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## RISK-ORIENTED MANAGEMENT OF PORTS IN THE IMPLEMENTATION OF CONCESSION PROJECTS

**The subject matter** of research in the article is the models and methods of risk management in the process of implementing concession projects within the port activities. **The goal** of the work is to develop a risk management model for the implementation of concession projects in the port to improve the efficiency of port activities and ensure the competitiveness of port services. The following **tasks** are solved in the article: analysis of international and national experience in reforming the port industry, consideration of the essence of the project-oriented approach in port management, determination of the relevance of the implementation of public-private partnership projects on the example of concession projects in the port, analysis of risks arising from the project management of ports within the concession, identification of concession project stakeholders, proposal of a classification model for risk distribution among project stakeholders, prioritization of risks based on the probability of their occurrence, identification and significance of negative consequences, development of a risk assessment model for port production in concession projects. The following **methods** are used: project management methods, failure mode and effects analysis method, risk management theory, quality management methods. The following **results** were obtained: based on analytical research of the world and Ukrainian experience in the operation of transport hubs, it was proved that an effective mechanism for increasing the competitiveness of ports is the implementation of reform principles based on project management methodology. It has been established that the most common type of port activity improvement is the implementation of concession projects. It is noted that in the process of managing a concession project, certain risks arise that require assessment. The stakeholders of the concession project are identified and a classification model for the distribution of risks between them is proposed. A model of risk-based port management in concession projects has been developed based on the failure mode and effects analysis method taking into account the determination of the risk priority rank. **Conclusions.** To increase the competitiveness of ports, it is proposed to develop and implement concession projects in port activities based on the project management methodology, the implementation of which can increase the efficiency of port services. There are risks in the management of port activities within a concession project. It is proposed to distribute them among stakeholders and determine the probabilities of occurrence, identifying risks, assessing the significance of their impact on the quality of port services. Based on the proposed risk assessment model, taking into account the determination of the priority rank, it is shown that the greatest risk is associated with the implementation of customs formalities and the danger of the port water area.

**Keywords:** port; management; project; concession; risk; competitiveness; stakeholder.

### Introduction

The strategic aspect of the country's economic development and the main direction of the dynamic functioning of the state's transport system is the implementation of effective port activities to service foreign trade cargo flows.

To ensure the competitiveness of port services, it is necessary to attract investments to modernize the port infrastructure in order to reduce the time required to handle cargo and vessels.

International experience proves the effectiveness of public-private partnership mechanisms as one of the main areas of improvement of port equipment through the implementation of concession projects in seaports.

The development strategy for Ukrainian seaports also includes attracting investment to prioritize the implementation of concession projects in port operations.

In addition, it is worth noting that the implementation of concession projects is inevitably associated with certain risks. This situation requires the development of a risk management system that will allow identifying certain bifurcation points of the port development investment project, which will be used to track project flexibility and timely effective management decisions.

This area of state transport policy also requires a change in the concepts of managing the system of interaction between concession participants through the use of structured methodological principles of project risk-oriented management.

### Analysis of recent research and publications

If we consider the essence of public-private partnership, it is noted in [1] that it is a balanced system of economic and legal relations between public and

private partners based on the principles of equality, benefit and risk sharing and created to implement strategically important seaport development projects.

The concept of concession can be defined as a model for creating or modernizing certain facilities. In the case of a seaport, concession projects perform the function of purchasing new equipment, improving port infrastructure and operational characteristics at the expense of a private investor [2].

The vast majority of global ports operate on the basis of a land concession. In this case, the port authority plays the role of a landlord, which has land within the port's waters at its disposal. Private operators perform stevedoring duties in the port on the lands and berths obtained under a concession for up to 40 years with the right to extend it [3].

The advantages of attracting private investment in port development are a short preparation period and savings of the state budget or state-owned enterprise for the development of a feasibility study for the project. In this case, the average estimated cost of such development at the preliminary stage is approximately \$300 thousand, and at the final stage, including tender support, it is \$1 million [4].

It is also worthwhile to focus on research, in particular [5], related to the information and communication network of critical infrastructure systems, which can be used to improve the efficiency of processing information related to the establishment of interaction between participants in port activities.

The advantages of state participation in the implementation of concession projects are the possibility of attracting small financial organizations – non-bank institutions that provide microcredit. Within the framework of the project, government agencies develop and discuss with stakeholders the terms of reference for the project preparation. The methodology for developing a decision-making system in the project planning process is proposed in the study [6]. In addition, attention is drawn to scientific research on risk-based enterprise management [7–9] and the developed models of project-oriented management of the modernization of organizations to ensure their investment attractiveness and competitiveness [10, 11]. The concepts of competitiveness and efficient operation of enterprises in the context of sustainable development are considered in [12–14].

The method of managing scenarios for the implementation of a complex infrastructure development project, which can be used to introduce mechanisms

for reforming the port, is presented in [15]. A hybrid method for managing project-oriented organizations is proposed in [16]. Actual models for managing the competencies of stakeholders in investment development projects in the context of digital transformation are presented in [17–19].

Given the analysis, it can be argued that the issues of port concession project management have not been sufficiently studied. Therefore, there is a need to develop scientifically based risk management mechanisms for the implementation of concession projects and a model for risk allocation among stakeholders. This is necessary to form a clear system of interaction between concession project participants and to develop mechanisms to prevent and eliminate risks that negatively affect the port's competitiveness.

**The purpose of the article** is to develop a model of risk management in the process of implementing concession projects in the port to improve the efficiency of port operations and ensure the competitiveness of port services.

#### **Presentation of the main material**

An analysis of international experience in port management suggests that the implementation of concession projects creates a system of interaction between the state and business, while maintaining state control over port activities and ensuring the port's competitiveness by attracting investment in port infrastructure development.

The mechanisms of port management in the leading countries of the world prove the need to attract capital from private investors, which will allow to accelerate cargo handling through the modernization or purchase of advanced port mechanized equipment, allocation of funds for the expansion of warehouse facilities or the creation of new container terminals, depending on the specifics of a particular port (Table 1) [20].

Let's analyze the forms of port management shown in Table 1. It should be noted that:

- Port Authority – provides for the organization of port activities using funds earned by the port;
- State – provides for the financing of port activities at the expense of the state budget;
- Public – funding is provided by regional and municipal governments;
- Private – the costs of port operation are covered by private entrepreneurs;

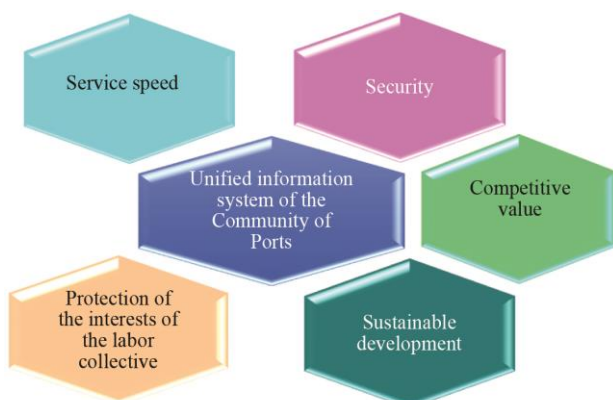
– Concession – the costs of port operations are borne by private companies that have signed a concession agreement and are implementing a concession project in the port.

**Table 1.** Analysis of the international port infrastructure management system [20]

| №  | Country        | Port         | Port infrastructure                  | Port water area infrastructure |
|----|----------------|--------------|--------------------------------------|--------------------------------|
| 1  | Argentina      | Buenos Aires | Port Authority + Private             | Port Authority + Private       |
| 2  | Belgium        | Antwerpen    | Public + Private                     | State                          |
| 3  | United Kingdom | Dover        | Port Authority + Concession          | Port Authority                 |
| 4  | Venezuela      | Guanta       | Port Authority + Private             | Port Authority                 |
| 5  | Greece         | Piraeus      | Port Authority + Public+ Concession  | State                          |
| 6  | Denmark        | Copenhagen   | Port Authority + Private             | Port Authority                 |
| 7  | Ireland        | Dublin       | Port Authority + Concession          | Port Authority                 |
| 8  | Spain          | Barcelona    | Port Authority + Concession          | Port Authority                 |
| 9  | Italy          | Genoa        | Port Authority + Public + Concession | State + Port Authority         |
| 10 | Cyprus         | Limassol     | Port Authority + Concession          | Port Authority                 |
| 11 | China          | Hong Kong    | Private                              | Port Authority                 |
| 12 | Malta          | Valetta      | Port Authority + Concession          | State                          |
| 13 | Mexico         | Tampico      | Port Authority + Private             | Port Authority                 |
| 14 | Netherlands    | Rotterdam    | Port Authority + Private             | State                          |
| 15 | Germany        | Hamburg      | Public + Private                     | State                          |
| 16 | Portugal       | Porto        | Port Authority + Concession          | Port Authority                 |
| 17 | Finland        | Hanko        | Port Authority + Private             | Port Authority                 |
| 18 | France         | Dunkirk      | Port Authority + Public + Concession | State + Port Authority         |
| 19 | Sweden         | Stockholm    | Port Authority + Concession          | Port Authority                 |

The analysis of the information presented in Table 1 confirms the existence of a developed port management network due to the implementation of concession projects. Out of the 19 ports listed, almost half of them provide for the organization of port activities within the framework of concession projects.

There are important elements and indicators of port management that affect the competitiveness of cargo and ship handling services [21] (Fig. 1), in particular, within the framework of concession projects in ports.



**Fig. 1.** Components of a competitive port

With regard to the constituent elements of a competitive port, it is worth noting that one of the

most important is the indicator of security both on the territory of the port and in its waters. It is this indicator that is of fundamental importance for the smooth operation of the port, the reliability of service provision, ensuring proper working conditions for the workforce, as well as meeting the conditions for cargo storage and ship handling. When looking at this indicator in detail, special attention should be paid to the safe operation of maritime infrastructure and the proper performance of port service providers, whose efficiency is crucial for the safe arrival, departure and handling of ships in the port. With regard to loading and unloading operations, it is important to qualify stevedores and operators, who must be specialists in working with modern port mechanization equipment. The processes related to compliance with the rules for handling and storing dangerous goods are also of paramount importance in the port's operation, including the prevention of environmental pollution.

Thus, the following risks arise:

- improper performance of port service providers (risk of delay in vessel or cargo handling);
- insufficient qualification of port personnel (risk of damage to port equipment);
- non-compliance with the rules for the storage and handling of dangerous goods (environmental risk

of pollution of the port water area or territory and surrounding areas);

- hazards of the port infrastructure (risk of injury to port workers);
- hazards of the port area (risks of damage to vessels, loss of cargo, accidents).

The competitiveness of the port is primarily ensured by the efficiency of the services provided in the port [22]. The level of their provision must meet international standards, fully satisfying the needs of customers. An important factor is the procedure for setting prices for certain port services and determining the productivity indicator that will ensure adequate handling of the existing cargo flow. In the case of a concession project with a single port operator, it is advisable to discuss and establish a certain set of parameters that will affect pricing. In this case, the port should constantly review this component, thus ensuring an effective balance between quality and cost characteristics. In this situation, we can identify:

- risk of customer dissatisfaction (risk of poor quality port services);
- risk of uncompetitive prices for port services (risk of inefficient pricing).

As for the speed of cargo and vehicle handling, it also plays an important role in the system of providing efficient port services. This indicator is influenced by the timeliness of various types of state control, including customs and border control. It also takes into account the time required to complete various formalities related to cargo certification and the preparation of the necessary documents for both export cargo and import cargo intended for free circulation in Ukraine. The speed of these procedures most often depends on two parties – the cargo owner (or his representatives, in particular, an employee of a freight forwarding company, customs broker) and the government authority that performs formalities to control the movement of goods and vehicles across the customs border of Ukraine. It is the level of qualification of the freight forwarder and customs broker that affects the timeframe for cargo clearance and its subsequent passage across the border, in particular to the port. Therefore, we can assert that there are risks in this situation:

- incorrect execution of cargo documents;
- late payment of customs duties;
- unreasonable detailed customs control (detailed inspection) of cargo.

If we continue this thesis and focus on the speed of service, one of the main factors that affects this indicator

and can be identified is the availability of the Unified Port Community Information System. It is this system, in particular in the process of implementing a concession project in a port, that can establish a stable connection between all participants in the cargo delivery system – the shipper, the consignee, state control authorities, the administration of ports and transport hubs on other modes of transport (rail, various intermediaries and representatives of the client – freight forwarders, agents, customs brokers, stevedores, talmans, warehouse and terminal workers, carriers, surveyors, insurance companies, and banking institutions. The availability of the aforementioned System will help to reduce the risks of:

- untimely delivery of goods;
- inconsistency of the participants in the cargo handling process and vehicles (vessel, wagon, car).

Taking into account the concept of sustainable development of society, in the process of implementing concession projects in ports, it is necessary to adhere to the established goals approved at the international level for the activities of enterprises. First of all, it is about ensuring the following principles:

- energy efficiency of port operation;
- decent work for port workers and economic growth of the enterprise, region, and the state as a whole
- safe operation of port infrastructure facilities through timely modernization, repair, and replacement of port equipment, taking into account the best innovative practices of the port industry;
- sustainable development of cities and communities adjacent to the port by creating new jobs and financing the development of infrastructure projects of local communities;
- preservation of marine resources by preventing pollution of the port area.

Failure to comply with these principles may result in the following risks

- insufficient energy efficiency of the port;
- unsafe working conditions for port employees;
- unsafe operation of port equipment;
- lack of involvement of advanced technologies and science-intensive solutions in the implementation of port investment development projects;
- insufficient participation in development projects of the communities and territories adjacent to the port;
- pollution of the port's sea area.

Another element of effective management of a port development project is to protect the interests of the labor collective by introducing incentive programs for the best employees, improving working conditions and paying

decent remuneration for the work performed. In this case, we can consider only one risk associated with the presence of an irresponsible employer, which is improper incentives for the labor collective.

Summarizing the above, we emphasize that in the process of implementing a concession project in a port, it is necessary to take into account the above risks associated with the activities of both a private investor and public authorities and other entities actively involved in port investment development projects. And it is precisely under the condition of the above factors, as well as effective investment support for business structures, that it is possible to ensure the competitiveness of port services and increase the volume of cargo flows that will pass through transport hubs.

Let's focus on the organizational aspects of project management of ports under concession, which are approved in Ukraine. In order to become a participant in the tender, which is a prerequisite for the implementation of a concession project in a port, a private business entity must file an official application with the Ministry of Community, Territorial and Infrastructure Development of Ukraine regarding its intention to develop a feasibility study for the project. This document contains information on the terms of the feasibility study and information on the organization that will develop the document. The next step is to conclude an agreement on non-disclosure of confidential information, as well as to provide information about the facility to the company that will develop the feasibility study. This is followed by the process of drafting the document and submitting it to the Ministry of Community, Territorial and Infrastructure Development of Ukraine.

Concession projects in Ukraine are implemented under the "build-operate-transfer" scheme, which is the most common in the world. The European experience of port management proves the existence of other forms of concession, the characteristics of which are shown in Fig. 2 [23].

Ukraine is currently implementing concession projects in the ports of Olvia and Kherson. According to the concession agreements, *QTerminals Olvia* will invest UAH 3.4 billion in the development of Olvia port (UAH 80 million for the development of Mykolaiv infrastructure) and *Risoil-Kherson* invested UAH 300 million in the development of the Kherson port (UAH 18 million for the development of the Kherson city infrastructure).

For Kherson, the plan was primarily to modernize port equipment, mechanize warehouses, and increase the capacity of areas for simultaneous storage of grain cargo by installing additional silos.

However, martial law in Ukraine slowed down all processes in the ports, which caused risks of violating the main terms of the concession projects prepared for implementation.

However, the current difficult situation in the transportation sector does not stop international transport companies from investing in the development of port infrastructure. This trend will have a positive impact on the economy of our country. In particular, the well-known shipping company Moller-Maersk is interested in implementing a container terminal concession project in the port of Chornomorsk. This will create new jobs in wartime, modernize the port infrastructure in line with modern international standards, and ultimately increase the port's competitiveness by expanding cargo and ship handling capabilities.

Let's identify the risks associated with concession projects in the ports under consideration in the current situation of martial law.

First, there is the risk of a reduction in the level of concession payments. According to the stolen agreements, *QTerminals Olvia* is supposed to pay UAH 80 million to the state budget of Ukraine annually, and the investor *Risoil-Kherson* is supposed to pay at least UAH 12 million, including indexation, and 7% of net income as a concession payment.

Secondly, there is a risk of a decrease in cargo transshipment volumes in ports. According to the terms of the concession projects in the port of Olvia, the investor must ensure a minimum annual cargo handling volume of at least 2.55 million tons, and in the port of Kherson, the volume of cargo handling must be at least 1.36 tons by 2030.

Third, there is a risk of a reduction in infrastructure investments that were planned to be directed to ensure the development of nearby cities. In particular, *QTerminals Olvia* was supposed to invest UAH 80 million in Mykolaiv, and *Risoil-Kherson* was supposed to invest UAH 18 million in Kherson.

Fourthly, there is a risk of disruption of construction and modernization of port infrastructure, in particular, the construction of a grain terminal and a universal transshipment complex has been suspended for the port of Olvia. The modernization of mechanized port equipment and grain storage warehouses has been frozen for the port of Kherson.

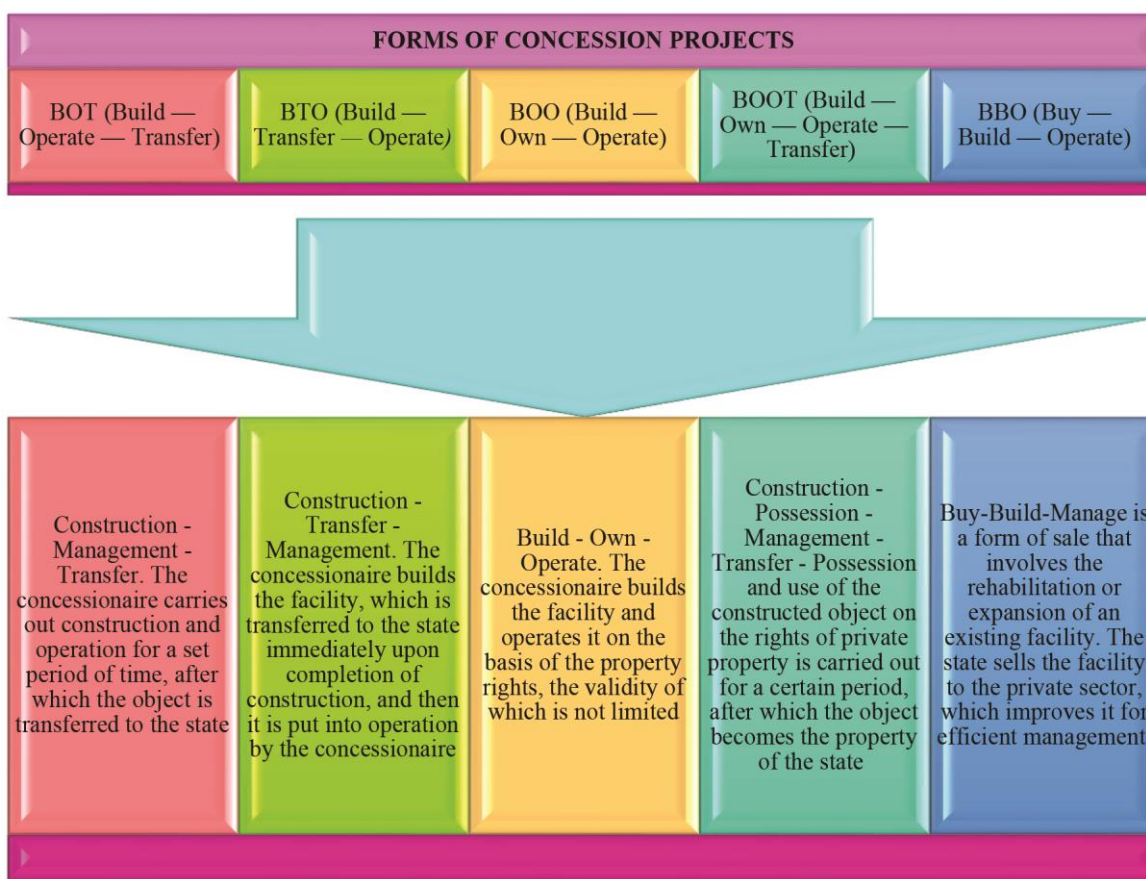


Fig. 2. Forms of concession projects [23]

In addition, the implementation of concession projects in the port also poses a risk of environmental pollution in case of improper loading and unloading operations and handling of ships and cargo, which negatively affects the environment of the region.

Other significant risks that need to be prevented are those related to the activities of the port's labor force. These risks include a decrease in the level of employment at the port and a reduction in wages.

According to the concession project in the port of Olvia, the investor undertook to guarantee the employment of port employees and prevent their dismissal for 6 years, and in the port of Kherson – for 10 years. In this case, there is a financial risk for the port workers associated with the payment of the proper level of wages.

There may also be a legislative risk associated with an imperfect regulatory system for the implementation of concession projects.

Another risk is the time and financial costs of the state. This risk arises due to the long period of preparation of the concession project and the mandatory involvement of an advisor, the cost of which is

approximately UAH 250 million. This risk also interacts with the risk of engaging an incompetent advisor.

The risk of rejection of the private investor's proposals by the state authorities has a significant impact. This may happen if the state transport policy or strategic priorities for port development change.

If the state, in order to attract private investors to implement concession projects in ports, provides insufficient information about port operations or insufficiently uses marketing research resources, there is a risk that stakeholders will not be interested in implementing such projects.

If the financial plan of the project is not approved, there may be a risk of inability to finance the project or the risk of inefficient spending of funds.

During martial law in Ukraine, state budget funds are being redistributed to military needs. At the same time, expenditures, in particular for the development of the port industry, are being reduced. In this situation, there is a risk that there will be no available funds to finance the feasibility study of a concession project in the port. To prevent this risk, international stakeholders are involved, including the Global Infrastructure Facility,

the European Bank for Reconstruction and Development, and the International Finance Corporation.

In order to assess port risks associated with the implementation of concession projects, we propose to use a risk assessment method based on FMEA analysis with the determination of the severity of hazards and analysis of the types and consequences of failures.

This method is used to prioritize the RPN risk, as well as to further calculate the total risk for each stage of port production and identify the most risky stage.

With the help of FMEA analysis in the process of implementing a concession project, the port's activities can be divided into certain stages, assess the severity of the risk consequences and the frequency of its occurrence, identify the cause of the risk, distribute the risk among the concession project stakeholders

(private investor, state, labor collective, third parties – customers, representatives of the cargo owner) and develop effective solutions to eliminate it.

Risk prioritization is carried out on an expert basis. To establish the evaluation criteria for the significance of consequences S, the occurrence of risk O, and the detection of risk D, 12 experts ( $K = 7$ ) were involved. During the expert assessment, the indicators were determined on a 10-point scale (see Table 2) and are presented in Table 3.

The priority risk number RPN is determined based on the product of three evaluation criteria: the significance of the risk consequences, the occurrence of the risk, and the identification of the risk in the process of implementing a concession project in the port.

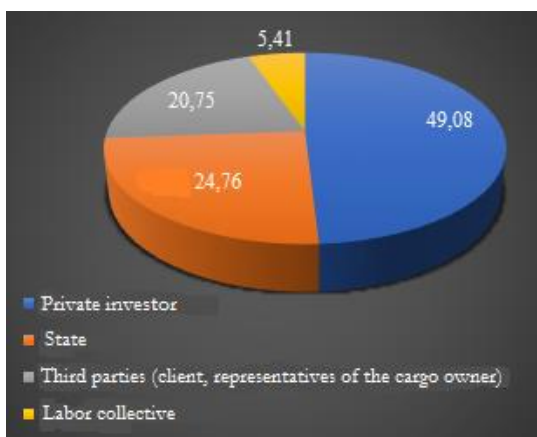
**Table 2.** Scale for determining indicators for FMEA analysis

| Rank | Evaluation criterion significance of consequences, S          |   | Evaluation criterion of risk occurrence, O |  | Evaluation criterion of risk identification, D |   |
|------|---|---|--|--|--|---|
| 10   | High  | The potential risk may cause a threat to the health or life of port workers                                     | Very high                                  | Risk is almost inevitable (more than once a day)               | Impossibility to detect                        | The existence of the risk is not verified and the risk cannot be identified |
| 9    |   | The potential risk leads to a violation of legal regulations or the safe operation of the port                  |  | High   |  |   |
| 8    | The risk leads to a complete loss of quality of port services | Recurring risks (once a week)   | High probability of non-detection          |  | Port service is fully checked for risks        |   |
| 7    | The risk leads to high customer dissatisfaction               | Permanent risks (once a month)  |  |  |  | There is a possibility of detection   |
| 6    | Medium  | The risk leads to a significant loss of quality of port services  | Medium                                     | Frequent risks (1 time per 3–4 months)                         | Very low probability of detection              |   |
| 5    |   | The risk leads to a partial loss of quality of port services  |  | Random risks (1 time per half-year)                            |  | Low probability of detection  |
| 4    | Low   | The risk does not affect the quality of port services, but leads to customer dissatisfaction                    | Medium                                     | Irregular risks (1 time per year)                              | Medium probability of detection                |   |
| 3    |   | The risk does not affect the quality of port services, but may be noticed by the concession project stakeholder |  | Infrequent risks (once every 2–3 years)                        |  | High probability of detection   |
| 2    |   | The risk has no significant consequences and may not be noticed by the concession project stakeholder           |  | Possible occasional risks (1 time in 4–5 years)                | Almost complete detection probability          |   |
| 1    | No significant impact   | Unlikely risks (less than 1 time in 5 years)  | 100% probability of detection              | Port services are checked automatically, no risk can be missed |  |   |

**Table 3.** Classification model for risk assessment of port services in concession projects

|    | Type of risk   | Stakeholder      | S  | O | D  | RPN |
|----|--|------------------|----|---|----|-----|
| 1  | The risk of violation of the terms of vessel or cargo handling   | Private investor | 7  | 7 | 2  | 98  |
| 2  | Environmental risk (the risk of pollution of the water area, port territory and surrounding areas)                 | Private investor | 9  | 2 | 7  | 126 |
| 3  | Risk of unsafe working conditions for port workers   | Private investor | 10 | 3 | 2  | 60  |
| 4  | Risk of damage to vessels  | Private investor | 6  | 4 | 5  | 120 |
| 5  | Risk of cargo loss   | Private investor | 7  | 5 | 4  | 140 |
| 6  | Risk of customer dissatisfaction   | Private investor | 5  | 5 | 7  | 175 |
| 7  | Risk of providing poor quality port services   | Private investor | 8  | 4 | 3  | 96  |
| 8  | Risk of inefficient pricing  | Private investor | 4  | 3 | 3  | 36  |
| 9  | The risk of inconsistency between participants in the cargo and vehicle handling process                           | Private investor | 7  | 6 | 4  | 168 |
| 10 | Risk of insufficient energy efficiency of the port   | Private investor | 3  | 5 | 3  | 45  |
| 11 | Risk of lack of innovative solutions   | Private investor | 1  | 3 | 2  | 6   |
| 12 | Risk of insufficient participation in development projects of the communities and territories adjacent to the port | Private investor | 2  | 2 | 2  | 8   |
| 13 | Risk of inadequate incentives for the labor collective   | Private investor | 5  | 2 | 1  | 10  |
| 14 | Risk of danger to the port area  | State            | 9  | 3 | 7  | 189 |
| 15 | Risk of unreasonable detailed customs control of cargo   | State            | 4  | 9 | 10 | 360 |
| 16 | Risk of accidents  | Third parties    | 9  | 4 | 5  | 180 |
| 17 | Risk of incorrect execution of documents for cargo   | Third parties    | 3  | 7 | 4  | 84  |
| 18 | Risk of untimely payment of customs duties   | Third parties    | 4  | 7 | 7  | 196 |
| 19 | Risk of insufficient qualification of port personnel   | Labor collective | 7  | 4 | 1  | 28  |
| 20 | Risk of damage to port equipment   | Labor collective | 8  | 3 | 3  | 72  |
| 21 | Risk of unsafe operation of port equipment   | Labor collective | 10 | 1 | 2  | 20  |

The distribution of risks of the concession project stakeholders in the organization of cargo delivery through the port is shown in Fig. 3. This figure shows that the most severe consequences of risks are borne by a private investor, who is one of the participants in the port concession project.

**Fig. 3.** Distribution of risks between stakeholders of the concession project

The average arithmetic score of the priority of the  $i$ -th risk is determined as follows:

$$A_i = \frac{RPN_i}{K}, i = 1, \dots, n, \quad (1)$$

where  $RPN_i$  – priority of the  $i$ -th risk ( $i = 1, \dots, n$ );  
 $K$  – is the number of experts.

The weighting factor of the  $i$ -th risk is determined as follows:

$$\gamma_i = \frac{A_i}{\sum_{i=1}^n A_i}, i = 1, \dots, n. \quad (2)$$

The results of the calculations are presented in Table 4.

**Table 4.** The importance of port services risks in concession projects

| n  | RPN <sub>i</sub> | A <sub>i</sub> | γ <sub>i</sub> |
|----|------------------|----------------|----------------|
| 1  | 98               | 14             | 0,044          |
| 2  | 96               | 13,71          | 0,043          |
| 3  | 126              | 18             | 0,057          |
| 4  | 60               | 8,57           | 0,027          |
| 5  | 120              | 17,14          | 0,054          |
| 6  | 140              | 20             | 0,063          |
| 7  | 175              | 25             | 0,079          |
| 8  | 36               | 5,14           | 0,016          |
| 9  | 168              | 24             | 0,076          |
| 10 | 45               | 6,43           | 0,020          |
| 11 | 6                | 0,86           | 0,003          |
| 12 | 8                | 1,14           | 0,004          |
| 13 | 10               | 1,43           | 0,005          |
| 14 | 189              | 27             | 0,085          |
| 15 | 360              | 51,43          | 0,162          |
| 16 | 180              | 25,71          | 0,081          |
| 17 | 84               | 12             | 0,038          |
| 18 | 196              | 28             | 0,088          |
| 19 | 28               | 4              | 0,013          |
| 20 | 72               | 10,29          | 0,032          |
| 21 | 20               | 2,86           | 0,009          |



Most of the risks arising in the process of implementing a concession project in a port cause critical and significant consequences that negatively affect the port's operations and reduce its competitiveness.

In particular, the inability to perform loading and unloading operations on time due to the late provision of cargo or a vehicle leads to a delay in cargo delivery. In other words, it is a case of inconsistency between the participants in port production.

If there is a risk of unreasonable customs formalities, the cargo is also delayed. And it is the risk of a detailed inspection of the cargo before it is unloaded from the container that causes a delay in delivery and possible negative consequences for the condition

of the cargo. This can lead to an unreasonable increase in the cost of delivery from the sender to the recipient. The risk of late payment of customs duties prevents customs from releasing imported goods into free circulation in Ukraine, which will also affect the delivery time and, consequently, the client's costs. After the two customs risks related to detailed inspection and payment of customs duties, the risk of danger to the port area is the third highest priority and is currently very significant given the introduction of martial law in Ukraine.

Fig. 4 shows the significance of risks for each stakeholder in the process of providing services in the port during the implementation of the concession project.

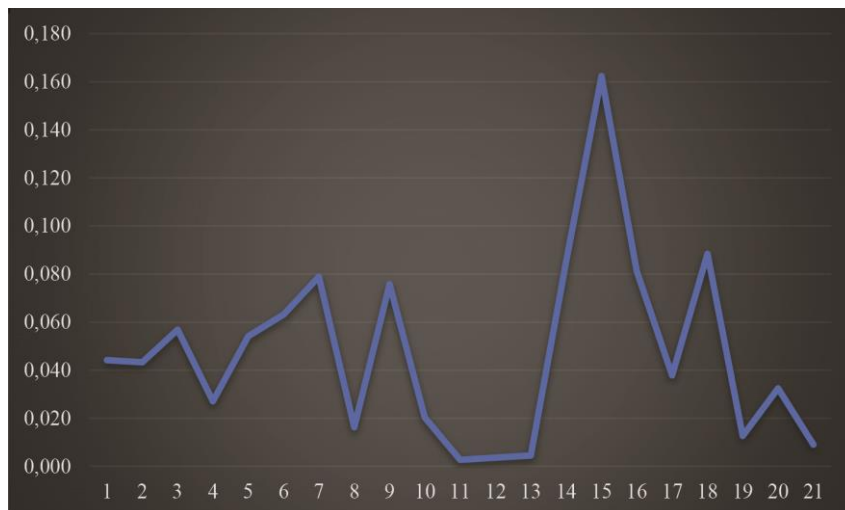


Fig. 4. Significance of risks for concession project stakeholders

The most significant risk for a private investor is the dissatisfaction of customers who receive port services under the concession project. As for the state mechanisms for regulating cargo flows across the customs border, it is the detailed customs inspection that leads to vehicle downtime and cargo delays and, as the analysis shows, is the most significant risk that needs to be mitigated in the first place. With regard to the activities of third parties involved in the port's operations, it is the risk of accidents in the port's waters caused by the carrier that has a significant impact on the port's competitiveness. If we consider the risks of the labor collective, they do not have a significant impact, unlike the risks associated with other stakeholders. However, it is still worth noting the risk of damage to port equipment that may arise due to the lack of qualifications of port workers.

It should be emphasized that it is the consequences of the private investor's risks that prevail over the

severity of the consequences of the risks of public authorities. It should be noted that the high priority of the risk indicates its greatest negative impact on the port's competitiveness and the low probability that the risk will be identified in time during the implementation of the concession project.

## Conclusions

The paper shows that the efficiency of foreign trade operations significantly depends on the state of the cargo delivery system. It is established that it is the port, as a transport hub, that provides management of large cargo flows. An important indicator that affects the efficiency of port activities is the competitiveness of port services.

The analysis of the state's strategic initiatives in the transport sector, as well as the study of the functioning of ports at the international and national levels,

has proved the need to use the methodology of project-oriented port management to ensure the sustainable development of the enterprise. One of the mechanisms of such management is the implementation of concession projects.

The study has shown that in the process of developing and implementing concession projects in the port, numerous risks arise that require appropriate decisions to mitigate the negative impact.

To assess risks in the implementation of concession projects, it is proposed to use a risk-based management approach based on FMEA analysis. The paper identifies the stakeholders of the concession project, which include a private investor, government agencies, third parties related to the client (shipper or consignee), and the labor collective.

The author proposes a classification model for distribution of risks between all participants of a concession project in a port and determines the priority

of risks for each stakeholder and for the process of providing port services in general within the framework of a concession project. It is established that a private investor has the most negative consequences of risks when participating in port concession projects. Based on the establishment of evaluation criteria for the occurrence, identification and significance of the consequences of risks, it is concluded that the risks of detailed customs control, late payment of customs duties and the dangers of the port area have a negative impact with the most severe consequences for the competitiveness of port services.

Further research will focus on developing a model for assessing the indicators that affect the competitiveness of the port, as well as creating a conceptual model for assessing the quality of port services in the implementation of concession projects, taking into account the goals of sustainable development and the principles of *Quality 4.0*.

## References

1. Vlasova, V. (2016), "Analysis and systematization of methodical approaches to determining the amount of concession payments in seaports" ["Analiz ta systematyzatsiia metodychnykh pidkhodiv do vyznachennia rozmiru kontsesiinykh platezhiv u morskyykh portakh"], *Business Inform*, No. 11, P. 149–155.
2. Shakhov, A., Pitera, V., Botsaniuk, V., Sherstiuk, O. (2020), "Mechanisms for Goal Setting and Risk Management of Concession Projects in Seaports", *IEEE 15th International Conference on Computer Sciences and Information Technologies (CSIT)*, P. 185–189, DOI: <https://doi.org/10.1109/CSIT49958.2020.9321963>
3. Shemaev, V., "From Antwerp to Rotterdam: What European experience can give Ukrainian ports" ["Vid Antverpena do Rotterdama: Shcho mozhe daty ukrainskym portam yevropeyskiy dosvid"], available at: [https://cfts.org.ua/articles/ot\\_antverpena\\_do\\_rotterdama\\_cho\\_mozhet\\_dat\\_ukrainskim\\_portam\\_evropeyskiy\\_opyt\\_1150/87511](https://cfts.org.ua/articles/ot_antverpena_do_rotterdama_cho_mozhet_dat_ukrainskim_portam_evropeyskiy_opyt_1150/87511) (last accessed 27.05.2023)
4. Holodnytskyi, O., "Concession vs privatization, private or state initiative? Talk about PPP in ports at UPF-2021", available at: [https://cfts.org.ua/spetsproekty/kontsessiya\\_vs\\_privatizatsiya\\_chastnaya\\_initsiativa\\_ili\\_gosudarstvennaya\\_razgovor\\_o\\_gchp\\_v\\_portakh\\_na\\_upf\\_2021](https://cfts.org.ua/spetsproekty/kontsessiya_vs_privatizatsiya_chastnaya_initsiativa_ili_gosudarstvennaya_razgovor_o_gchp_v_portakh_na_upf_2021) (last accessed 22.05.2023)
5. Kosenko, V., Persyanova, E., Belotskiy, O., Malyeyeva, O. (2017), "Methods of managing traffic distribution in information and communication networks of critical infrastructure systems", *Innovative technologies and scientific solutions for industries*, No. 2 (2), P. 48–55. DOI: <https://doi.org/10.30837/2522-9818.2017.2.048>
6. Kosenko, V. (2018), "Decision support system in planning investment projects", *Innovative technologies and scientific solutions for industries*, No. 4 (6), P. 113–119. DOI: <https://doi.org/10.30837/2522-9818.2018.6.113>
7. Kosenko, V. (2017), "Principles and structure of the methodology of risk-adaptive management of parameters of information and telecommunication networks of critical application systems", *Innovative technologies and scientific solutions for industries*, No. 1 (1), P. 46–52. DOI: <https://doi.org/10.30837/2522-9818.2017.1.046>
8. Shakhov, A., Pitera, V., Sherstyuk, O., Botsaniuk, V., Babayev, I. (2021), "Mechanisms for the effective sharing of risks of seaport concession projects", *Proceedings of the 2nd International Workshop IT Project Management (ITPM 2021)*, Slavsko, Ukraine, February 16–18. CEUR Workshop Proceedings, No. 2851, P. 34–44.
9. Shakhov, A., Kyrylova, O., Sagaydak, O., Pitera, V., Sherstiuk, O. (2022), "Conceptual risk-oriented model of goal setting in the implementation of concession projects in seaports", *Proceedings of the 3rd International Workshop IT Project Management (ITPM 2022)*, Kyiv, Ukraine, August 26. CEUR Workshop Proceedings, No. 3295, P. 149–158.
10. Fedorovich, O., Kosenko, V., Lutai, L., Zamirets, I. (2022), "Methods and models of research of investment attractiveness and competitiveness of project-oriented enterprise in the process of creating innovative high-tech", *Innovative technologies and scientific solutions for industries*, No. 3 (21), P. 51–59. DOI: <https://doi.org/10.30837/ITSSI.2022.21.051>

11. Fedorovich, O., Kosenko, V., Pronchakov, Y. (2020), "Management of the modernization of the enterprise developing in the conditions of the short-term prospect", *Innovative technologies and scientific solutions for industries*, 1(11), P. 90–96. DOI: <https://doi.org/10.30837/2522-9818.2020.11.090>
12. Shakhov, A., Piterska, V., Botsaniuk, V., Sherstiuk, O. (2022), "Competitiveness Assessment of Services in Seaport Concession Projects", *IEEE 17th International Conference on Computer Sciences and Information Technologies (CSIT)*, P. 406–409, DOI: <https://doi.org/10.1109/CSIT56902.2022.10000554>
13. Obradović, V., Todorović, M., Bushuyev, S. (2018), "Sustainability and Agility in Project Management: Contradictory or Complementary?", *IEEE 13th International Scientific and Technical Conference on Computer Sciences and Information Technologies (CSIT)*, Nur-Sultan, Kazakhstan, P. 1–5. DOI: <https://doi.org/10.1109/STC-CSIT.2018.8526666>
14. Bushuyev, S., Murzabekova, S., Khusainova, M., Bushuyeva, N. (2022), "Modelling of Breakthrough Competencies for Managing an Innovation Project", *International Conference on Smart Information Systems and Technologies (SIST)*, P. 1–6. DOI: <https://doi.org/10.1109/SIST54437.2022.9945773>
15. Wiecher, C., Tendyra, P., Wolff, C. (2022), "Scenario-based Requirements Engineering for Complex Smart City Projects", *IEEE European Technology and Engineering Management Summit (E-TEMS)*, Bilbao, Spain, P. 97–102, DOI: <https://doi.org/10.1109/E-TEMS53558.2022.9944441>
16. Domanskyi, V., Wolff, C., Sachenko, A., Badasian, A. (2021), "A Hybrid Method for Managing Agile Team in a Distributed Environment", *11th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS)*, Cracow, Poland, P. 247–251, DOI: <https://doi.org/10.1109/IDAACS53288.2021.9660882>
17. Mikhridinova, N., Wolff, C., Hussein, B. (2021), "Competences Management for the Digital Transformation: Development of an Assessment Method", *11th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS)*, Cracow, Poland, P. 1190–1194, DOI: <https://doi.org/10.1109/IDAACS53288.2021.9660974>
18. Wolff, C., Omar, A., Shildibekov, Y. (2019), "How will we Build Competences for Managing the Digital Transformation?", *10th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS)*, Metz, France, P. 1122–1129, DOI: <https://doi.org/10.1109/IDAACS.2019.8924432>
19. Mikhridinova, N., Wolff, C., Hussein, B. (2019), "Data Acquisition Framework For Competence Profiles Selection and Project Staffing", *10th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS)*, Metz, France, P. 835–838, DOI: <https://doi.org/10.1109/IDAACS.2019.8924379>
20. Maltseva, A., "How to get ports for pennies" ["Yak otrymaty porty za kopiyki"], available at: <https://www.epravda.com.ua/rus/publications/2012/10/23/340788/> (last accessed 22.05.2023)
21. Hacks, O., "Infrastructure breakthrough: how to create a world-class port" ["Infrastrukturnyi proryv: yak stvority port svitovoho rivnia"], available at: [https://biz.ligazakon.net/analytics/202368\\_nfrastrukturniy-proriv-yak-stvoriti-port-svtovogo-rvnya](https://biz.ligazakon.net/analytics/202368_nfrastrukturniy-proriv-yak-stvoriti-port-svtovogo-rvnya) (last accessed 27.05.2023)
22. Shakhov, A., Piterska, V., Sherstiuk, O., Botsaniuk, V. (2020), "Mechanisms for risk-oriented management of concession projects in seaports", *Transport Development*, No. 1(6), P. 30–39. <https://doi.org/10.33082/td.2020.1-6.03>
23. "Concession" ["Kontsesiia"], available at: <https://uk.wikipedia.org/wiki/%D0%9A%D0%BE%D0%BD%D1%86%D0%B5%D1%81%D1%96%D1%8F> (last accessed 27.05.2023)

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## РИЗИКО-ОРІЄНТОВАНЕ УПРАВЛІННЯ ПОРТАМИ В ПРОЦЕСІ РЕАЛІЗАЦІЇ ПРОЄКТІВ КОНЦЕСІЇ

**Предметом** дослідження в статті є моделі й методи управління ризиками під час реалізації концесійних проєктів у межах портової діяльності. **Мета роботи** – розробити модель управління ризиками в процесі реалізації проєктів концесії для підвищення ефективності портової діяльності та забезпечення конкурентоспроможності надання портових послуг. У статті вирішуються такі **завдання**: аналіз міжнародного та національного досвіду реформування портової галузі; розгляд сутності проєктно-орієнтованого підходу в управлінні портом; визначення актуальності реалізації проєктів державно-приватного партнерства на прикладі проєктів концесії в порту; аналіз ризиків, що виникають у процесі проєктного управління портами в межах концесії; ідентифікація стейкхолдерів концесійного проєкту; створення класифікаційної моделі розподілу ризиків між стейкхолдерами проєкту; визначення пріоритетності ризиків на основі оцінних критеріїв їх виникнення, виявлення значущості негативних наслідків; розроблення моделі оцінювання ризиків портового виробництва в межах реалізації проєктів концесії. Використовуються такі **методи**: управління проєктами, аналіз причин і наслідків відмов, управління якістю, теорія управління ризиками. Здобуто такі **результати**. На основі проведення аналітичних досліджень світового й українського досвіду функціонування транспортних вузлів доведено, що ефективним механізмом підвищення конкурентоспроможності портів є реалізація принципів реформування на основі методології управління проєктами. Установлено, що найбільш поширеним видом покращення портової діяльності є реалізація проєктів концесії. Визначено, що в процесі управління концесійним проєктом виникають певні ризики, які потребують оцінки. Ідентифіковано стейкхолдери концесійного проєкту й запропоновано класифікаційну модель розподілу ризиків між ними. Розроблено модель ризико-орієнтованого управління портом у проєктах концесії на основі методу аналізу причин і відмов з урахуванням визначення рангу пріоритетності ризиків. **Висновки**. Для підвищення конкурентоспроможності портів на основі методології управління проєктами пропонується розробляти та впроваджувати в портову діяльність концесійні проєкти, реалізація яких здатна підвищити ефективність портових послуг. В управлінні портовою діяльністю в межах концесійного проєкту з'являються ризики, що запропоновано розподілити між стейкхолдерами та з'ясувати ймовірності виникнення, виявлення ризиків, оцінити значущість їх впливу на якість надання портових послуг. На основі запропонованої моделі оцінювання ризиків у процесі визначення рангу пріоритетності показано, що ризик, пов'язаний із виконанням митних формальностей, і ризик небезпеки акваторії порту мають найтяжчі та найсерйозніші наслідки для системи оброблення вантажів у порту.

**Ключові слова**: порт; управління; проєкт; концесія; ризик; конкурентоспроможність; стейкхолдер.

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