Creating the value of services as a factor of efficiency of production activities of transport enterprises in the digital economy

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Abstract. At the present stage of economic and logistics development, information technologies, artificial intelligence, as well as other achievements of scientific and technological progress are singled out as one of the promising areas, the introduction of which exposes the conditions for creating value of services to forced transformation. Many factors have become the catalyst for such rapid changes. However, among the key ones, it is worth noting the pandemic, thanks to which contradictions between the development of elements of economic systems, both at the state level and in individual production and marketing links were revealed. The pandemic has shown that it is technology, digitalization and innovation that determine the most significant factors for increasing the efficiency of production and distribution systems, including transport and logistics. In this regard, the subject of the study is the process of creating the value of transport services in the new conditions of maritime business. The purpose of the study is to develop a conceptual approach to creating the value of transport services, which will increase the efficiency of production activities of enterprises by maximizing the satisfaction of new business conditions. The methods of studying and generalizing domestic and foreign experience, the analytical method were used in the work. A review of scientific sources was carried out, analytical materials were investigated, and an oral survey of representatives of the maritime business was conducted. It is determined that in the new conditions the value of the transport service is formed due to the coordinated interaction of all participants in the cargo delivery chain. A model of value creation of transport services based on a globally synergetic approach and considering information innovations implemented today in maritime transport is presented.

1 Introduction

The search for approaches to creating the value of goods and services always remains relevant, since value is one of the key factors in increasing the efficiency of an enterprise's production activities. At the same time, it is worth emphasizing that consumer requirements, as well as the competitive market situation and value creation mechanisms are susceptible to continuous transformations [1]. This obliges sellers to be in constant interaction with business partners, to look for new tools and approaches focused on meeting the wishes of customers. After all, it is the number of customers that ultimately determine the effectiveness of the economic system. It is worth emphasizing that modern trends and achievements of scientific and technological progress which largely determine the vector of economic development play a special role in the development of this direction. For example, today researchers are talking about the virtualization of socio-economic processes, which implies the development of various types of economic activities in a computer network [2]. Respectively, it is difficult to argue with the fact that many approaches, tools, and methods in the field of value creation of services used both earlier and at the moment, will no longer be able to provide the desired result in the future. This applies to all sectors of the economy, without exception. But I would like to highlight transport, because it is thanks to its rhythmic work that the needs of the state and business in transportation are met, the budget is replenished through the development of foreign and domestic trade.

Based on the analysis of the current situation in the world, we can safely say that the transport industry and maritime transport, including, are at the epicenter of global economic and logistics problems, the solution of which requires timely and non-trivial actions from market participants aimed at a positive financial result not only in the foreseeable future, but also for a long-time perspective [3, 4].

At the same time, it is worth considering that today, when determining further areas of activity, transport companies need to consider the ongoing processes of digitalization, both economic and transport and logistics aspects of the development of the transport services market, including the port component and, in particular, the port administration [5]. Separately, according to the authors, it is necessary to clarify that it is sea transport that is one of the key elements of the successful functioning of the mechanism for regulating international trade, as well as the most important component in the formation of the final price for

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transported goods [3,4]. All this substantiates the objective need for a deeper and comprehensive study of the problem of the development of modern shipping from an economic point of view, since based on the results obtained, it will be possible to confidently identify key trends for developing approaches to the formation of the value of transport services today.

2 Materials and Methods

The stated purpose of the study is to develop a conceptual approach to creating the value of transport services, which will increase the efficiency of production activities of enterprises by maximizing satisfaction with new business conditions.

To achieve this goal, scientific tasks were formulated and solved: to study the peculiarities of the operation of a marine vessel in the context of the use of information technology as one of the links in creating the value of a transport service; to develop and substantiate a scientific approach to creating the value of a transport service, considering the modern realities of doing business and transport specifics.

The author's hypothesis of the study is as follows: when developing an approach to the formation of the value of transport services (for example, cargo delivery by sea) in the context of global digital transformation, it is necessary to shift the emphasis and consider the process of value creation in a comprehensive manner, through the synergy of economic and operational sectors, the successful work of which is impossible without the introduction of digital innovations.

The economic sector is understood as an economic system, the effectiveness of which is determined through the achievement of economic indicators declared in accordance with the contract for the supply of cargo (financial result, value of services, etc.). The operational sector (within the framework of the ongoing research) is the direct operation of the vessel, on the competent work of which the delivery time and the safety of the cargo depend.

3 Results and Discussion

Practice shows that as one of the significant conditions for the long-term development of maritime navigation at the moment, it is possible to designate the active introduction of information technologies into the operation of the fleet and the management of the port infrastructure [4, 6, 7]. Nevertheless, a detailed study of this issue has revealed a contradiction that is difficult to resolve based on traditional approaches, which consists in the following.

On the one hand, the use of advanced technical means of navigation, as well as the operation and management of coastal infrastructure facilities provides a unique opportunity to solve multidimensional tasks more quickly (which is extremely characteristic of the current stage of development of both the transport complex and the requirements of the external environment). Nevertheless, on the other hand, the problem of the so-called "human factor” that still exists is getting worse. In this case, we are talking about the fact that the transition to a new format of doing business, Russia's active participation in the fourth industrial revolution, the rapid spread of information technologies around the world makes the previously existing economic and other systems not so productive, not always satisfying global economic challenges.

In maritime navigation, this has led to the fact that the conditions for acceptance by the boatmaster and employees of the coastal infrastructure are radically different from those that were five to ten years ago [8]. Today, the number of display tools and sources of information based on which management and operational decisions are made has increased many times.

In this regard, there is a problem of inaccurate interpretation of the received information due to its redundancy, certain duplication, ambiguity, and untimely perception [9]. All this leads to the appearance of errors, which in certain cases can lead to extremely negative consequences of both production (accidents, late delivery of goods to the consumer, etc.) and economic (financial losses, cost increases, etc.) nature. As a result, this has an exclusively negative impact on the business economy, which can be reflected both in an increase in price and non-fulfillment of contractual obligations on the part of the carrier (loss of cargo, violation of its safety, delay of the vessel in the voyage, etc.). All the above reduces the value of transport services, which can cause loss of competitiveness and, in some cases, withdrawal from the market or transition to a less attractive segment.

The study of this problem from a technical point of view allows the authors to conclude that there is a contradiction between the traditionally established type of interaction “man-machine” and the ever-growing capabilities of modern information technologies that allow us to switch to interaction of the type "man-environment.” Thus, when forming the value of the services of both the shipping company itself and the representatives of the port business involved in the transportation of goods by sea, at the present stage it is necessary to follow the path of close cooperation between the economic and operational sectors of the transport services market. Such a collaboration, according to the authors, will ensure the emergence of a synergetic effect in the field of economics and logistics (transport component), the manifestation of which can be traced through the effectiveness of interaction with buyers of services. In this regard, it seems to the authors that a revision of the already existing rules, tools, and regulations for doing business is required, which naturally leads to the need to develop a new approach to the formation of the value of services. This approach will not only consider the economic fundamentals, but also organically fit into the new standards of operation of a marine vessel [9] and will also create fundamental prerequisites for the further development of the theoretical provisions of the economics of maritime transport.
To maintain competitive positions and increase production efficiency (cargo transportation by sea) in modern conditions, shipping companies must ensure a high level of customer satisfaction. This can be achieved only by building internal business processes at a high-quality level and constantly improving them. It is also necessary to be flexible in dealing with customers and their needs [10].

Traditionally, the value creation of services relies on a chain, which is a set of processes (main and auxiliary). Also, some researchers emphasize that the buyer should take an active part in creating value, acting as a co-creator. To this end, it is recommended to study in detail all the processes of the enterprise, as well as to be in constant contact with the consumer of services in order to respond in a timely manner even minor changes in his wishes regarding quality criteria.

An oral survey carried out by the authors among managers of middle and top-level maritime companies of Novorossiysk and St. Petersburg ports (a total of 65% of the total number of companies in each port were interviewed) showed the following. Firstly, the following key criteria determining the value of a transport service have been leading for several years: price, costs, duration and timeliness of delivery, transparency, and timeliness of information. Secondly, it has been established that to control the relationship with the consumer, many service sellers implement monitoring systems. According to its results (most often performed by means of an oral survey, as a rule, with the fixation of the results by the manager or an information questionnaire – the use of special information technologies, for example, the company's website, questionnaires), actions, rules, regulations, and other tools aimed at increasing the value of the service (the process of co-creation with the buyer) are adjusted.

At the same time, the peculiarity of the transport service is that many companies take part in creating its value, the key to which are shipping, stevedoring and logistics (which also provides forwarding services). Each company is responsible for a specific front of work, creating value on its site. At the same time, as a result of the survey, it was found that a separate link in the general chain conducts its own monitoring, trying to improve its indicators used in the competition for the consumer. At the same time, the stevedoring and logistics company should be attributed to the economic sector, and the shipping company to the economic and operational, since the efficiency of its work is determined through economic indicators that are formed as a result of competent operation of the vessel (we do not take into account the economic component of the vessel's work in this case, since this is a separate topic for large–scale research). This division is proposed by the authors from the perspective of the participation of individual links in the creation of a common value chain, considering the development and application of information technologies. In this regard, we will explain the following.

Considering that it is the shipping company that carries out cargo transportation, within the framework of this scientific work we will determine the directions for increasing the value of services in the context of the transformation of the operational component. The conducted research, including a survey of long-distance sea captains (a total of 30 respondents with more than 15 years of experience on vessels making intercontinental crossings were interviewed) showed that a modern marine vessel should be considered as part of a marine ergatic system, which includes the following components: personnel (boatmaster, operator), control object (sea vessel), human-machine interface (user interface) [9]. According to the authors, the effective interaction of the user of the marine ergatic system with an ever-increasing flow of digital data requires the introduction of an intelligent interface in a mixed reality environment. The task of the interface is for the boatmaster to intuitively receive aggregated information with a large thesaurus to prepare for decision-making. This will reduce the likelihood of errors, which can cause both global (accidents, environmental disasters) and economic consequences (increased costs, penalties due to non-fulfillment of contractual obligations, etc.).

The practical implementation of effective communication of all elements of the marine ergatic system is proposed to be developed based on the “e-Navigation” concept, which is focused on creating conditions for the integration and improvement of ship navigation systems, including the coastal segment and fifth-generation communication systems [11]. This concept is designed using “end-to-end” digital technologies (artificial intelligence, etc.) to form the prerequisites for the transition to a new stage in the development of maritime navigation: autonomous navigation. It is also worth noting that the e-Navigation services being developed due to the introduction of fifth-generation communication elements will be able to provide processing of the required information flows, both for the vessel and for the coastal component.

Connecting the coastal component (representatives of the economic sector) to the “e-Navigation” concept system will increase the value of services due to faster transmission of information, for example, about the location of the vessel, characteristics, and condition of cargo, etc., which may interest the consumer. Thus, relying on new information technologies, it is possible to increase the value of services, both through cost reduction and increased transparency of the receipt and transmission of information (these two criteria were included among the first by respondents). All this requires the development of an appropriate infrastructure, but, as practice shows, developments in this direction are already underway [8].

In addition to the above, we note that in the future, in the field of navigation, the possibility of introducing a multi-agent system (a separate type of artificial intelligence) is being considered, which is a set of interconnected software modules (agents), fragments of knowledge available to other agents. The purpose of this system is to coordinate knowledge, goals and plans used to solve emerging problems and tasks. These are open, active, developing systems that ensure the cooperation of agents based on the rules of interaction. At the same time, we note that the order of interaction between
agents is not strictly defined: only the means for organizing cooperation of transaction participants (messaging language, protocols, etc.) are defined. The order of interaction between all links of the logistics chain of cargo delivery by sea can be organized by applying one of the types of interaction of intelligent algorithms: crowd intelligence, swarm intelligence, collective intelligence. Summarizing the results obtained, the authors believe that the use of new scientific achievements in the field of information technology in the economy will allow finding additional ways to increase the efficiency of economic systems, which, of course, will require the transformation of traditional approaches and further development of theoretical provisions of the economics of maritime transport.

4 Conclusion

The development of the economy in recent years can be characterized as a period of rapid scientific and technological progress in all sectors, and especially in maritime navigation. A significant technological breakthrough was caused mainly by the global spread of information and communication technologies, which led to a rapid transition to the fourth industrial Revolution or industry 4.0. Intelligent technologies such as the Internet of Things and Services, big data, biotechnical systems, autonomous robotics, including in relation to marine autonomous vessels, cloud computing, virtual and augmented reality, artificial intelligence, blockchain technology and others are singled out as indicators of the manifestation of this revolution [11]. It is obvious that such a shift requires an active response from service providers, and first, the transformation of the current conceptual approach to creating value for transport services.

Considering the results obtained and described in detail above, the authors in modern conditions propose to consider the process of creating the value of transport services, shifting the focus to meeting the requirements of service buyers through the implementation of information technologies. In this regard, it was found that today the key link in the logistics chain of cargo delivery by sea is the most susceptible to the introduction of such innovations – a marine vessel, which is one of the components of the marine ergatic system. The transition to new digital standards, as well as the development of unmanned navigation in the future have already created prerequisites for the operation of a marine vessel based on the concept of "e-Navigation". At the same time, it should be noted that within the framework of this concept, not only the marine, but also the port infrastructure will need to be transformed, the likelihood of errors when making decisions in the field of ship operation will decrease. There will also be an opportunity for a faster and simplified exchange of information between the participants of sea transportation and the further development of human-machine interaction through the new format "man-machine-environment", which will certainly increase the efficiency of the production process of the enterprise.

Fig. 1. A model of value creation of transport services based on a globally synergetic approach in the digital economy.

Thus, the authors propose to apply a globally synergetic approach to creating the value of transport services, the essence of which is to focus on the interaction of actors through the active introduction of common digital standards and the use of unified information technologies and concepts in a global aspect. In practice, this will become real thanks to the introduction of a multi-agent system aimed at ensuring the coordination of knowledge, goals and plans, and, accordingly, streamlining the interaction of agents participating in the process of cargo delivery by sea at different levels of management.

A multi-agent system, according to the principle of declarative expression, has the form:

\[ \text{mas} = \{\text{AG, env, INI, ORG}\} \]
where AG – multiple agents;  
env – the environment in which the MAC is located;  
INI – many elements of structuring interactions between agents (languages, protocols, etc.);  
ORG – a set of basic organizational structures corresponding to the specific functions of agents and the relationships between them in shaping the value of a transport service.

Thus, according to the new approach, it seems to the authors that all participants in the process of creating value for transport services, including consumers, represent a single non-deterministic polyergatic business ecosystem of the second and higher order (the order is determined in each case depending on the number of management levels). As a result of its functioning, a synergistic effect arises, expressed in the creation of additional value obtained from the interaction of agents regarding the exchange of information in real time based on innovative developments in the field of information technology: for example, the concept of "e-Navigation" (Figure 1).

The order of interaction between all participants in the logistics chain of cargo delivery by sea can be organized by applying one of the types of interaction of intelligent algorithms: crowd intelligence, swarm intelligence, collective intelligence. It should be noted that an example of using the method of collective interaction – “flock” is considered in detail in work [12], in which the authors substantiate the prospects of this method for maritime transport. Summarizing the obtained results, the authors believe that the use of new scientific achievements in the field of information technology in the economy will allow finding new ways to increase the efficiency of production activities of enterprises, which, of course, will require the transformation of traditional approaches and further development of theoretical provisions of the economics of maritime transport.

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