, Slovak Republic, Austria and Germany) as well as to the regular transportation services in separate sections of Lower Danube.

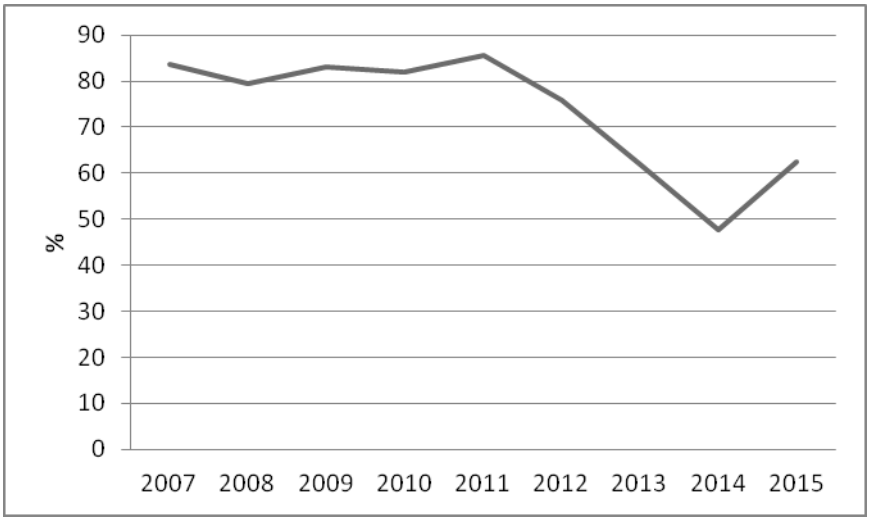
3. Danube Fleet Performance

The analysis of operational activity of Bulgarian river fleet is an important prerequisite competitive price of river transportation services to be achieved. In this regard the influence of a group of economic factors defining the usage of vessels according to their carrying capacity must be reported (Via Donau, 2007). The first group of factors consists of: coefficient of capacity usage; empty running coefficient and the second group includes average stay of ships at ports; travel time coefficient; speed of vessels and river fleet performance.

The coefficient of vessels capacity usage is calculated when the influence of a few factors is concerned – travel distance, type of trip and carrying capacity of the vehicle. Its value is accustomed to be lower than 1.

Figure 5

Annual average variations of the vessels capacity usage coefficient (%)



Source: Annual reports of Bulgarian River Shipping Company for the period 2007-2015.

The values of this indicator were the lowest in 2014 – 47.5%, compared to 2011 (see figure 5) when the carrying capacity of vessels was optimally used – 85.5%. These decreases are caused by the conditions of navigations because during this period high and low waters occurred many times in the year. Another problem is also the drop of cargo volumes imported and exported through Bulgarian river ports.

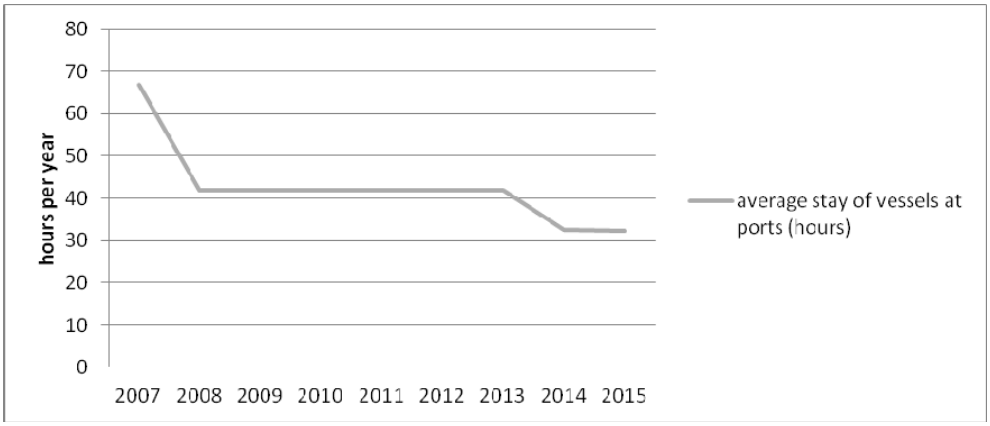
The empty running coefficient is the loaded and empty trip ratio. Empty trips in inland waterway transport occur when in one direction the vessels are loaded and in the opposite direction they are empty. Another reason for the barren trips is the long stay of ships at locks or ice formation at separate sections of the waterways.

The travel time coefficient measures the productive trips of the ships when they are in motion. It is defined by the travel time and total vessels trip ratio. The travel time includes the time when the vessel is in motion as well as the time for average stay at locks and at river ports for handling operations. The travel time depends on the vessels direction of movement (upstream or downstream).

The average stay of vessels at river ports is calculated when the time of vessels in motion is deducted from the total travel time. The duration of average stay of vessels at ports is determined mainly by the technical development of handling facilities.

Figure 6

Dynamics of the average stay of vessels at ports



Source: Annual reports for the operational activity of Bulgarian river ports for the period 2007-2015, Ministry of Transport information technologies and communications.

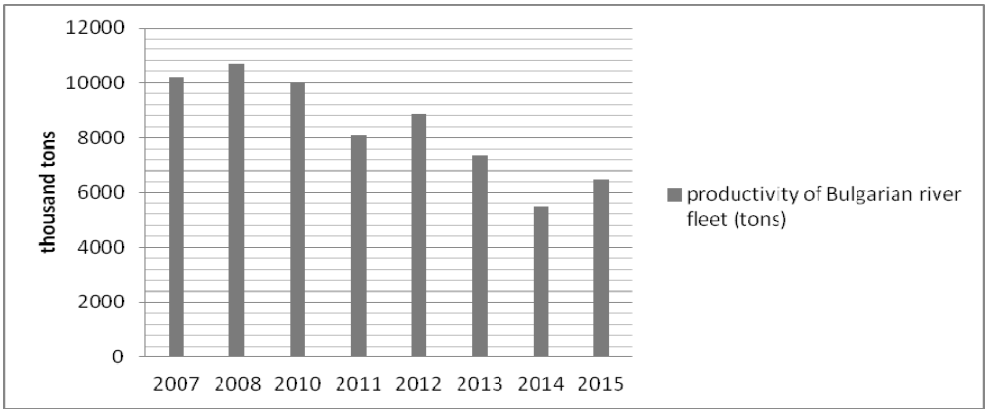
As can be seen on figure 6, the average stay of a ship for handling operations at ports is decreasing as in 2015 approximately this time was 32.5 hours while in 2007 it was 67 hours per year. These variations show that innovative handling facilities are implemented at ports.

Vessels speed is measured in kilometers or miles travelled per day. Its calculation is of great importance for the regularity of freight transportation services and the competitiveness of the inland waterway transport.

River fleet performance is an indicator that measures the volumes of cargoes carried by river shipping companies. It can be calculated separately per type of vessels or totally for the whole fleet. In accordance with the observed decrease in the number of self-propelled vessels and pushed convoys (see figure 2) as well as in the carrying capacity coefficient (see figure 5) the fleet performance index is also decreasing (from 11 000 tons in 2008 to 6500 tons in 2015).

Figure 7

Bulgarian river fleet performance



Source: Author's calculations.

The performance of Bulgarian river fleet depends also on crew. The human resources in inland waterway transport unite the total number of employees, whose main objective is the strategic goal of the organization to be achieved (Torrington, Hall, Taylor, 2005). Labor organization at companies is a complex of the following activities: personnel selection; allocation of duties; education and development of personnel; working time; wages. In this regard the main indicator for secure and effective navigation is the well-managed and high qualified personnel.

Human resources in inland waterway transport are divided into two categories: *vessels crew*, whose main responsibilities concerns ensuring secure and safe freight and passengers' transportation, and *stevedores*, who are occupied with the main and auxiliary services at river ports. The necessary number of crew members depends on the type and size of vessels, as well as on the cargo type transshipped. Each vessel is steered by the captain, who possesses the necessary certificate and is responsible for the carrying out of the transportation. The other important element of the labor organization process in inland waterway transport is the wages of personnel.

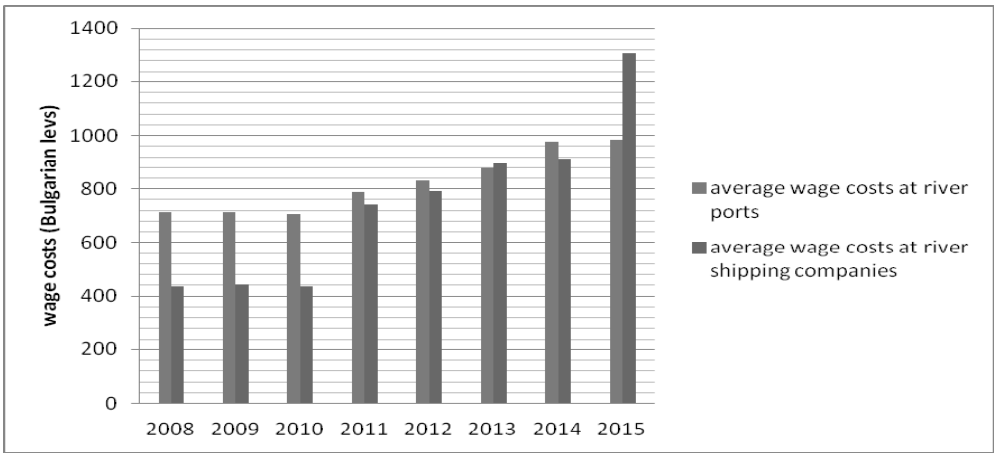
The analysis of average wage costs can be determined by the following:

- Efficient use of labor – any increase in its value is accompanied by an increase in labor productivity as a result of the improvement of working conditions and personnel management, application of information and communication technologies in the management and organization of logistics processes;
- Purchasing power of population – any increase in the amount of average personnel costs deals with increased disposable income of population which is directly related to social welfare;

- Competitive prices of transportation services – any reduction in the amount of average personnel costs reflects in reduction in transport services price.

Figure 8

Dynamics of the average wage costs in inland waterway transport of Bulgaria



Source: Ministry of Transport, Information Technologies and Communications, Executive Agency Maritime Administration.

A trend of continuous increase in the average wage costs in Bulgarian river ports and shipping companies is observed on the figure above. In 2015 the amount of wage costs at river shipping companies increases approximately 3 times compared to 2008. As far as the river ports are concerned, the average wage costs are again increasing but not so sharply as in the river shipping companies, e.g. in 2015 their amount rises with 37.4% compared to 2008. This result again dues to the reduction of the number of persons employed on one hand and on the other, many of the port terminals in this period were managed in the form of public-private partnership and much of the personnel were retired.

The growth in the amount of these costs is mostly driven by the established trend of continuous reduction in the number of employees (see Figure 14). The reported variations in the sum of wages due to the economic, social and demographic development of the various regions, as well as the changes in macroeconomic indicators such as GDP, inflation rate, unemployment rate and others.

Another important indicator that concerns freight transportation services of inland waterway transport is the crew performance. It can be defined as the marginal product, produced by a separate employee for a certain period of time (per hour, per day) (Gille, 2011). Labor productivity covers both the effectiveness of the fixed assets exploitation (vessels) and the crew performance (crew and stevedores) according to the cargo volumes shipped. It depends on many factors such as education and professional qualification of employees, application of information and communication technologies; working

conditions, developing human resources management and etc. These factors influence directly also the image of inland waterway transport as a favorable environment for professional realization of transport workers. In this way the harmonization and unification of standards for certification and education of crew, as well as the free access to the labor market are of great importance for the effective transportation services. As can be seen on figure 9, fluctuations of crew productivity during the observed period are reported. Crew performance was the lowest in 2014 (1842 tons) compared to 2008 (2332 tons). Main problems evolve from both the decreasing number of personnel and low cargo volumes in this period.

Figure 9

Dynamics in labor productivity of crew in Bulgaria

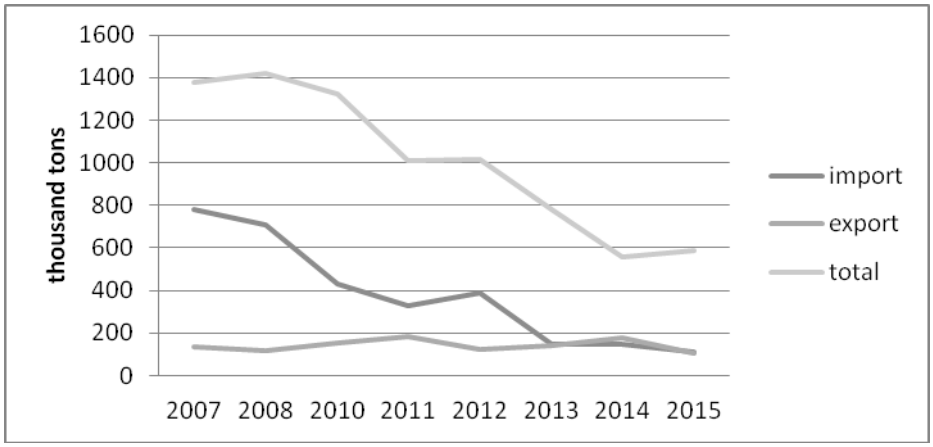
Source: Author's calculations.

The economic and political situation in Bulgaria has led to many changes in its development – on one hand an increase in the cargo turnover of road transport is observed and on the other – overloading of the transport infrastructure, traffic jams and noise pollution, as well as increased green house gas emissions in the atmosphere. At the same time, as a result of the world economic and financial crisis, many economic sectors suspended their productions and this affects the structure and volumes of cargoes carried by river shipping companies and especially the river fleet performance.

On figure 10, volume of cargoes (including export, import and transit traffic) carried by Bulgarian River Shipping Company is presented.

Figure 10

Dynamics of cargo volumes carried by Bulgarian river fleet



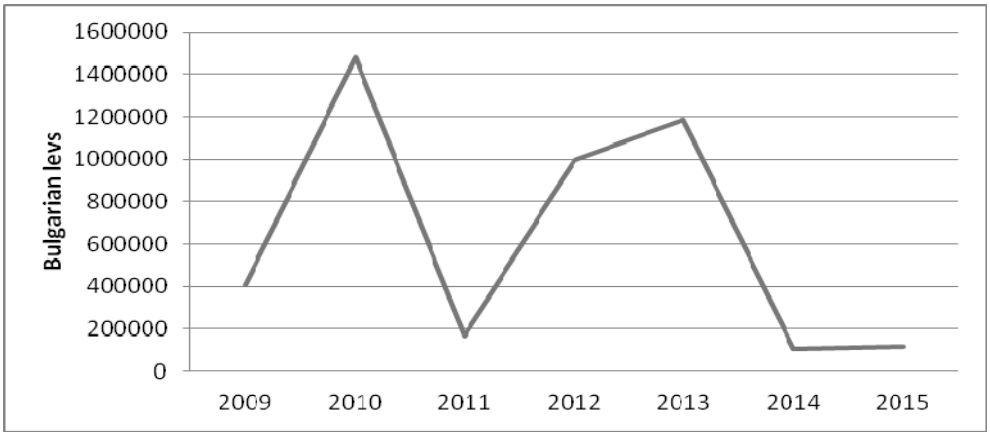
Source: National Statistical Institute and the Annual reports of Bulgarian River Shipping Company for the period 2008-2015.

At the beginning of the analyzed period, the cargo volumes carried are constant. The main reasons are related to the accession of Bulgaria to the EU; free movement of goods, capital and work force, as well as elimination of much of the tariff barriers. The share of imported cargoes from Germany, Hungary, Austria and Slovak Republic is the biggest. The observed decrease in cargo volumes in 2010 dues to the unfavorable conditions of navigation in the Bulgarian section of the river Danube, affected by ice formation during the winter months. As far as the export is concerned, the biggest share is possessed by the exported agricultural products. The general trend observed is of permanent decrease in the imported (drop of 85.5% in 2015 compared to 2007) and exported (drop of 20% for the same period) goods by Bulgarian river fleet. The observed trends in the volumes of cargoes carried impact directly the investment policy of Bulgarian river shipping companies, which is important for the modernization and innovation of the fleet.

The investment costs in inland waterway transport could be defined as the cash payments that river shipping companies made in order to purchase or improve the status quo of the river fleet. The investment costs impact the performance of river shipping companies as the effect of their increase or decrease occurs over a long period of time. In this regard their influence over the economic activity of river shipping companies differ significantly from the running costs for repair and maintenance which aim at servicing the short-term goals of the river operators. The importance of these costs is related to the improvement of the quality of transportation services provided; safety, security and regularity of the freight carriages. It concerns also the increase in the loading capacity of vessels; usage of specialized ships; application of information and communication technologies.

Figure 11

Investment costs of Bulgarian river shipping companies for modernization of fleet



Source: National Statistical Institute and the Annual reports of Bulgarian River Shipping Company for the period 2008-2015.

As one can see on figure 11 river shipping companies invested financial resources for modernization of fleet mostly in 2010 – 1 480 300. Subsequently, the investment costs sharply decreased and their sum in 2015 is merely 117 700. The investment activity of river shipping companies is oriented mainly towards modernization of fleet as the average age of vessels in Bulgarian river fleet is between 45 and 60 years. On the other hand it depends on the volumes of cargoes carried as well as on the coefficient of the vessels capacity usage.

As it was mentioned in the introduction of the current research, the main objective of the European transport policy is the sustainable development of the transport sector. The implementation of energy effective and environmentally friendly vessels and promoting the participation of inland waterway transport in the intermodal transportation services is of great importance for enhancing Danube river fleet performance.

Intermodal transportation services involve freight transportation by using various transport modes without any handling of cargoes when changing the mode (Commission for Navigation on the Rhine, 2010). The intermodality is a quantitative indicator that assesses the level of interaction among transport modes – rail, road, sea, air and inland waterway, as high operation efficiency of the transport system could be achieved. The intermodal transport allows the relevant competitive advantages of each mode of transport to be integrated in the transportation process. It can be defined also as a process through which the application of information and communication technologies and well established and managed transport infrastructure could lead to optimization of the transportation services.

The specialized vessels could be successfully used when involving two modes of transport such as: inland waterway and sea transport; inland waterway and road transport and inland waterway and rail transport. In this way it is necessary:

1. Interoperability of information and communication technologies, applied in the various modes of transport;
2. Harmonization of the operation of handling facilities and transport units carried according to the construction of the rolling stock;
3. Enhancing the handling facilities performance and improving the quality of the main and auxiliary operation services provided at river ports;
4. Improving the organization of the intermodal transport services in order the capacity of the rolling stock to be optimally used.

Mostly used forms of intermodal transportation services on the river Danube are the Ro-Ro and inland waterway –sea freight transportation carriages.

What is typical for the Ro-Ro transportation services is the horizontal transshipment of cargoes on special Ro-Ro ramps at the river ports. This type of intermodal services is widely used in the transportation of cars, trailers, semi-trailers, tractors and etc. Such type of transportation services are carried in destinations such as Passau – Vidin – Passau; Magdeburg – Vienna; Passau – Budapest. The main benefits, concerning the usage of this technology are:

- The variable costs per transport unit carried for river shipping companies decrease significantly;
- The free capacity for transportation services of river Danube is optimally used and the quality and reliability of the transportation services is improved as the road traffic in the living areas is reduced;
- Carrying out environmentally friendly and energy efficient transportation services of oversized and bulk cargoes;
- Competitive prices of the river transportation services are achieved;
- The operational costs of the oversized freight carriages are decreased (e.g. in the road transport there is restrictions concerning the movement of oversized vehicles in various periods of the day and additional infrastructure charges need to be paid).
- The implementation of a regular Ro-Ro service in a relevant destination allows better planning of the delivery time of cargos.
- Enhancing the fleet performance and productivity of crew.

The intermodal transportation services, involving inland waterway and sea transport are suitably used in carriages of large containers on container ships. The so called LASH pushing barges are also applied. They are typically used for navigation on inland waterways, where the barges are transshipped at the sea harbor with special facilities. Such kind of transportation is carried between Europe and Middle East through river Danube and the Black Sea. The main advantages of this technology are as follows:

- Vessels with huge loading capacity are used compared to ordinary ships;

- The average transshipment time is shortened as the lighter is directly loaded on a "mother ship" for 15 minutes;
- The delivery time to the destination is being forwarded;
- Lower various costs due to the absence of handling operations.

Another type of carriage is the usage of river-sea ships that is not classified as intermodal transportation services. Thanks to them, cargoes are directly loaded through ports and harbors or between two river ports by coastal shipping. The main requirements such carriages to be done are (Buck Consultants, et.al. 2004): *first of all* the construction and the main technical parameters of ships to allow its navigation in inland waterways and at sea; *secondly* the special conditions of fairway and locks to allow safe and secure navigation of sea ships. Such kinds of ships are used on the Romanian section of the river Danube. The main purpose of such technology is:

- The price of transportation services to be reduced as a result of the transportation carried simultaneously in inland waterways and at sea waters;
- The delivery time of cargoes to be shortened due to the missing handling operations at a way ports.

4. Application of Information and Communication Technologies in the Danube Fleet Management

The application of information and communication technologies could be determined as a prerequisite for the development of the current status quo of Danube river fleet and improvement if its economic effectiveness. The proposition of information secured transport services is a way for optimal transport process management. The adoption of such services is of great importance for the customer's needs satisfaction and enhancing the safety, security, regularity and reliability of inland waterway freight carriages.

The organization of the transport services nowadays is related to the continuous exchange of information among stakeholders and transport operators. The core component of information and communication technologies in the field of inland waterway transport is the **River Information Services (RIS)**. They are harmonized information services that assist transport and traffic management in European inland waterways and help the interoperability among different transport modes.[2] These services enhance the information exchange between stakeholders and transport operators through the use of harmonized and standardized information and communication applications. These services could also be determined as a way to achieve efficient, safe and flexible transport processes management and optimal usage of the transport infrastructure.

[2] In accordance with art. 3 of DIRECTIVE 2005/44/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on harmonised river information services (RIS) on inland waterways in the Community, 2005, Brussels

The core element of the system of river information services is the **information**. It is defined as a set of data that prevent the stakeholder's uncertainty and help them take the right decisions in the right time (Alassane, et.al. 2006). The main information that is exchanged among participants in the transportation process is the following (Via-Donau, 2007):

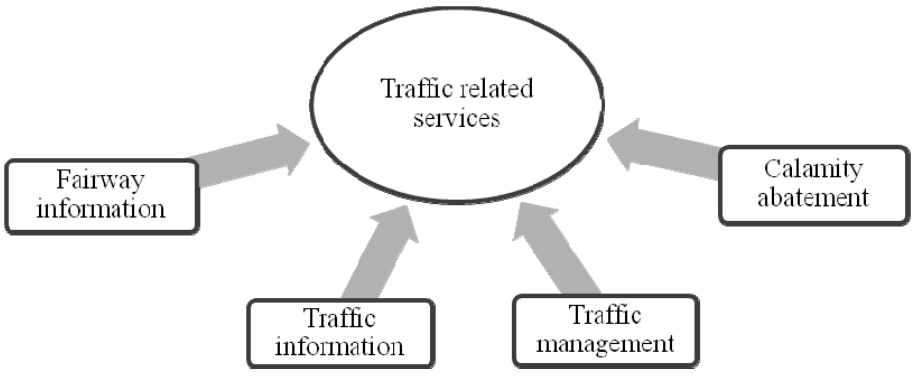
- About the actions of ship crews in order safe and secure navigation to be achieved – when it is necessary the trip or destination to be changed;
- About the optimal organization of the transportation services – when it is necessary the shortest destination to be chosen or efficient transshipment operations to be made;
- About the operational time of locks along the inland waterways – temporary closed locks; a change of technical parameters of bridge clearance; insufficient fairway depth and etc.;
- About the volume, state (hard, liquid or gaseous) and packing of cargoes;
- About the transport operator – technical parameters of the vessels; travel time and trip of the ships.

River information services are applied both in inland waterways of class IV and higher and at ports. They could be classified into two groups: **traffic related services (figure 12)** and **transport related services (figure 13).**

On figure 12 the information about traffic related services is presented as a system of four elements:

Figure 12

Traffic related river information services



Source: Directive 2005/44/EC and conclusions of the author.

1. *Fairway information services* – propose geographical, hydrological and administrative data which is necessary for captains and crew members in order to plan, execute and

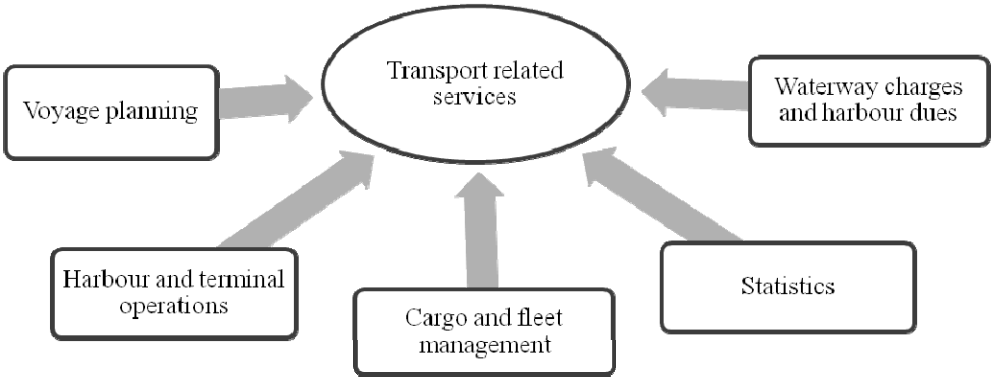
monitor voyages. These services propose static (about water levels) and dynamic (about traffic signs, opening hours of locks) one-way information – it is sent between port authorities and crews and is related to the infrastructure and conditions of navigation;

2. *Traffic information* – includes tactical and strategic information about the traffic management. **Tactical** information contains data about position, speed and direction of vessels movement (upstream or downstream) in a separate section of the waterways. **Strategic** information is mainly used to plan and monitor traffic on a certain section of the waterways. Through this type of information the delivery time of ships; traffic and working cycle of locks are calculated;
3. *Traffic management* – it is carried out by the relevant port authority and its purpose is to be optimally used the infrastructure capacity and to be ensured safe navigation. In this way the port authorities and transport operators could sufficiently exchange information about delivery time of cargoes as well as the staying of ships at locks and at ports for transshipment operations.
4. *Calamity abatement* – through these services the vessels and data throughout the whole transportation process is registered and it is updated on every stage of navigation. In this way when an accident is registered, the port authorities could immediately inform and send the data to the rescue teams. For that purpose the vessels are equipped with reporting systems, where the data is recorded and could be accessed at any time by the port authorities.

On figure 13 the river information services related to transport management are presented.

Figure 13

Transport related river information services



Source: Directive 2005/44/EC and conclusions of the author.

From the figure above could be seen that the main elements of the system of transport related river information services are:

1. *Voyage planning* – the voyage is the distance that the ship must travel from the initial to the final port. Voyage planning is related to the calculation of the expected arrival time of vessels at ports and measurement of the permissible wading depth of ships;
2. *Harbor and terminal management* – these services help the port authorities to be informed about the exact time of ship arrival at ports and the volume of cargoes they carried. In this way the capacity of ports and their superstructure could be optimally used and the time for transshipment operations could be reduced;
3. *Cargo and fleet management* – two types of data are important for these services: information about the vessels and information about the type, volume and packing of the cargoes carried. As far as the ships are concerned the information exchanged is related to calculate their accurate location; exact time for handling operations and share of the empty voyages.
4. *Statistics* – river information services facilitate the collection of statistical data on national and European level. The data exchanged consists of information about volumes of cargoes carried; freight performance of river operators; number of vessels served at ports and locks; ports turnover; number of the accidents. This information is of great importance for the transport process planning and optimization;
5. *Waterway charges and harbor dues* – river information services facilitate also the payment of waterway charges and port dues. They could be successfully used to automatically calculate the amount due between transport operators and port authorities. In this way the river operator receives an electronic notification that certifies the charges paid.

Based on the aforementioned, it could be concluded that the system of river information services depend both on *the geographical, hydrological conditions and density of the river section* and *on the subject that will apply it* (crew members; port authorities and transport operators; inland waterway administrations).

In order to successfully carry their functions, the river information services must be harmonized, standardized and interoperable with the intelligent transport systems, applied in the other transport modes. This could be achieved by the application of communication technologies at vessels and ports in a way that allows reliable data exchange among participants in the transportation chain. These technologies consist of the following:

1. *Inland Electronic Charts Display and Information System (ECDIS)* – it is a set of nautical electronic atlases that allow safe and secure navigation as they generate audible and visual alarms about the technical parameters of the river section (e.g. fairway depth). This system is interoperable with a similar system used in maritime transport;
2. *Automatic Identification System (AIS)* – is an automatic tracking system that exchange data between port authorities and crew members. The main requirement for using it is all of the participants in the transportation process to be applied with the system, otherwise the exchanged information will be imperfect and useless;

3. *Electronic Ship Reporting System (ESRS)* – it facilitates paperless exchange of data about the traffic management; waterway charges and statistics among the participants in the logistic chain;
4. *Notice to Skippers* – key technology that provides standardized information about the technical parameters of the fairway; traffic on the waterway section and hydrological and meteorological conditions of the river section.

Taking into account the analyzed river information services, it could be determined that they are of great importance for both *the crew members* as they facilitate safe and secure navigation and *port authorities* as they allow the variable costs for transshipment operations to be optimized and throughput of ports to be improved. In this regard it is necessary the system of river information services to be harmonized in the waterways of all of the Danube countries. As a result exchange of reliable and up-to-date information will be achieved. In table 1 the information and communication technologies applied in inland waterway transport at the separate Danube countries that are member states are presented.

Table 1

River information services implemented in the Danube countries

Country	Information and communication technologies	River information services	Implementation phase
Austria DoRIS	AIS; Notice to Skippers; ESRS; ECDIS	Fairway information; cargo and fleet management; calamity abatement; statistics	The project is implemented in 2006; measures for development of the information and communication technologies are taken
Bulgaria BulRIS	AIS; Notice to Skippers; ESRS; ECDIS	Fairway information; cargo and fleet management; calamity abatement	Fully implemented communication net; the project is expected to be fulfilled in 2019
Romania RoRIS	AIS; Notice to Skippers; ESRS; ECDIS	Fairway information; traffic management; vessels location at Danube and the Black Sea	The project is implemented in 2013
Slovak Republic	AIS; ESRS	Fairway information; cargo and fleet management	The project is implemented in 2006
Hungary PannonRIS	AIS; Notice to Skippers; ESRS; ECDIS	System for danger goods transportation monitoring; calamity abatement	The project is implemented in 2004 and measures for development of the communication application are taken

Source: Conclusions of the author.

As one can seen in table 1, the vessels in most of the Danube countries are equipped with notice to skippers, as the data is transmitted through national web sites that could be accessed by river transport operators, port authorities and national river administrations. An electronic transfer of data about the type and packing of cargoes as well as the conditions of navigation and location of vessels is done.

Approximately 45% of the Danube fleet is equipped with electronic charts display and information system that ensure safe and secure navigation and protection of the environment.

To be achieved fully harmonization of the river information services on the river Danube; some of the countries have taken measures for development and modernization of the communicational infrastructure. The main objective of such measures is to be optimized the transportation processes as well as the handling operations at ports.

5. Conclusions for the Development of the Bulgarian River Fleet

For transportation services in the Rhine-Danube Core Network Corridor, various types of vessels are used, depending on the structure of cargo flows. What is typical for the Danube fleet is the long-term period of exploitation and that it is out of date. Most of the vessels are purchased as second hand from Rhine shipping companies. This hinders the application of modern information and communication technologies at ships. Another disadvantage of fleet is the absence of such innovations that makes the integration of inland waterway transport in intermodal transportation services much more complicated.

Some of the important factors that determine the competitiveness of vessels are their speeds of movement; energy efficiency of traction; environmentally friendliness and total various costs. Compared to the vehicles and rail rolling stock, river vessels move at lower speeds, that impacts negatively on delivery times and help customers choose another mode of transport.

In general, the total various costs depend on the technical specifications of vessels traction and on the average fuel consumption per cargo carried. The absence of investments for reconstructions or purchasing new vessels is serious obstacle for improvement of the effectiveness of freight transportation services. This fact influences also the volume of green house gas emissions.

Another important problem is the lack of interoperability among navigation on the various inland waterways – e.g. in the Danube region mostly convoys of push boats are used while in the Rhine corridor the self-propelled vessels are prevailing. These differences hinder safe and secure navigation on Rhine-Danube Core Network Corridor, as in some section additional services are necessary for the adoption of vessels to the fairway conditions.

The effectiveness of river freight transportation services and sustainable development of the sector are determined to a great extent by the professional qualification (Nozharov, 2014) of the work force. The main problem here is the lack of well-educated and qualified crew members at the Bulgarian river fleet. A sharp drop in the number of personnel at river

shipping companies as well as high share of aging ship crews is observed in many Danube countries, including Bulgaria.

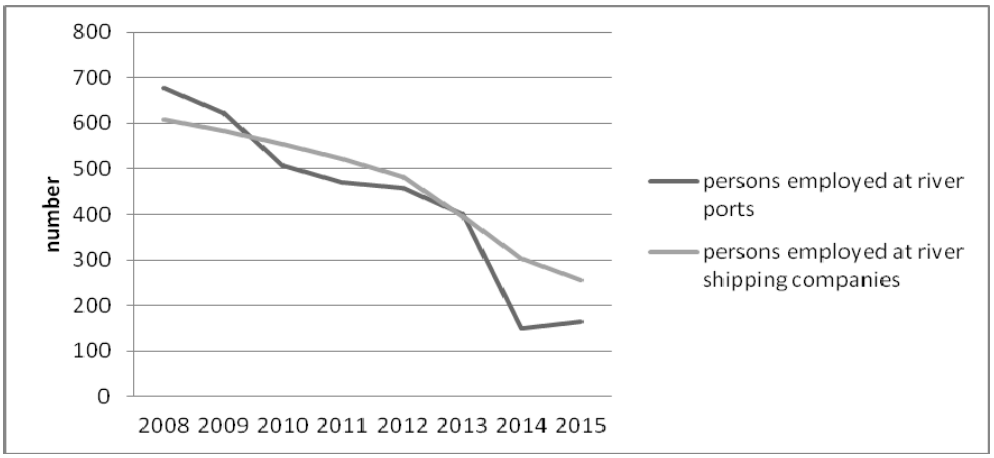
Structure and employment of staff at ports is determined by the volume of transshipped and stored cargoes as well as by the number of handling and warehousing facilities. The number of persons employed at ports depends also on the required time for handling operations.

The general trend that can be seen in the figure below is of continuous reduction in the number of employees at river ports. The total number of employees at ports in 2014 decreases approximately 5 times compared to 2008.

The observed decline is determined by the reduction of cargo flows from one hand and the concession of several port terminals on the other.

Figure 14

Dynamics in the number of persons employed in inland waterway transport of Bulgaria



Source: Ministry of Transport, Information Technologies and Communications, Executive Agency Maritime Administration.

The observed general trend is of reduction also in the number of persons employed at river shipping companies. For the analyzed period their number decreases with 257 in 2015.

The working conditions at ships, characterized by the long time during which members of the crew are far away from their families, are unattractive for most of the graduates. On the other hand the wages of crew in East-European countries, especially in Bulgaria are five times lower (EUROSTAT, 2016) than these in the West-European countries and lead to much more migration of workers.

The lack of high qualified workers in the East-European countries (incl. Bulgaria) force river shipping companies to expand the working time of personnel. In general the duration

of the working shift is 14, 18 or 24 hours. Due to the situation in the country most of the river transportation services are carried in 24 hours working shifts. This has negative impact and contributes to the decision of transport workers to leave the sector because they cannot use their resting time sufficiently. The increasing of working shifts influences negatively also the productivity of crews.

The effectiveness of river transportation services depends also on the professional qualification of transport workers. The theoretical and practical training in the country is conducted in accordance with the Bulgarian legislation. However the absence of unified educational standards in the field of inland waterway transport in EU impedes the mutual recognition of certificates of crew members (NEA, 2008).

In terms of personnel structure, the group of retirement aged workers (between 51 and 60 years) is prevailing at Bulgarian river shipping companies. This will directly lead to increase of deficit of qualified workers in the next years.

The lack of adequate knowledge of crew for movement of vessels at optimal speeds, as well as the application of modern information and communication technologies and ability to lower fuel consumption, are the main prerequisites for decreasing the effectiveness of river transportation services.

In table 2 the main strengths, weaknesses, threats and opportunities for the development of the Bulgarian river fleet are summarized.

Table 2

SWOT analysis of the Bulgarian river fleet

Strengths	Weaknesses
• Safe, reliable, secure and regular transportation services are provided; • Carriages of environmentally friendly and energy efficient transportation services are made; • Huge variety of vessels in the river fleet, concerning type and technical specifications is observed;	• Prolonged lifetime of vessels; • Lack of harmonized application of information and communication technologies; • Prolonged time for transshipment operations at river ports; • The number of retirement aged workers is prevailing at river shipping companies in the country; • Irrational distribution of the working time between working and resting time is accounted; • Lack of unified communication language;

Opportunities	Threats
• Increase in the volume of freight transportation services of containers; • Involve inland waterway transport in intermodal freight carriages; • Promote shipbuilding and use of environmentally friendly and energy efficient vessels; • Develop the vessels 'traction systems; • Harmonize the educational systems for training of the crew members on EU level; • Ensure favorable working conditions for personnel and sufficient use of the resting time.	• Change in the cargo flows structure because of the necessity of high value and small butch cargoes transportation services; • There are differences in legislation of the River Commissions, concerning the technical specifications and equipment of vessels; • Deficit of qualified working force; • Lack of mutual recognition of certificates of crew members among single river corridors;

Source: Author's conclusions.

6. Perspectives for the Development of Bulgarian River Fleet

During the last years many structural changes have occurred in the Bulgarian river fleet, such as privatizing the monopoly state-owned companies; appearance of small and medium-size enterprises; emergence of intermediaries, governing the transportation services among customers and shippers. The unfavorable conditions of the business environment, the cumbersome administrative procedures and changes of cargo flows lead to lower competitiveness and effectiveness of the river freight transportation services. That is why the gradual and continuous developing of the river fleet is one of the key factors for achieving environmentally friendliness, energy efficiency of inland waterway transport, increase of its market share and entering new market niches as well as improving the safety and security of carriages.

Implementing technical upgraded river fleet is one of the reasons for improving the performance of the vessels and their environmentally friendliness. These actions are related mostly to the adoption of innovations in shipbuilding and ship mechanics, improvements in the navigation facilities and involving inland waterway transport in the intermodal freight carriages, which result in:

- Lower consumption of scarce liquid fuels;
- Improved safety and security of navigation;

- Improved interoperability among different transport modes in direction the total fixed costs to be decreased.

Conditions of navigation in inland waterway are determined by the fairway depths that impact the sustainability of vessels over water. This influences the fuel consumption of vessels. The climate changes are important factor for the fluctuations of Danube water levels and ice formation in winter months of the year. As a result the payload of vessels is significantly decrease and the total various costs increase. In order these problems to be overcome; the shipbuilding industry should be oriented towards production of vessels with developed traction systems and design that allow optimal adoption to the navigation conditions in each section of the river Danube.

This also helps the loading capacity of ships to be increased even when their technical specifications are the same; the days of the year when navigation is impossible to be shortened, as well as interoperability with the other transport modes (rail and road transport) and increased share of specialized vessels to be achieved.

The hydrodynamic sustainability of vessels depends on the technical structure and design of the ship. These parameters impact directly the vessels speeds and fuel consumption and indirectly the volume of green house gas emissions in the environment. The ship design determines its function to carry various types of cargoes.

As a result of the aforementioned, the performance of the Danube river fleet will be improved if high capacity vessels are applied and much more trips are carried. Consequently the ship design must be optimized as the status quo of port infrastructure and fairway conditions are taken into account as well as the specific needs of customers and working conditions on board.

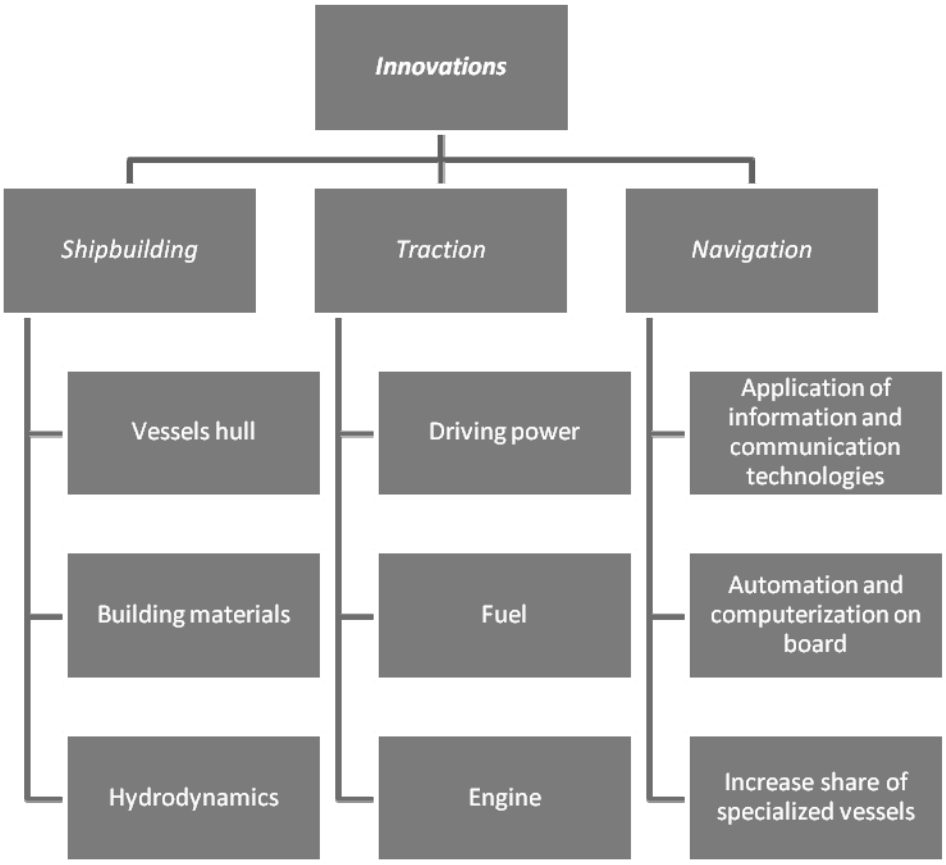
The application of light materials in the shipbuilding industry is a way the ships gross tonnage to be reduced and as a result their payload to be increased. In other words, limiting the gross tonnage of vessels could enhance its loading capacity even when the conditions of navigation are unfavorable.

On figure 15 are presented the opportunities for improvements of the Danube fleet, concerning the innovations in the shipbuilding industry, in the traction systems of vessels and in the conditions of navigations. The technical specifications of driving power of vessels are factors that influence their consumption of scarce liquid fuels and determine the energy efficiency of fleet. The continuous reduction of fossil fuels stocks force the usage of renewable energy resources (liquid petroleum gas) for vessels and the necessity of environment protection requires the ships to be equipped with catalyst converters and particulate filters engines that comply with the European standards for environmentally friendliness, such as EURO V and EURO VI, implemented in road transport. In 2009, the European Commission funded a project “The Cleanest Ship” through which methods for improving the energy efficiency and environmentally friendliness of inland waterway transport are proposed. The ship built was powered in a way that allows the green house gas emissions evolved to comply with EURO V in road transport. This ship is equipped with catalyst converter and particulate filter, as well as with a Tempomaat, which main function is to help the captain of the ship steer the vessel at optimal speed. The main results

of the project prove that the green house gas emissions are reduced to 82% (A. Roos, 2008). Consequently the construction of such vessels is an important innovation in the river fleet in order the environmental friendliness of inland waterway transport to be enhanced and at the same time the modal split of this mode of transport to be increased compared to road and rail transport.

Figure 15

Opportunities for improvements of the Danube Fleet



Source: Manual on Danube Navigation and conclusions of the author.

Another step of innovation of the river fleet is the application of information and communication technologies. The intelligent transport systems are based on the concept for traffic management and they are used mainly when the optimal exploitation of vessels loading capacity and transport infrastructure is necessary. Through their application the following results are achieved:

- Reduction of operation and administrative costs for transport infrastructure usage;
- Reduction of green house gas emissions;
- Reduction of the delivery time of cargoes and low share of empty carriages;
- Increase the safety and security of transportation services and better working conditions for the crews.

The application of intelligent transport systems in inland waterway transport is related to certain benefits for the river and port operators, operators of ground facilities and state administrations.

The main benefits for **the river operators** in short term are direct effects related to safer transportation services and better labor productivity; lower variable costs and higher profit. Evidence for that are the maintenance and operation costs savings as well as savings of the fuel costs per ton carried. If the Bulgarian river fleet is equipped with communication applications (AIS; ECDIS; ESRS) the total sum of the maintenance costs of vessels are reduced with (COMPRIS, 2006):

1. 7.25% as a result of the application of ESRS software;
2. 0.75% when using radar;
3. 2.25% as a result of the application of AIS software;
4. 2.75% when using ECDIS software.

These applications are necessary for the live monitoring of cargo carriages with inland waterway transport. They allow the liability of transport operators to be limited in the event of uncertain circumstances such as total or partial loss of the cargo carried. As a result the total costs for compensation losses will be reduced and higher financial performance of river shipping companies will be achieved. E.g. the gross added value of the river shipping companies in Austria is continuously increasing after 2006 (in this period the river information services DoRIS are fully deployed).

The reduction of fuel consumption is related to less variable costs and lower prices of the transportation services. This also leads to maximization of the positive effects for the society and environment as the volume of green house gas emissions is reduced.

The application of the aforementioned communication technologies is important also for the decrease of the average wage costs and the increase of labor productivity of crew with 16.1% in 2015 compared to 2013 (in this period most of the activities related to the deployment of river information services in Bulgarian section of the river Danube are fulfilled). This fact is an evidence for the better working conditions for crew and the optimization of the transportation process.

The application of river information services is of great importance for the improvement of safety and security of freight carriages. For example the number of incidents on Middle and Lower Danube is decreasing in 2014 compared to 2010 (DC, Annual Navigation Statistics, 2010, 2011, 2012, 2013, 2014). That is why the application of communication technologies (AIS, ECDIS and ESRS) is very important as the cargoes carried could be monitored

through the whole transportation process and in such way to be limited the possibilities of environmental catastrophes especially in the freight carriages of dangerous goods on inland waterways.

The port operators get benefits through the application of river information services as direct effects related to better usage of the free capacity of port infrastructure; better productivity of the stevedores and handling facilities. When the ports are equipped with communication and information technologies the productivity of handling facilities increases with 5% (BMVIT, 2006). E.g. the average hours for staying of ships at Bulgarian river ports decreases with 52% in 2015 compared to 2007 (see figure 6).

The application of intelligent transport systems in the port management process is very important for the precise calculation of the mooring time of vessels in order the handling facilities to be ready for operations. The continuous monitoring of vessels location allows port operators to prepare the necessary wharf depending on the vessels technical parameters so the safety moorage of ships to be guaranteed. This results in low variable costs for river operators and fuel and time savings.

Ground station operators (lock operators) get benefits through the application of information and communication technologies in the form of direct and indirect effects, such as increasing number of passed and serviced ships at the lock stations which results in better productivity of these facilities – it can be increased from 1% to 10% (COMPRIS, 2006) depending on the traffic. The equipment of gateway stations with river information services helps the capital costs to be decreased with 7.8% (BMVIT, 2006).

The state authorities benefit from the application of information and communication technologies in the form of direct economic effects. They are related to 21% (BMVIT, 2006) decrease in the sum of average costs per employee as a result of the shorten personnel due to the automation of most of the services provided. Furthermore the implementation of river information services rationalizes the services of custom clearance of vessels and makes easier the statistics for inland navigation. They allow also the electronic transfer of data among river administration agencies and shorten the time for analysis and prevent making mistakes. Data is collecting on a paperless basis leading to reduction in the amount of government spending.

The application of intelligent transport systems makes possible the integration of inland waterway transport in the intermodal transportation services, based on the harmonization and interoperability among communication technologies in the relevant transport modes. The implementation of sensors, automatic locators, computer signals and radio- and navigation applications allows efficient use of the transport infrastructure, rolling stock and freight carriages in the fastest, safest and most optimal route. Such interoperability is possible among the following systems (DGMT, 2016):

- „Telematics" in road transport;
- European rail traffic management system (ERTMS) in rail transport;
- Vessel traffic management information system (VTMIS) in sea transport;
- Single European sky air traffic management research (SESAR) in the air transport;

- River information services (RIS) in inland waterway transport.

The interoperability among the aforementioned communication technologies allows:

1. Continuous data transfer between forwarders and consignees;
2. Accelerating the cargo delivery process as the competitive advantages of each transport mode are combined;
3. Limit the harmful effects of transport on the environment;
4. The probability of accidents and environmental disasters is reduced.

The application of information and communication technologies in vessels movement allows the main operations on board to be computerized. The electronic systems control the information flow and relieve the crew of many complicated obligations, concerning the vessels exploitation. These systems influence positively the fuel consumption. The application of river information services helps the safety and security of inland navigation to be enhanced. The electronic exchange of data in the supply chain allows the cargoes transportation process to be observed during the whole trip and any lacks and damages of the goods to be avoided.

In order inland waterway transport to be involved in intermodal transportation services the application of specialized vessels is needed. In this way the performance of vessels will be improved and the total various costs will be decreased. The usage of specialized ships is especially effective for oversized and bulky cargoes carriages and that is why the inland waterway transport takes the biggest market share, compared to road and rail transport. Another way the effectiveness of river freight transportation to be improved is the building of hybrid vessels:

- River snake (Holtman, Zigic, 2004) – it can be used when large cargo flows are aggregated in a separate sections of the river. The convoy is composed by few pushed boats, attached to each other as a snake. In this way many cargoes to different destinations could be carried as each push boat can be set free from the convoy.
- Self-discharging vessels – they could be used in Ro-Ro transportation services. They are equipped with special cranes or Ro-Ro platforms by means of which the vessels are self-discharging their payload when berthing at the quays. This leads to reduced total costs as no handling facilities are used and the price of transportation services decreases. The implementation of self-discharging vessels is related to better competitiveness of inland waterway transport as quality indicators such as safety and reliability of freight carriages are improved (WP, 2004).

The effectiveness of river freight transportation services is determined by the employment of professional crew members. Better training of graduates; the guaranteed free movement of working force through the separate river corridors and the sufficient social and labor conditions on board are the factors of great importance that determine the labor productivity. The effectiveness of river freight transportation can be improved by:

1. Ensuring more public and European funds for fully deployment of information and communication technologies for statistics collection, voyage planning, waterway

charges and port dues in the Bulgarian section of the river Danube in order the delivery time of vessels to be improved and administrative and custom formalities to be reduced.

2. Ensuring governmental support in bank crediting of fleet modernization or new vessels purchasing (vessels are one of the most capital intensive assets compared to the rolling stock of the other transport modes) in order the technical conditions of vessels to allow efficient transport of containerized products and goods as well as lower green house gas emissions.
3. Conducting post-graduate courses for theoretical and practical training of crew members in order their knowledge to be up-to-date;
4. Amendments of the labor legislation in the field of inland waterway transport in order harmonized rules for mutual recognition of certificates among European inland waterways to be adopted;
5. Make equal the level of wages among the European inland waterway corridors in order the crew members to be motivated to improve their labor productivity;
6. Financial grants through European and national funds for establishment of educational institutes that will help the image of inland waterway transport as a working environment to be improved.

Conclusions

The development of the Danube river fleet and the usage of specialized and innovative vessels will lead to the realization of benefits such as:

First of all the usage of technically updated traction systems and design of vessels will allow high speeds and low fuel consumption of vessels to be achieved. In this way, inland waterway transport will be preferred by logistic operators, trading and industrial companies for freight transportation as a competitive mode of transport, concerning reliability, flexibility and cost-effectiveness.

Secondly, the implementation of information and communication applications on the board of vessels will allow the consumption of scarce fuels and green house gas emissions to be lowered. In this way, the crew members will have the opportunity to choose the optimal speed of movement of vessels and have the necessary information about the fairway conditions (ice formation, low or high water levels) in advance.

Thirdly, the development of handling facilities at ports and the implementation of communication applications related to the waterway charges and port dues will allow the average stays of ships at ports to be decreased. This will helps the delivery times of cargos to final destination to be improved and inland waterway transport to be successfully involved in the intermodal transport planning.

Lastly, the existence of regular line services in the Danube region as well as an efficient transport link between Bulgarian section of the river Danube and the Black sea will allow a

balance among the export and import flows through river ports in the country to be achieved. In this way, Bulgarian river fleet will optimally work at full capacity and the implementation of hybrid vessels (self-discharging or river-snake vessels) will be possible. This fact will contribute to the sustainable development of inland waterway transport and to the provision of combined and multimodal transportation services at Bulgarian river ports.

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