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PUBLIC–PRIVATE PARTNERSHIP AS AN EFFECTIVE TOOL FOR STATE REGULATION OF INNOVATIVE DEVELOPMENT OF TRANSPORT INFRASTRUCTURE

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Introduction. Effective functioning of transport infrastructure is a basic condition for modernization of the Ukrainian economy and improvement of the quality of life of the population. Currently, there are no effective tools and techniques for comprehensively assessing the effectiveness and priority of project implementation within public-private partnership (PPP) models.

The research hypothesis is to find out how public-private partnerships can act as an effective tool for government regulation of innovative development of transport infrastructure.

The aim is to conduct a qualitative and quantitative assessment of the efficiency of the implementation of projects in the field of transport infrastructure using PPP models.

The methodology of the study is the apparatus of system, economic and statistical analysis, construction of mathematical models, with their subsequent computer implementation.

Results: clarified the concept of public-private partnership in the field of transport infrastructure; systematic analysis and classified models of PPP were carried out with identification of their main features; identified the main factors and parameters (financial and economic characteristics of the projects) that determine the effectiveness of PPP in transport infrastructure and proposed algorithm for evaluating the effectiveness of PPP projects; performed research on the ranking of characteristic risks for transport infrastructure projects, performed ranking of characteristic risks; a mathematical model of risk assessment of PPP projects in transport infrastructure has been developed; practical recommendations are given to improve the mechanism for assessing the efficiency and priority of implementation of transport infrastructure development projects based on PPP.

Conclusions: it is proved that ranking and implementation of public-private partnership models on the basis of the developed basic principles (payment, competitiveness, equality of all economic agents in access and in the right of PPP contract negotiation) allows to realize the benefits of a comprehensive PPP mechanism for each of its participants. The practical recommendations of the mechanisms for assessing the risks and priorities of PPP projects in the field of transport infrastructure will improve their implementation by further shaping the overall environment of PPP development, enhancing the support and guarantees of the state and developing a unified concept of PPP mechanism development in Ukraine.

Keywords: public-private partnership; transport infrastructure; innovative development; concession.

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ДЕРЖАВНО-ПРИВАТНЕ ПАРТНЕРСТВО ЯК ЕФЕКТИВНИЙ ІНСТРУМЕНТ ДЕРЖАВНОГО РЕГУЛЮВАННЯ ІННОВАЦІЙНОГО РОЗВИТКУ ТРАНСПОРТНОЇ ІНФРАСТРУКТУРИ

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Вступ. Ефективне функціонування транспортної інфраструктури є основною умовою модернізації економіки України і підвищення якості життя населення. На поточний момент відсутні ефективні інструменти і методики комплексної оцінки ефективності та пріоритетності реалізації проектів в рамках моделей державно-приватного партнерства (ДПП).

Гіпотеза наукового дослідження є з'ясування яким чином державно-приватне партнерство може виступати як ефективний інструмент державного регулювання інноваційного розвитку транспортної інфраструктури.

Метою є проведення якісної і кількісної оцінки ефективності реалізації проектів в області транспортної інфраструктури з використанням моделей ДПП.

Методологією дослідження є апарат системного, економічного і статистичного аналізу, побудови математичних моделей, з їх подальшою комп'ютерною реалізацією.

Результати: уточнено поняття державно-приватного партнерства в галузі транспортної інфраструктури; проведено системний аналіз і класифіковані моделі ДПП з виявленням їх основних ознак; виявлено основні чинники та параметри (фінансово-економічні характеристики проектів), що визначають ефективність ДПП в транспортній інфраструктурі і запропонований алгоритм оцінки ефективності проектів ДПП; виконано дослідження по ранжирування характерних ризиків для проектів транспортної інфраструктури, здійснено ранжування характерних ризиків; розроблена математична модель оцінки ризиків проектів ДПП в транспортної інфраструктури; дані практичні рекомендації щодо вдосконалення механізму оцінки ефективності та пріоритетності реалізації проектів розвитку транспортної інфраструктури на засадах ДПП.

Висновки: доведено, що ранжування та реалізація моделей державно-приватного партнерства на основі розроблених основних принципів (платності, конкурсності, рівності всіх економічних агентів в доступі і в праві узгодження контрактів ДПП) дозволяє реалізувати переваги комплексного механізму ДПП для кожного з його учасників. Запропоновані практичні рекомендації механізмів по оцінці ризиків та пріоритетності проектів ДПП в області транспортної інфраструктури дозволять підвищити ефективність їх реалізації шляхом подальшого формування загального середовища розвитку ДПП, підвищення підтримки і гарантій держави і вироблення єдиної концепції розвитку механізму ДПП в Україні.

Ключові слова: державно-приватне партнерство; транспортна інфраструктура; інноваційний розвиток; концесія.

Formulation of the problem. In the context of limited financial support, attracting private partners and their capabilities is one of the promising areas of transport infrastructure development. Therefore, an important problem for the development of any type of transport is the establishment of effective interaction of public authorities, local self-government and business in the development and regulation of transport infrastructure.

An analysis of recent research and an unresolved part of the problem. The issues of innovative development of transport infrastructure, which are devoted to public-private partnership, are investigated by well-known foreign and domestic scientists: G. Hodge and K. Greve [1], R. Bain [2], G. Fishbein [3], D.J. Delmon [4], A. Quim [5], R. Kucher [6], M. Solodarenko [7], Y. Pashchenko [8], K. Lernichenko [9]. These scholars address such important issues as the management and risk management of public-private partnership projects; substantiation of the choice of winners of the concession tender; road financing schemes etc. All these studies allow us to identify the main aspects and issues that arise in the field of public-private relations, including in the transport sector. Some institutional, organizational and socio-economic aspects of establishing a system of effective relations between public authorities and business, innovative development of transport infrastructure on the basis of public-private partnership remain beyond the attention of scientists and legislators and require consideration and resolution.

The aim is to identify the main areas for improving public-private partnerships to ensure innovative development of transport infrastructure.

Research results. There are several basic models of interaction between government and business in the world. A. Schleifer and T. Frye distinguish three models of interaction between the state and business: "invisible hand", "helping hand", "robbery hand" [10; 11]. According to their theory, these three types of interaction are distinguished by legal environment and administrative regulation. Comparative characteristics of these models of *interaction between power and business are shown in Table 1.*

According to Table 1, when using the "invisible hand" model (the first model), the government is well organized, mostly not corrupt and relatively friendly. Its functions are limited to the provision of essential public goods – such as the protection of contracts, law and order, and some regulation. Resource allocation decisions remain with the private sector. Many Eastern European countries (especially those seeking to join the European Union) are adhering to this model of reform.

In the second model of the "supporting (partnering) hand" (China example), the government plays a more significant role: bureaucrats are often involved in supporting private economic activity. Legislative institutions in this model are of very limited importance. Bureaucrats are corrupt, but corruption is somewhat

limited and organized. An extreme version of this model, the Iron Hand model, exists in some East Asian countries, such as South Korea and Singapore.

Table 1

Models of interaction between the state and business

Models	Legal environment	Administrative regulation
Invisible Hand: Most Eastern European countries	The government does not stand above the law. Contracts are protected by the courts	The government follows legal rules. Regulation is minimal. Corruption is weak
Supporting (Affiliate) Hands: China, South Korea, Singapore	The government stands above the law, using power to help businesses. Contracts are protected by government officials	The government is aggressively assisting some entrepreneurs. Organized corruption
Robbing Hand: Most of the post-Soviet republics	The government stands above the law, using power to get rent. The legal system does not work, contracts are protected by the mafia	Numerous semi-autonomous state institutions carry out predatory regulation. Disorganized corruption

In the third model, the Robbing Hand model, the government is equally interventionist, but much less organized than in the "supporting hand" model. Authorities consist of a large number of relatively independent bureaucrats who pursue their own goals, including bribery.

The analysis shows that the most effective model of interaction between government and business is the "partnership" model, which is based on mutually beneficial exchange of resources. In today's socio-economic context, it is the most acceptable, because it works on the principle "benefit everyone – benefit everyone".

Foreign experience in implementing public-private partnership projects is quite extensive. Thus, according to the European Center of Expertise in Public Private Partnership (PPP), in 2018, nearly 60 PPP projects with a total value of 12 billion euros were implemented in the EU (Figure 1).

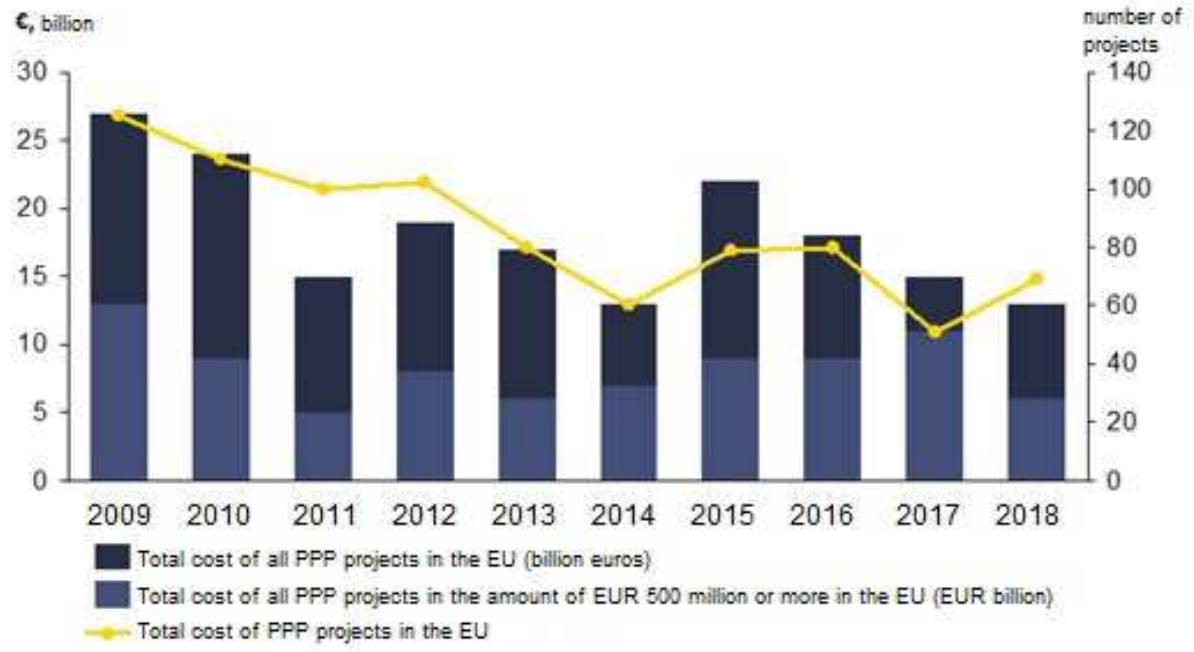
Areas of PPP implementation in developed foreign countries are very diverse (Table 2).

Areas of PPP implementation in different countries:

the financial sector – private insurance and management companies with experience in dealing with consumers in competitive markets are gradually taking a stronger position in the statutory social security and public pension sectors;

electricity – construction of power plants and grids, generation and distribution of electricity;

education and medicine – construction or renovation of hospitals, school buildings and educational establishments, whereby private companies are entitled to commercial development and development of neighboring sites;



Source: [12; 13].

Figure 1. **Number and cost of PPP projects implemented in the EU from 2009 to 2018**

Table 2

Spheres of PPP projects in different countries of the world

Objects / Country	Highways	Railways	Water supply and sewerage. Residential Construction	Waste Management and Recycling	Energy	Health Care	Education	Prison Offices	Defense	Offices
Australia	V	V	V			V	O	V	V	
Belgium	V	O	V	V		V	O			
Canada	V	V	V	V		O	O	V	O	V
Finland	V	O				V	O			V
France	V		V						O	
Germany	V	O	V	O					O	
Greece	V	V				O	O			
Holland	V	O	O							
Ireland	V	O	V	O	V		O	V		V
Italy	O	V	O	V						
Portugal	V	O	V			O			O	
South Africa	V		V			O	O	V		
Spain	V	V	V			V				
United Kingdom	V	V	V	V		V	V	V	V	V
USA	V		V							

Note: O – Announced, V – Agreements.
Source: [12; 13].

municipal services – renewal and construction of new municipal networks (water supply, sewerage, heat and energy supply, garbage collection and waste management);

transport – construction and operation of pipelines, highways and railroads, airport terminals, construction, operation and maintenance of traffic monitoring and control systems and other projects in road, rail, air, urban, pipeline, maritime and river transport, ports and inland lines.

In Ukraine, one of the options for developing a dialogue between public authorities and business is also a public-private partnership. Public-private partnership is a special form of cooperation between the state / territorial community and private business for the implementation of socially significant, complex and costly projects. PPP is widespread in advanced market relations and transition economies, with a corresponding reflection in law. According to the Law of Ukraine "On Public-Private Partnership", public-private partnership is a cooperation between Ukraine, the Autonomous Republic of Crimea, territorial communities represented by the relevant state and local self-government bodies (state partners) and legal entities other than state and municipal enterprises or physical Persons-entrepreneurs (private partners), which is carried out on the basis of the contract in the manner established by legislative acts [16].

The scope of public-private partnership in Ukraine is quite diverse, which is reflected in the Law on Public-Private Partnership: production, transportation and supply of heat and distribution and supply of natural gas; construction and / or operation of motorways, roads, railways, runways at aerodromes, bridges, overpasses, tunnels and subways, seaports and river ports and their infrastructure; engineering; ensuring the functioning of irrigation and drainage systems; waste management other than collection and transportation; generation, distribution and supply of electricity; real estate management. The interaction of the state with private business is not new to Ukraine, although the relevant terminology has been used in recent years – initially in bills ("On public-private partnership" or "On the basic principles of interaction of the state with private partners"), and subsequently – in the Concept of public-private partnerships in housing and communal services and the PPP Law.

PPP provides an opportunity for a private partner to perform the following functions: design; financing; construction; restoration (reconstruction, modernization); operation; search; services and other functions related to the performance of public-private partnership contracts. The law stipulates that PPP is carried out on the basis of a contract. Concession contracts may be concluded within the PPP; joint activity; distribution of products; other contracts.

In Ukraine since the beginning of 90th of XX century. different forms of cooperation between the state / local self-government bodies and private entrepreneurs / business organizations are used, namely:

1) contractual (concession agreement, Law of Ukraine "On concessions", Law of Ukraine "On concessions for construction and operation of highways", agreement / agreement on the distribution of products (Law of Ukraine "On Agreements on the division of production"), lease of state or municipal property (Law of Ukraine "On leasing of state and municipal property"), contract-purchase of sale of privatization object with buyer's investment obligations);

2) organizational and legal: by establishing economic organizations with the participation of the state and / or territorial community, in particular:

- joint stock companies in the process of corporatization or privatization, in which significant participation of the state / territorial community of Ukraine remains;
- business associations with the participation of the state and private entities.

3) by introducing a special (favorable) legal regime for economic entities implementing priority investment and innovation projects.

PPP is a special kind of cooperation between public interest and private interests with certain characteristics:

- the public need for the implementation of a complex and long-term project, for the successful implementation of which the appropriate public interest carrier lacks opportunities;
- Partnership parties: one of the parties – the bearer of public interests – the state, the territorial community, acting in the person of authorized bodies, the other party – the representative (representatives) of private business;
- the partnership (equal) nature of PPP relationships (although at the stage of its establishment the leading role is played by the state / territorial community, determining the feasibility, effectiveness and parameters of such partnership);
- the presence of PPP parties with a common goal and clearly defined public interest of a certain level (national, regional, local), whose dominance in PPP relations is compensated for by a private partner by giving him some support;
- pooling of assets and management experience / skills of PPP participants;
- mediating PPP relations through legal documents, first of all contracts (contracts) concluded within the framework of PPP;
- fairness in risk sharing between PPP parties and their involvement in the use of the results of such partnerships;
- the need to protect economic competition and the interests of the main categories of its participants in order to: prevent or minimize the negative effects

of market monopolization and abuse; ensuring the effective use of the opportunities provided.

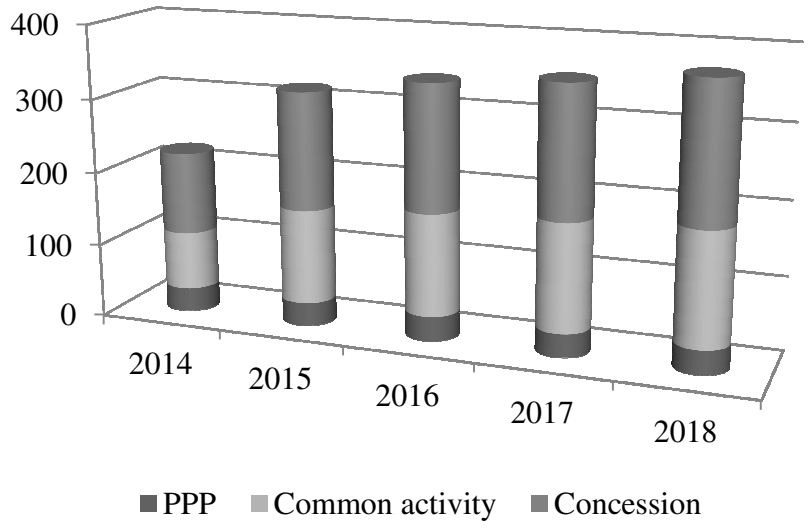
Public-private partnership in Ukraine (as a mechanism of interaction between public authorities and business) has not yet become widespread. This is evidenced by public-private partnership projects in Ukraine, total investment in infrastructure projects based on the use of public-private partnerships during 1993–2018, although they amounted to 14.792 billion USD. The United States, however, accounted for 81% of the telecommunications sector, the development of which is a trend in today's information world. To analyze the state of public-private partnership development in Ukraine, our study used statistical information from the World Bank database. This approach is due to the fact that similar statistics in our country are not taken into account due to the lack of institutional support. The state of implementation of PPP in Ukraine is shown in Table 3 and Figure 2.

Table 3

Main characteristics of public-private partnership projects in Ukraine, 1993–2018

Indicators	Energy	Telecommu-nications	Transportation	Natural Gas	Water and Sewerage	Total	State commitment
Number of projects	30	14	2	11	2	59	1838
Cost of projects	2262	12010	280	38	202	14792	0

Source: Powered by [14; 15].



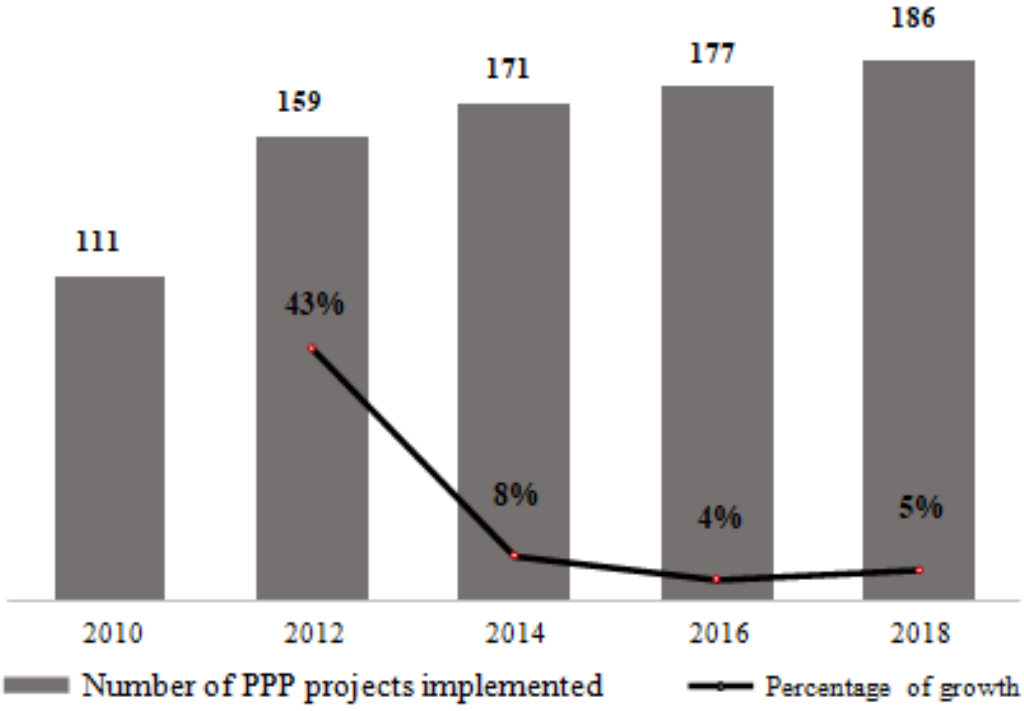
Source: powered by [14; 15].

Figure 2. **Structural analysis of the number of PPP projects implemented in 2014–2018**

On the basis of the analysis of the forms and the main applications, the following are distinguished as integral components for public-private partnership in the transport sector:

- PPP is a contractual form (agreements, contracts, etc.) in which the rights and obligations of each party are clearly recorded;
- the implementation of projects in the field of transport infrastructure implies a common economic benefit for all project participants through the best possible results-oriented interaction at the lowest cost;
- public-private partnership is characterized by increased risks, which implies the need to clearly separate the main risks and costs between its participants.

Quantitative and qualitative analysis of implemented projects on the basis of PPP in the field of infrastructure of the transport industry are shown in Figure 3 and Table 4.



Source: Powered by [14; 15].

Figure 3. **Dynamics of quantitative and percentage growth of projects implemented on the basis of PPP in the field of transport infrastructure, in 2014–2018**

According to the central and local executive authorities in Ukraine, as of January 1, 2019, 186 projects were implemented on the basis of PPP in the field of transport infrastructure (151 concession contracts, 22 joint activity agreements, 13 public-private partnership contracts were concluded). The most

common form of cooperation between the public and private sectors remains a concession, contracts for which accounted for 82.3% of the total number of PPP contracts.

Table 4

PPP mechanisms in the context of transport sectors

Types of PPP	Airports	Share, %	Railway	Share, %	Highway	Share, %	Ports	Share, %
Total	148	100	121	100	744	100	386	100
Concessions, of which:	74	50	66	55	473	64	183	47
BROT	53	36	14	12	345	46	51	13
RLT	5	3	16	13	0	0	30	8
ROT	16	11	36	30	128	17	102	26
Privatization, of which:	19	13	10	8	19	3	21	5
Complete	4	3	2	2	0	0	6	2
Partially	15	10	8	7	19	3	15	4
New construction projects, of them	35	24	33	27	225	30	157	41
BTO	0	0	1	1	0	0	2	1
BOT	31	21	30	25	225	30	141	37
ROT	1	1	1	1	0	0	6	2
Management and lease contracts	20	14	12	10	27	4	25	6

where BROT – construction, rehabilitation, operation, transfer of the object; RLT – renewal, rental, transfer of property; ROT – restoration, operation, transfer of the object; BTO – construction, transfer, operation of the facility; BOT – construction, operation, transfer of the object.
Source: powered by [14; 15].

The data of Table 4 indicate that more than 80% of PPP projects in the field of transport are implemented in accordance with three types of PPP: concessions (47–64%), joint activities (4–14%), new construction projects (24–41%). In particular, for the road sector, the share of PPP subtypes is 94%.

Transport is one of the main areas of application of PPP mechanisms. This is due to the fact that the socio-economic efficiency of transport projects, as a rule, far exceeds the direct financial benefits of the investor and the operator of the transport infrastructure object. Transport infrastructure, even in the presence of user payments, is characterized by high capital intensity and long payback periods. In addition, political, economic and social risks are often present in transport projects, which also reduce their attractiveness to private businesses.

According to the World Bank, the main focus of PPP on transport is the road sector, in particular the construction and operation of toll plots of roads, bridges, tunnels. There are three main types of objects:

1) main highways with high (not less than 20 thousand cars per day) traffic intensity, which when introduced will provide high profitability of the project and its financial attractiveness;

2) the so-called development roads, which are being built to revitalize the economy of individual regions or to link up with natural resources. Such projects are primarily of high economic importance;

3) projects aimed at embroidering the bottlenecks of the road network. Usually these are bridges, tunnels or short missing sections of roads which, after construction, greatly increase the traffic flow. Projects of this type are profitable both economically and financially.

In Mexico, Korea, Indonesia, 100% of the motorways are constructed and operated on a concession basis. More than half of the motorways are in concession in Japan, France, Argentina, Italy, Malaysia, South Africa. PPP is also widely used in the port industry. In the mid-1990s, most major ports in the world embarked on reforms of management systems and the active involvement of private capital, with the development of PPP mechanisms as a general direction. The form and scope of participation of private partners depend on the management model involved in a particular port. The most commonly used are classic concessions and greenfield contracts.

Rail is also a classic area of PPP. Railway systems of many countries of the world, including Ukraine, were created in the late XIX – early XX centuries. on the basis of concessions. The main types of PPP railway projects are:

- management and maintenance of individual sections of the railway network;
- performing a certain type of transportation on a network owned by the state;
- management and maintenance of terminal facilities (stations, freight terminals);
- complex operation of separate sections of railways.

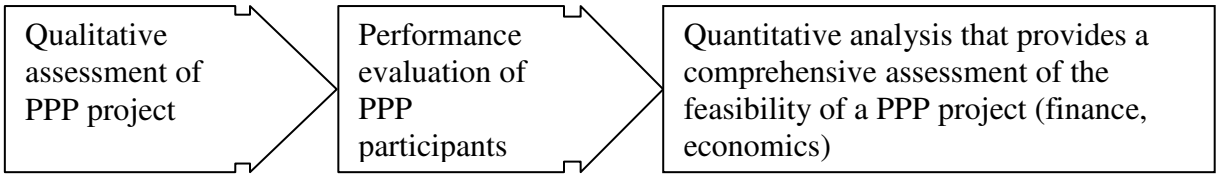
In the airport business, where most projects are cost-effective, private equity is typically active in the construction and operation of airports without partnering with the state. However, in countries where the possibility of privatization of airport facilities is restricted by law, PPPs at airports have developed in recent years. The main types of PPP facilities in the airport business are the construction, modernization, management and maintenance of runways, aerodrome facilities or airport complexes, as well as complex development and management at airports.

Examples of major public-private partnership transport projects include the Eurotunnel, a bridge across the Eresund Strait connecting Denmark and Sweden, and an airport in Hong Kong with a complex of transport approaches to it.

These data prove that concessions and contracts are best suited to attract extra budgetary investments in infrastructure, which is due to the following reasons:

- agreements are of a long-term nature that allows the parties to plan for long periods of time (the state – to plan economic development, to the private partner – to make long-term investments with a high degree of reliability);
- the private partner has sufficient freedom to make managerial and economic decisions, as well as being able to invest in government-guaranteed projects and to obtain stable income over a long period of time;
- only the rights of ownership and use of the state property are transferred to the private partner, and the state has sufficient leverage to influence the private partner in violation of the terms of the agreement;
- the state receives from the private party advanced management methods, as well as the opportunity to apply more efficient and modern technical solutions by the developer and, as a consequence, to improve the quality of services;
- the state partially removes the risks of the functioning of infrastructure facilities;
- the investor is interested in meeting the terms of construction of the objects, since it depends on the return on investment, the concession scheme has incentives to reduce the actual cost of construction.

The following sequence of determination of efficiency of PPP of innovative development of transport infrastructure is offered (Figure 4).



Source: suggested by the author.

Figure 4. **The sequence of determining the effectiveness of transport infrastructure innovation projects based on PPP**

The study identified and classified more than 25 types of risks for PPPs in the area of transport infrastructure in the implementation of projects related to the construction of roads and facilities of the transport complex. The main ways of mitigating risks allow different parties to the project to benefit from more effective project management. For a complete and comprehensive assessment of transport infrastructure projects, a refined risk matrix is proposed (Table 5), which includes the key and most significant types of risks, as well as the parties involved in the project implementation (private investor, government, special fund or state company) among which there is risk sharing.

Table 5

Risk matrix for transport infrastructure projects based on public-private partnerships

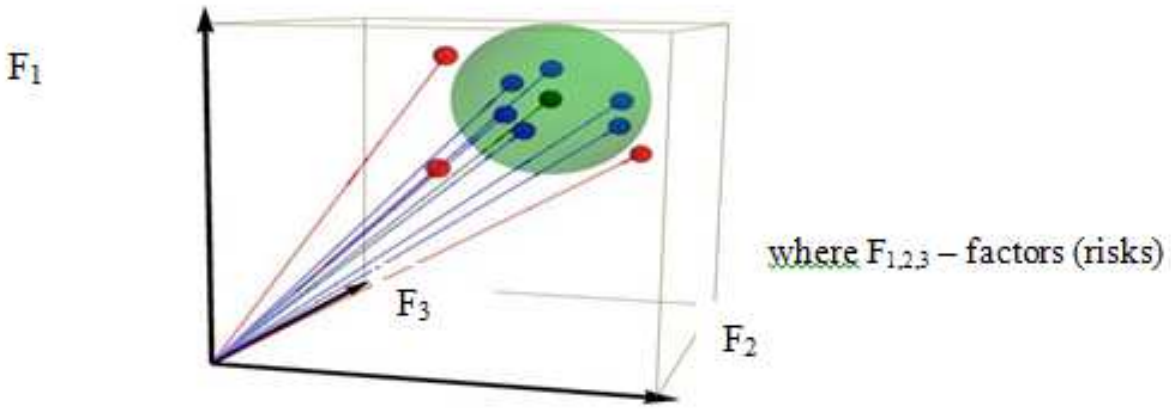
Project risks	Participation in risk identification			
	Private Investor	Regional Government	Municipal Association (United Community)	Special Fund / State-Owned Company
Risk of preparation of the feasibility study of the project; permitting and competition documentation	+	+		+
Political risks		+		+
Risk of sufficiency of own funds	+		+	+
Construction risk (budget overruns, deadlines)	+		+	+
Currency risk during construction and operation	+			+
Inflationary risks during construction and operation		+		
Financing cost risk	+			+
Revenue risk at the operating stage	+	+		+
Risks of operating costs	+			
Quality risks of the services provided	+	+		

Source: substantiated by the author on the basis of [7–9; 14; 15].

It is the hedging of these risks that enables you to select and implement the most effective projects. At all stages of the implementation of PPP projects in the field of transport infrastructure, nine risk groups were identified: financial, political, economic, social, fiscal and monetary, commercial, design and construction risks, business event risk, force majeure. For a more general classification, risks have been segmented into traditional ones that relate to all investment projects, as well as specific ones that arise in those projects where the state is involved. Based on the data of Table 5, a methodology for assessing public-private partnership risks in the implementation of transport infrastructure projects based on the construction of a mathematical model was proposed, and methodological support was provided for conducting an expert survey, a methodology for PPP risk assessment for transport infrastructure objects was developed on the basis of expert survey, as well as a mathematical model that is used to process the results and weigh the risks of PPP. An expert group on PPP infrastructure projects was formed to carry out the analysis of the possible risks. Based on the information received, a rating model for risk assessment of PPP projects was constructed. An expert risk analysis algorithm was proposed, including: determination of the coherence of experts 'opinions on the basis of the

coefficient of concordance, which allows to reject the experts' final estimates; carrying out a differentiated assessment of the level of competence of experts for each type of PPP risk and establishing its limit level acceptable for PPP participants implementing projects in the field of construction of toll roads and infrastructure; risk assessment by experts in terms of the likelihood of a risk event (in units of unit) and the risk of the risk involved in the successful completion of the project.

Methods for processing expert information included three steps: 1) the stage of control of the consistency of individual opinions of experts; 2) the stage of determining the consistency of experts' opinions; 3) the stage of aggregation of opinions of experts – construction of a single, cumulative opinion of experts. After the results of the survey were systematized, a mathematical model was proposed to process the data and weigh the risks of PPP projects with the subsequent assignment of the significance factor of each of them (Figure 5).



Source: Listing of STATISTICA 10.0.

Figure 5. **Illustration of the combination of experts' opinions with the area of the squared radius of estimating the consistency of data in the space of factors**

Figure 5 is a variant of a possible combination of expert testimony is presented with the following data – the number of parameters evaluated – 3 (respectively, the demonstration is carried out in a multidimensional space), the number of experts – 9. In this case, Figure 5: green – sphere of radius σ to find the number of thoughts that fell into the permissible area around the central (weighted) point, shown in dark green, blue shows those points that fell into the σ-sphere, red shows points that are not fall into the σ – sphere. By analyzing the spread of points (the vector value of expert testimony across many factors in the group), those data that significantly deviate from the group's main view were removed.

A preliminary correlation analysis was performed using STATISTICA 10.0. As noted above, the analysis of the consistency of expert opinions was

initially performed by determining the correlation coefficients between the variables representing the risk estimates of PPP projects given by different experts and with the generalized (average) risk value. The calculations were performed on the full field of data (all tables of subfactors, all types of rows / impact), and on separate sections – separately for each table and separately for each impact class. According to the results of the peer review, purified risk groups of PPP projects were formed for further inclusion in the model. Thus, having analyzed the expert data summarized in Table 5, it was possible to reduce the generalized variation of opinion vectors of PPP risk assessors collected by sub-factors and to obtain more accurate values for PPP project risk assessments.

Testing of the research results was carried out on the example of the future construction of the toll highway Lviv-Krakowiec and Lviv-Odesa on the section from Zhashkov to Chervonoznamyanka. The calculation of the financial efficiency of the projects was carried out by using different values of the benefit factor (0.5; 0.6; 0.7; and 0.8), with different operating concessions – 20, 25, 30, 35, 40 years. A comparative analysis and calculation of such project performance indicators as the internal rate of return, net present value of cash flows, discounted and undiscounted payback periods, and project profitability indices were carried out. The testing of the proposed toolkit made it possible to improve the accuracy of forecasting the quantitative values of risk factors and to reduce the possible losses through a more efficient risk sharing among project participants.

Conclusions and suggestions. Implementation of the proposed model of interaction between public authorities and business on the basis of the principle of partnership, the main mechanisms of which should be the mechanisms of public-private partnerships, will improve the comprehensive approach to innovative development of transport infrastructure on the basis of public-private partnership. The recommendations should clearly state the commitments of the parties: the state guarantees to the business the creation of a favorable environment and production necessary for its functioning and development of such public goods as industrial, social and institutional infrastructure; In addition, the business commits itself to paying taxes and reproducing the economic resources used in society for the development of transport.

References

1. Hodge, G., Greve, C. (2005). The Challenge of Public-Private Partnerships: Learning from International Experience. Cheltenham, UK: Edward Elgar. 357 p.

Література

1. Hodge G. The Challenge of Public-Private Partnerships: Learning from International Experience / Graeme Hodge, Carsten Greve. – Cheltenham, UK: Edward Elgar, 2005. – 357 p.

2. Bain, R. (2007). PPP construction risk: international evidence from the roads sector. Proceedings of the European Transport Conference, 17–19 October 2007, Noordwijkerhout, Netherlands. CP. Retrieved from: http://www.robbain.com/ETC%20Paper%20Bain%202007.pdf.

3. Fishbein, G., Babbar, S. (1996). Private Financing of Toll Roads. Demand or Revenue Risk for Transport Projects. RMC Discussion Paper Series, No. 117. 1996. Retrieved from: http://www.worldbank.org/transport/roads/tr_docs/117.pdf.

4. Delmon, D.J. (2010). Gosudarstvenno-chastnoe partnerstvo v infrastrukture: prakticheskoe rukovodstvo dlia organov gosudarstvennoi vlasti [Public-Private Partnership in Infrastructure: A Practical Guide for Public Authorities]. The World Bank Group. 250 p. [in Russian].

5. Quium, A. (2011). Guidebook on Public-Private Partnership in Infrastructure. UNESCAP, Bangkok, January 2011. 76 p.

6. Kucher, R. (2014). Derzhavno-pryvatne partnerstvo yak innovatsiinyi instrument rozvytku prykordonnykh terytorii [Public-Private Partnership as an Innovative Border Territorial Development Tool]. Sotsialno-ekonomichni problemy suchasnoho periodu Ukrainy [Socio-economic Problems of the Modern Period of Ukraine], No. 4, P. 256–262 [in Ukrainian].

7. Solodarenko, M. (2015). Rozvytok derzhavno-pryvatnoho partnerstva: zarubizhnyi dosvid [Development of public-private partnership: foreign experience]. Naukovyi visnyk Uzhhorodskoho universytetu [Scientific Bulletin of Uzhgorod University], No. 2, P. 91–96 [in Ukrainian].

8. Pashchenko, Yu. (2015). Derzhavno-pryvatne partnerstvo u rozvytku transportnoi infrastruktury [Public-Private Partnership in Transport Infrastructure Development]. Molodyi uchenyi [Young Scientist], No. 5, P. 54–56 [in Ukrainian].

9. Lernichenko, K. (2015). Vprovadzhennia derzhavno-pryvatnoho partnerstva u haluz miskoho richkovoho transportu [Implementation of public-private partnership in the field of urban

2. Bain R. PPP construction risk: international evidence from the roads sector / Robert Bain // Proceedings of the European Transport Conference, 17–19 October 2007, Noordwijkerhout, Netherlands. CP. – Retrieved from: http://www.robbain.com/ETC%20Paper%20Bain%202007.pdf.

3. Fishbein G. Private Financing of Toll Roads. Demand or Revenue Risk for Transport Projects / Gregory Fishbein, Suman Babbar // RMC Discussion Paper Series. – 1996. – No. 117. Retrieved from: http://www.worldbank.org/transport/roads/tr_docs/117.pdf.

4. Делмон Д. Дж. Государственно-частное партнерство в инфраструктуре: практическое руководство для органов государственной власти / Д. Дж. Делмон. – The World Bank Group, 2010. – 250 с.

5. Quium A. Guidebook on Public-Private Partnership in Infrastructure / A. Quium. – UNESCAP, Bangkok, January 2011. – 76 p.

6. Кучер Р. Державно-приватне партнерство як інноваційний інструмент розвитку прикордонних територій / Р. Кучер // Соціально-економічні проблеми сучасного періоду України. – 2014. – № 4. – С. 256–262.

7. Солодаренко М. Розвиток державно-приватного партнерства: зарубіжний досвід / М. Солодаренко // Науковий вісник Ужгородського університету. – 2015. – № 2. – С. 91–96.

8. Пащенко Ю. Державно-приватне партнерство у розвитку транспортної інфраструктури / Ю. Пащенко // Молодий учений. – 2015. – № 5. – С. 54–56.

9. Лерніченко К. Впровадження державно-приватного партнерства у галузь міського річкового транспорту / К. Лерніченко // Науковий вісник

river transport]. Naukovyi visnyk Khersonskoho derzhavnoho universytetu [Scientific Bulletin of the Kherson State University], No. 11, P. 71–74 [in Ukrainian].
10. Frye, T., Shleifer, A. (1997). The Invisible Hand and the Grabbing Hand. American Economic Review. May 1997. Retrieved from: http://papers.nber.org/papers/W5856.pdf
11. Shleifer, A., Vishny, R. (1999). The Grabbing Hand: Government Pa-thologies and their Cures. Harvard University Press. Retrieved from: http://ez2www.com/go.php3?site=book&go=0674358872
12. European Investment bank (2019). Review of the European PPP Market in 2018. 12 p.
13. European Investment bank (2018). Review of the European PPP Market in 2017. 11 p.
14. Derzhavno-pryvatne partnerstvo yak mekhanizm realizatsii novoi rehionalnoi polityky: mozhlyvosti zastosuvannia ta praktychni aspekty pidhotovky i vprovadzhennia investytsiinykh proektiv: Zvit za pidtrymky prohramy U-LEAD z Yevropoiu, Yevropeiskoho Soiuzu ta yoho derzhav-chleniv Danii, Estonii, Nimechchyny, Polshchi ta Shvetsii [Public-Private Partnership as a Mechanism for Implementing New Regional Policy: Possibilities and Practical Aspects of Preparation and Implementation of Investment Projects: Report with the support of the U-LEAD program with Europe, the European Union and its Member States of Denmark, Estonia, Germany, Poland and Sweden]. Kyiv, 2019. 108 p. Retrieved from: http://rdpa.regionet.org.ua/images/129/PPP_report_U-LEAD_30_10_2017.pdf [in Ukrainian].
15. Baza danykh pro uchast pryvatnykh partneriv v infrastrukturnykh proektakh [Database on participation of private partners in infrastructure projects]. Retrieved from: http://ppi.worldbank.org/explore/ppi_exploreCountry.aspx?countryId=97 [in Ukrainian].
16. Pro derzhavno-pryvatne partnerstvo: Zakon Ukrainy vid 1.07.2010 № 2404-VI [On Public-Private Partnership: Law of Ukraine of 1.07.2010 No. 2404-VI]. Vidomosti Verkhovnoi Rady Ukrainy, No. 40, Article 524 [in Ukrainian].

Херсонського державного університету. – 2015. – № 11. – С. 71–74.

10. Frye T. The Invisible Hand and the Grabbing Hand / T. Frye, A. Shleifer // American Economic Review. – 1997. – May. – Retrieved from: http://papers.nber.org/papers/W5856.pdf.
11. Shleifer A. The Grabbing Hand: Government Pa-thologies and their Cures / A. Shleifer, R. Vishny // Harvard University Press, – 1999. – Retrieved from: http://ez2www.com/go.php3?site=book&go=0674358872.
12. Review of the European PPP Market in 2018 // European Investment bank. – 2019. – 12 p.
13. Review of the European PPP Market in 2017 // European Investment bank. – 2018. – 11 p.
14. Державно-приватне партнерство як механізм реалізації нової регіональної політики: можливості застосування та практичні аспекти підготовки і впровадження інвестиційних проектів: Звіт за підтримки програми U-LEAD з Європою, Європейського Союзу та його держав-членів Данії, Естонії, Німеччини, Польщі та Швеції [Електронний ресурс]. – Київ, 2019. – 108 с. – Режим доступу: http://rdpa.regionet.org.ua/images/129/PPP_report_U-LEAD_30_10_2017.pdf.

15. База даних про участь приватних партнерів в інфраструктурних проектах [Електронний ресурс]. – Режим доступу: http://ppi.worldbank.org/explore/ppi_exploreCountry.aspx?countryId=97.
16. Про державно-приватне партнерство: Закон України від 1.07.2010 № 2404-VI // Відомості Верховної Ради України. – 2010. – № 40. – Ст. 524.