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Use of Public-Private Partnership Resources in Construction

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Abstract

This study considers the use of resources in public-private partnerships (PPP) in the construction sector, providing a comprehensive analysis of the complexities and challenges inherent in these collaborations. Based on qualitative research design, the study dwells on the multifaceted nature of PPPs by sourcing data from a range of scientific publications indexed in the Russian Science Citation Index and international databases, such as Web of Science and Scopus. Through thematic and content analysis, the authors identify critical themes and patterns concerning resource management, risk allocation, and the economic impact of PPP projects. While PPPs offer substantial benefits, including effective risk sharing and optimized resource use, they face significant challenges, such as financial instability, project delays, and unmet performance expectations. The study highlights the need for strategic planning and risk management to improve the efficiency of PPP projects in the construction industry. Ethical considerations are rigorously maintained, ensuring participant confidentiality and informed consent. This study contributes significantly to the theoretical understanding and practical implementation of PPPs in construction, providing valuable insights for policymakers, industry practitioners, and academic researchers. These insights aim to optimize resource use and mitigate risks associated with large-scale infrastructure projects, ultimately promoting more sustainable and resilient construction practices.

Keywords: Analysis, Competences, Construction, Public-Private Partnership, Resources.

Introduction

Being a special mechanism of economic relations between the state and business, public-private partnership (PPP) allows businesses to develop through long-term agreements, risk sharing, full or partial financing, development of new markets (1), increased revenue, etc. (2). PPPs are comprehensive tools of public infrastructure, contributing to the development of business and society (3).

PPPs in many countries (4), including Russia, are an effective way to create and modernize socio-economic infrastructure and strategic planning (5, 6). However, due to their multifaceted nature and complexity, PPP projects are often at risk (7). Risks arise during the implementation of projects and are associated with financial losses, additional costs, disrupted project deadlines, failure to achieve desired results, etc.

The problems and difficulties of using PPP resources in construction serve as the main prerequisites for this study.

The research hypothesis is that if the PPP mechanism is used, the sustainable development of business and the state will increase ensuring the country's economic security.

The scientific novelty of this study is determined by the thorough clarification and substantiation of the problems associated with using public-private partnership (PPP) resources in construction projects. By identifying and addressing specific challenges and obstacles in the application of PPP resources, this research contributes new insights and perspectives to the field. It delves into the intricacies of PPP implementation, examining the factors that influence the success and efficiency of these partnerships in construction. Through detailed analysis and empirical evidence, the study not only highlights existing issues but also provides substantiated solutions and recommendations, thereby advancing the academic discourse and offering practical guidance for future PPP initiatives. This focused exploration and its implications for improving the utilization of PPP resources underscore the innovative and original nature of the research. In recent years, the integration of sustainable

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building methods and green financing approaches has become a significant trend in the development and execution of public-private partnership (PPP) projects, especially in the construction sector. Sustainable building methods, such as the use of eco-friendly materials, energy-efficient systems, and low-carbon construction processes, are gaining importance due to increased environmental awareness and stricter regulatory requirements.

Green financing has emerged as a pivotal mechanism for funding these initiatives, promoting investments that contribute to environmental sustainability. It includes financial instruments like green bonds and sustainability-linked loans, which are specifically designed to support projects that deliver measurable environmental benefits.

The incorporation of green financing into PPPs not only facilitates the completion of infrastructure projects but also aligns with global efforts toward reducing carbon footprints and achieving the United Nations Sustainable Development Goals (SDGs). In Russia, as in many other countries, there is a growing need for PPP frameworks to adapt to these trends by ensuring that projects are both economically viable and environmentally responsible. By leveraging green financing, PPPs can encourage the adoption of cutting-edge technologies that minimize resource consumption, reduce emissions, and enhance the long-term sustainability of infrastructure.

The controversial nature of PPPs has been traced by scholars for more than a decade. Researchers (8) considers the limitations and possibilities of the federal law on PPPs. Researcher (9) discusses the effectiveness of PPP projects. Researchers (10, 11) consider risk management in projects. The issues of entrepreneurship and state support are reflected in the scientific works (12-14).

The operational effectiveness of public-private partnerships (PPPs) is strongly influenced by the geopolitical background in which they function. In industrialized nations, PPPs tend to benefit from robust legislative frameworks, well-developed financial systems, and strong governance structures. These countries typically have long-established legal precedents supporting PPP projects, allowing for smoother risk allocation and better resource management.

In contrast, developing nations often face more complex challenges, including weaker institutional frameworks, political instability, and a higher dependency on international financial aid or foreign investments. The legislative frameworks governing PPPs in these regions are often underdeveloped or fragmented, resulting in increased risks for both public and private stakeholders.

The distinct legislative and governance differences between industrialized and developing nations necessitate tailored approaches to managing PPPs. It is important to consider these geopolitical factors when designing and implementing PPP projects to ensure that they are adapted to the local regulatory and socio-economic environment

The study sets several tasks in terms of using PPP resources in construction. The main tasks are to analyze and evaluate emerging risks and vectors for the development and expansion of projects.

The article aims to analyze the use of PPP resources in the construction sector and make recommendations to improve the efficiency of PPP projects through strategic planning and robust risk management.

Methodology

Research Design

This article uses qualitative research design to study the use of PPP resources in the construction sector. The qualitative approach is selected for its effectiveness in understanding the complex and multifaceted nature of PPPs, allowing for in-depth analysis of participants' experiences, perspectives, and contexts influencing the implementation processes and results of PPP projects.

Data Collection

The data for this study were collected and carefully selected from various scientific sources to ensure a comprehensive understanding of the topic. The sources for this study were meticulously gathered from a combination of reputable and comprehensive databases. These included the Russian Science Citation Index (RSCI), which provides extensive coverage of scholarly publications and research output within Russia, ensuring a robust collection of locally relevant studies and data. Additionally, international databases such as Web of Science and Scopus were utilized. Web of Science is renowned for its broad multidisciplinary content and high-quality, peer-

reviewed research articles, while Scopus offers an expansive abstract and citation database, covering a wide range of academic disciplines and providing access to numerous journals, conference proceedings, and patents. By sourcing data from these distinguished platforms, the study ensured a diverse and well-rounded compilation of scholarly materials, enhancing the depth and reliability of the research findings. The selection of sources was guided by specific keywords relevant to the research goals, including "public-private partnership", "construction", "resource utilization", "risk management", and "economic development".

Sampling: The sampling strategy employed in this study was purposive sampling, a method chosen to identify and select cases that are particularly information-rich concerning the use of public-private partnership (PPP) resources in construction projects. This approach allowed the researchers to focus on specific instances that could provide deep insights and valuable data about the effectiveness and outcomes of PPP implementation. By targeting these information-rich cases, the study aimed to gather comprehensive and detailed evidence, ensuring that the selected examples would significantly contribute to understanding the broader implications and practical applications of PPP resources in the construction sector. This method ensured that the study focused on the most relevant and impactful examples of PPPs in construction.

The selection of public-private partnership (PPP) initiatives for analysis in this study was guided by a set of well-defined criteria aimed at ensuring the inclusion of diverse, representative cases that reflect both the successes and challenges of PPP implementation in the construction sector. The selection of PPP initiatives in this study was based on several key criteria. Projects with significant financial commitments from both public and private entities were prioritized, focusing particularly on the construction sector, including infrastructure development such as transportation, public utilities, and large-scale urban projects. To capture the diverse regional dynamics of PPP implementation, initiatives from various parts of Russia, both industrialized and developing regions, were included. The study analyzed both mature projects and those still in progress, allowing for a comparative look at different stages of PPP development. Special attention was also given to projects incorporating sustainable building practices or innovative financing models, reflecting emerging trends in the field.

Data Analysis: The collected data were analyzed using a combination of thematic and content analysis. Thematic analysis was used to identify and examine recurring themes and patterns in the qualitative data, and content analysis facilitated the systematic coding and categorization of texts. This dual approach allowed for a better understanding of the issues surrounding resource utilization in PPPs.

Results and Discussion

Modern society cannot develop without economic relations aimed to improve the mechanism of interaction between partners. One of the effective global mechanisms is PPP. PPPs based on medium- and long-term cooperation help achieve socially significant tasks. The evolution of PPP forms dates to the 1990s (Figure 1).

The PPP mechanism ensures interaction between government bodies and the business community and promotes the mutual development of both parties. Such tools help to consider the interests of stakeholders.

Using private experience and capital-intensive financing, the PPP mechanism aims at effective partnerships in various sectors of the country and the world. The main features of the partnership in question are presented in Figure 2.

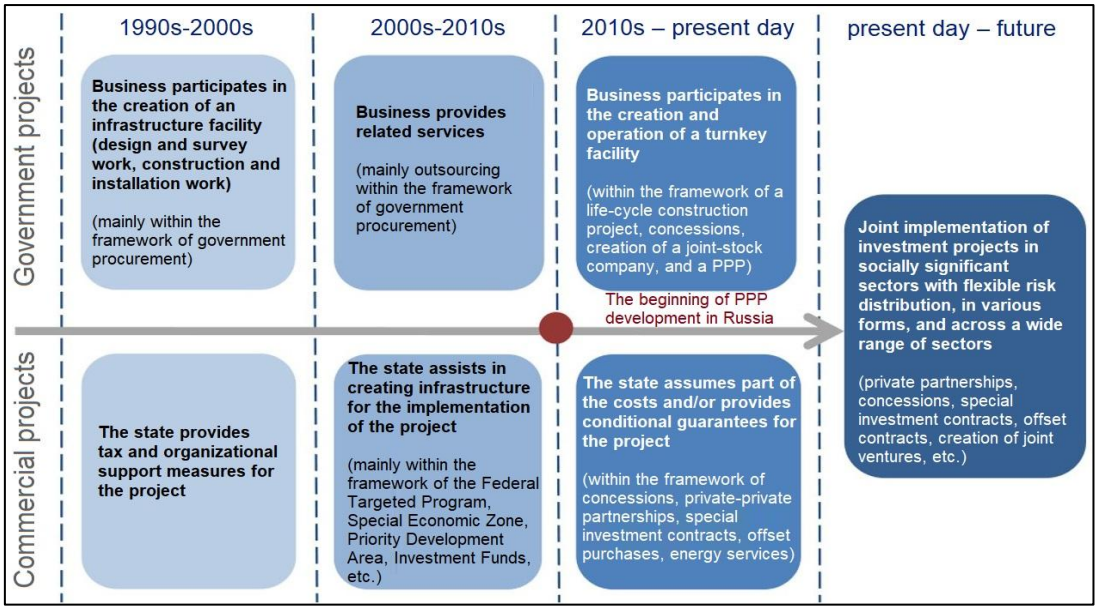

Figure 1: Evolution of PPP Forms (15)

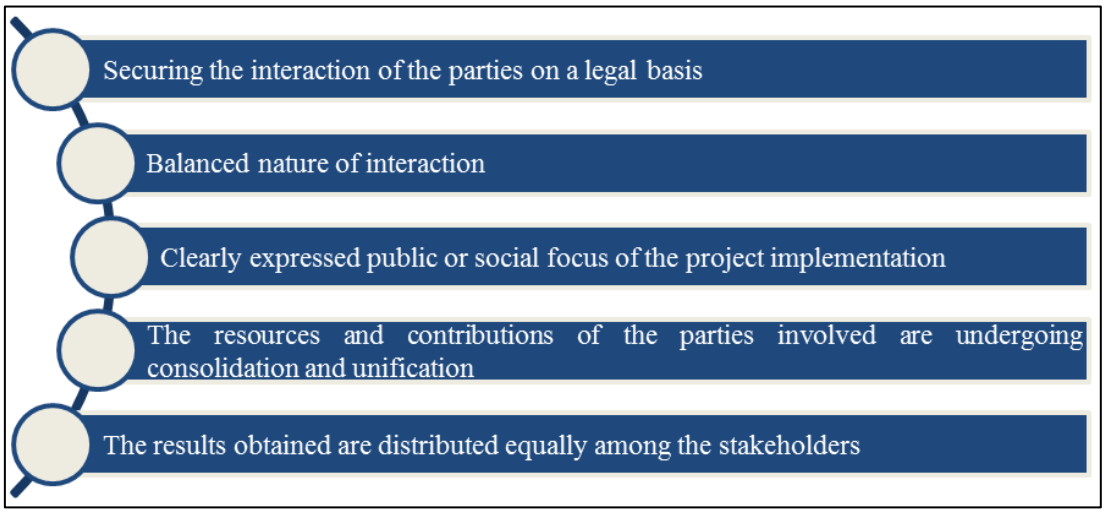

Figure 2: Features of PPP Partnerships (16)

The PPP mechanism is actively used in the construction sector facilitating the implementation of large, complex infrastructure and industrial projects. PPPs help to share operational and financial risks with other project participants. This approach is provided for by this model and ensures economic sustainability and broad focus. In 2019, five major PPP agreements were implemented in Russia (Figure 3).

As shown in Figure 3, the largest volumes of PPP investments are directed towards the construction sector, particularly in transport infrastructure. This investment contributes to a comprehensive plan aimed at enhancing spatial connectivity, thereby improving access to various regions. Increased infrastructure development fosters population mobility, which in turn promotes the growth of tourism sectors and supports local economies. Additionally, these projects facilitate the expansion of cargo transport volumes and reduce delivery times, optimizing logistics efficiency. Significant emphasis is also placed on advancing multimodal logistics solutions, promoting digitalization, and encouraging low-carbon developments within the industry. The adoption of innovative technologies is accelerated through these investments, ensuring that the infrastructure remains adaptable and competitive in the long term.

Great attention is paid to key performance indicators (12) and business support (13).

The dynamics of PPP investment volumes over several years are shown in Figure 4.

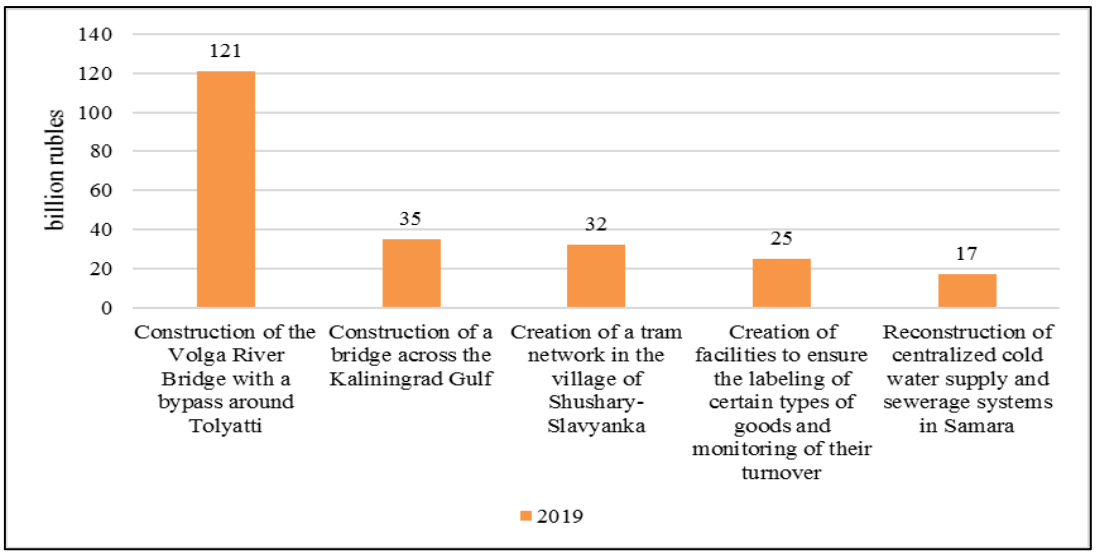

Figure 3: The Largest PPP Agreements in Terms of Investment Volumes in Russia in 2019 (17)

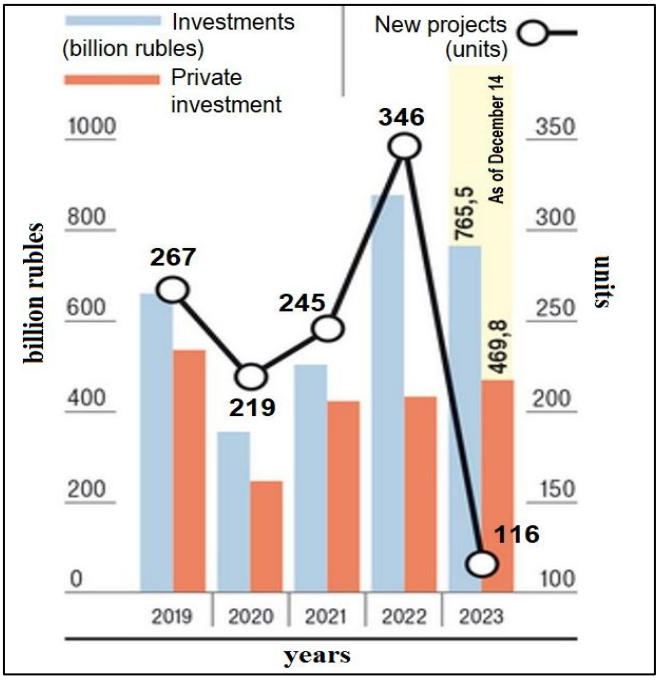

Figure 4: Volumes of PPP Investments in Russia (18)

The five-year dynamics of PPP investment volumes show a decline. Compared to 2022, the number of projects decreased by three times in 2023. However, the decline was not so significant in value terms. The positive dynamics are that projects got more investments, the volume of which amounted to 6.8 billion rubles, which is 4.3 billion rubles more than in 2022. The main projects are related to the implementation of capital-intensive projects with state support for construction, recycling of solid municipal waste, development of urban transport, etc.

The volumes of investments in PPP projects of the constituent entities of the Russian Federation in 2020 are shown in Figure 5.

In 2020, the Moscow Region, the Republic of Sakha (Yakutia), Moscow, the Tula Region, and Saint Petersburg received the largest volume of PPP investments. Concessions are mainly related to improving transport infrastructure and social and public utilities that have a long validity period. Figure 6 demonstrates the lower limits of validity (upper limit intervals are not included).

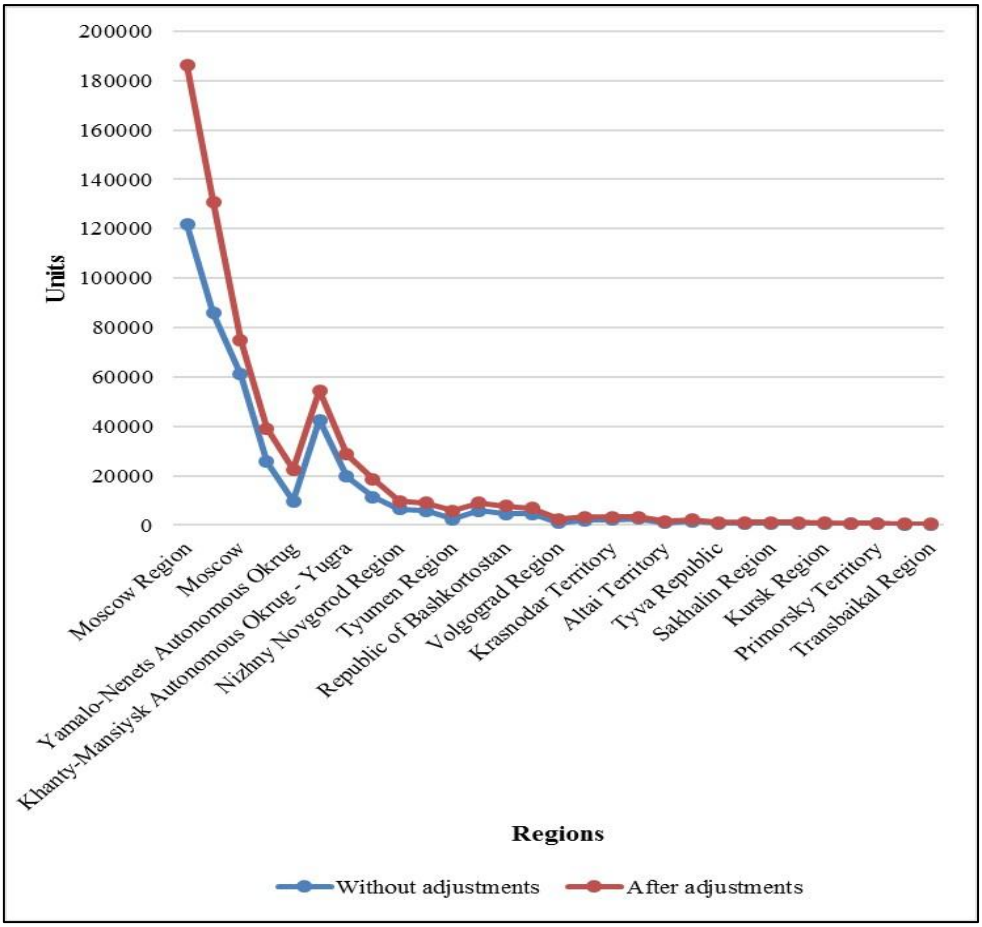

Figure 5: Volumes of Investments in PPP Projects of the Constituent Entities of the Russian Federation in 2020 (19, 20)

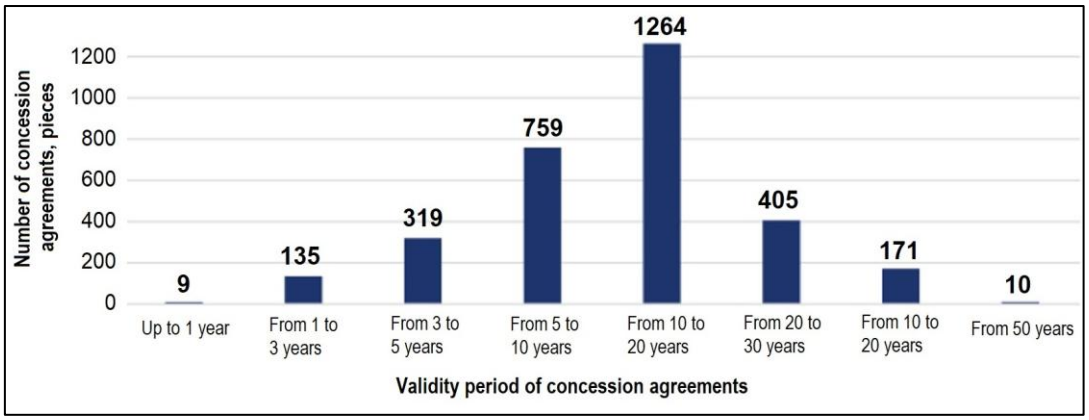

Figure 6: Validity Periods of Concessions for the Distribution of Investments in 2020 (17)

Extra-budgetary funds play a crucial role as the primary financial source, contributing to over 70% of the total investment volumes. This significant reliance on extra-budgetary funds underscores their importance in the economic framework.

In 2020, the investment volumes prioritized the enhancement of transport infrastructure and the development of social and military sectors. This strategic focus, as illustrated in Table 1, was largely driven by the prevailing economic crisis and the imposition of sanctions against Russia. The economic challenges and external pressures necessitated targeted investments in these critical areas to ensure stability and growth.

Table 1: Volumes of Investments in Concession Projects in 2020, Million Rubles (17)

Project name	Region of implementation	Total investment volume*, billion rubles
Transport		
Construction of the Solntsevo – Butovo – Vidnoe – Lytkarino – Tomilino – Kraskovo – Zheleznodorozhny highway	Moscow Region	113
Construction of a bridge across the Lena River near Yakutsk	Republic of Sakha (Yakutia)	83
Construction of the second Severomuysk railway tunnel	Republic of Buryatia	68
Creation of infrastructure facilities of a multifunctional cargo area in the seaport of Poronaysk	Sakhalin Region	33
Reconstruction of Levashovo airport	Saint Petersburg	7
Creation of a system of weight and dimension control on federal highways	Russian Federation	5
Social sphere		
Reconstruction of the ice arena in Omsk	Omsk Region	12
Reconstruction of the G.K. Ordzhonikidze sanatorium in Kislovodsk	Stavropol Territory	6,5
Military sphere		
Creation of a production and logistics complex of the Russian Ministry of Defense in Vladivostok	Primorsky Territory	26
Creation of a production and logistics complex of the Russian Ministry of Defense in Novosibirsk	Novosibirsk Region	26
Creation of a production and logistics complex of the Russian Ministry of Defense in Khabarovsk	Khabarovsk Territory	26
Creation of a production and logistics complex of the Russian Ministry of Defense in Yekaterinburg	Sverdlovsk Region	22
Creation of a production and logistics complex of the Russian Ministry of Defense in Kaliningrad	Kaliningrad Region	18

Moreover, in 2020, the Ministry of Economic Development of the Russian Federation took a proactive step by drafting a federal law titled "On Amending Certain Legislative Acts of the Russian Federation to Improve Public-Private Partnership Mechanisms." This legislative initiative aimed to refine and enhance the mechanisms of public-private partnerships (PPPs), thereby fostering greater collaboration between the government and private sector in addressing infrastructural and economic needs. The proposed amendments were intended to streamline processes, improve efficiency, and attract more private investment into public projects, ultimately contributing to the country's economic resilience and development.

In 2021, concession and PPP tenders increased by 33% compared to 2020. Projects were distributed unevenly between levels: 38 projects were implemented at the federal level, 505 projects at the regional level, and 3,105 projects at the municipal level. Private investments were distributed as follows: 974.7 billion rubles at the federal level, 1,957 million rubles at the regional level, and 669 million rubles at the municipal level. However, PPP market indicators experienced stagnation in Russia in 2021.

"In 2021, we managed to overcome the 'budgetary shoulder' in regional and municipal PPP projects due to the established mechanisms of federal support for PPP projects by regions and municipalities" (21).

In accordance with past researches (22, 23), which allows the allocation of subsSidies for the creation of social infrastructure for economic growth

centers in the Far East under concession agreements with terms of 10 years, Far Eastern Concessions were launched, facilitating long-term investments for the development of business infrastructure. Figure 7 shows the volumes of investments in PPP projects of the constituent entities of the Russian Federation in 2021 (million rubles).

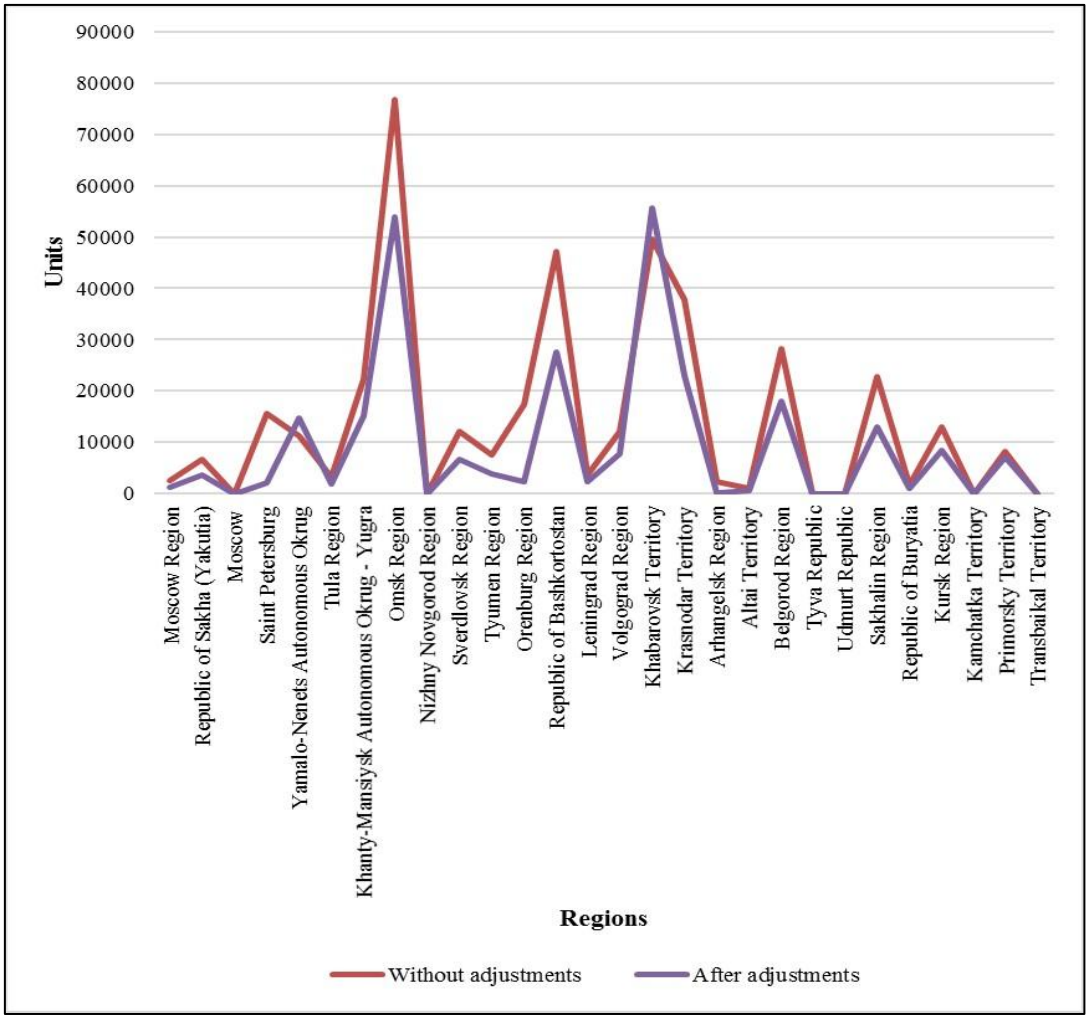

Figure 7: Volumes of Investments in PPP Projects of the Constituent Entities of the Russian Federation in 2021 (19)

Under the DOM.RF Infrastructure Project Financing Program, funds were allocated for the development of social infrastructure, healthcare facilities, roads, housing, and communal services, among other areas. Additionally, the Russian Environmental Operator's solid municipal waste management initiative involved issuing green bonds, which secured funding for projects exceeding 100 billion rubles. The fight against the COVID-19 pandemic required the creation of high-quality infrastructure. "During this period, the online module of IRIIS (a unified digital system) was developed and launched. The module ensured the work of all participants in the IRIIS assessment in a single digital space, which allowed a convenient transition to the assessment of projects posted on the platform" (21). The volumes of investments in PPP projects of the constituent entities of the Russian Federation in 2022 (million rubles) are shown in Figure 8.

During this period, a positive outlook emerged in the social sector, primarily due to the modernization of medical, sports, and educational facilities, which are crucial for the sustainable development of the country. A total of thirty-four projects were successfully implemented across various regions of Russia, including the Republic of Sakha (Yakutia), Yamalo-Nenets Autonomous Okrug, Republic of Buryatia, Samara Region, and Nizhny Novgorod Region, among others.

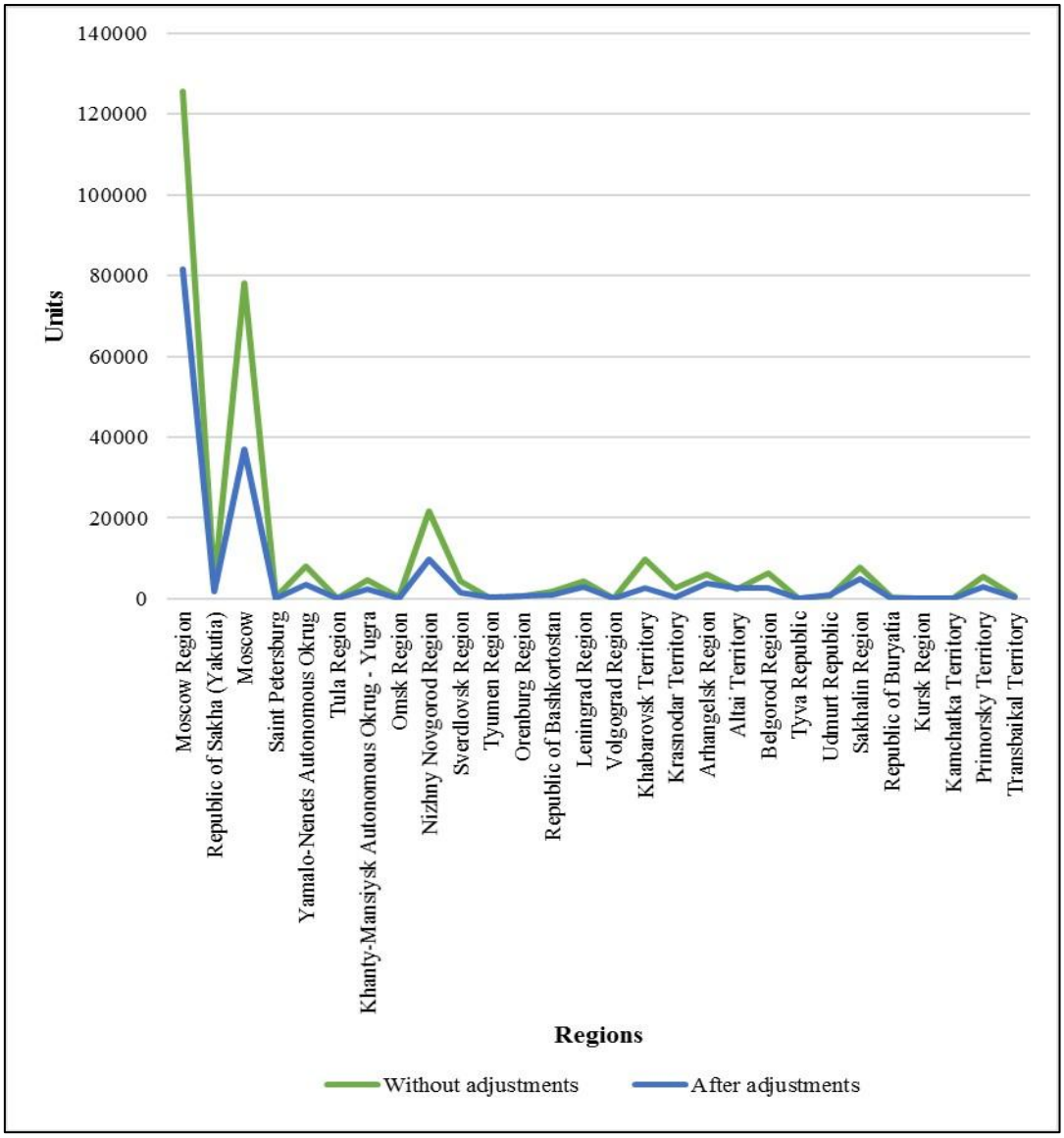

Figure 8: Volumes of Investments in PPP Projects of the Constituent Entities of the Russian Federation in 2022 (19)

As the modernization of critical infrastructure continues, the importance of integrating sustainability principles into public-private partnerships (PPPs) has become increasingly clear. Sustainable PPPs prioritize the use of environmentally responsible materials, energy-efficient technologies, and practices that reduce the carbon footprint of construction activities. This approach ensures that infrastructure projects not only meet current needs but also contribute to long-term environmental resilience.

In 2022, the imposition of restrictions on budget participation significantly boosted the dynamics of private investment volumes. This shift led to an increase in private sector involvement, which positively influenced the number of projects undertaken at federal, regional, and municipal levels. The distribution and specifics of these projects are illustrated in Figure 9, highlighting the extensive reach and impact of private investments across different administrative levels.

In 2023, 55 projects with state support were implemented, the cost of which amounted to 586.9 billion rubles. The projects highlight their primary task of ensuring interaction between the environment and society, determining the socio-ecological and economic balance (24-27). As these projects aim to balance environmental, social, and economic factors, the role of sustainability becomes a key focus in public-private partnership (PPP) initiatives. Sustainable development in PPP projects is not only about meeting present needs but also ensuring that future generations benefit from resilient and eco-friendly infrastructure. In

recent years, sustainability has increasingly been integrated into PPP frameworks, especially in sectors like construction, energy, and transportation.

The relevance and severity of issues related to the interaction between the state and business are typical in many countries. Long-term investments in PPPs across the world are significant. The volumes of infrastructure investments of current and projected global significance are represented by long-term dynamics in Figure 10.

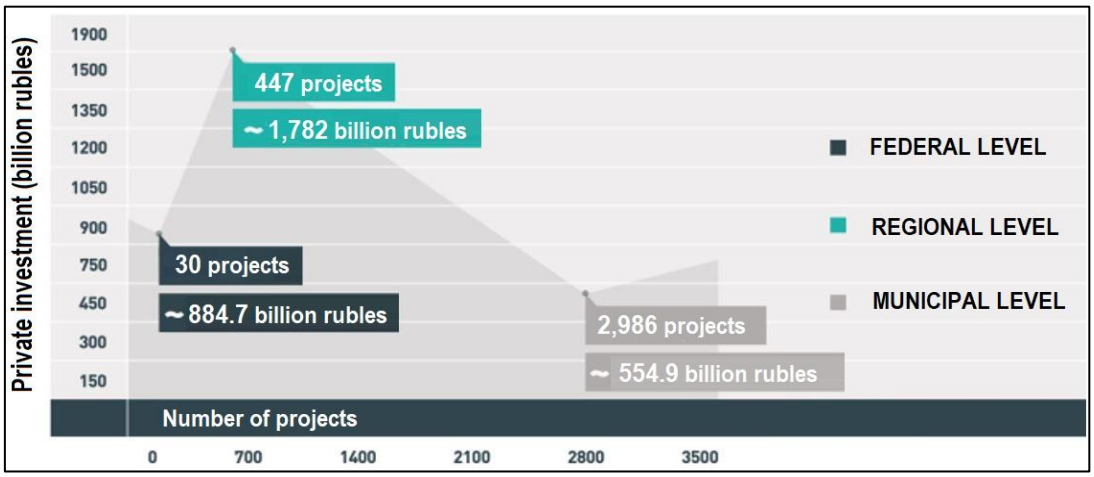

Figure 9: Number of Projects at the Federal, Regional and Municipal Levels (18)

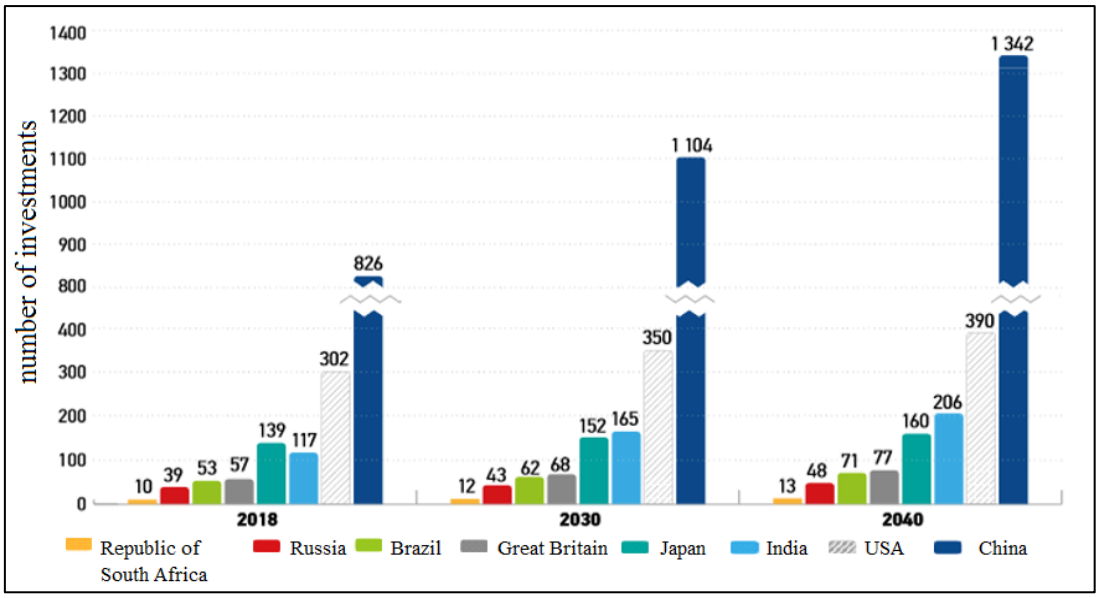

Figure 10: Global Dynamics of Infrastructure Investments from 2018 to 2040 (18)

As can be seen from Figure 10, the leader in this sphere is China, followed by the USA, India, and Japan. Russia ranks seventh, which causes several problems and tasks in terms of concessions and PPPs.

The PPP model is attractive, but it is subject to change due to several factors. These include the significant volume of investments required, the long-term nature of concession policies, and the number of participants involved in each project. As these factors evolve, they can influence the overall structure and execution of PPP initiatives, requiring flexibility and adaptability from both public and private entities.

When implementing PPP, risk factors should be analyzed (28, 29). The risks arising during the implementation of PPP are presented in Figure 11.

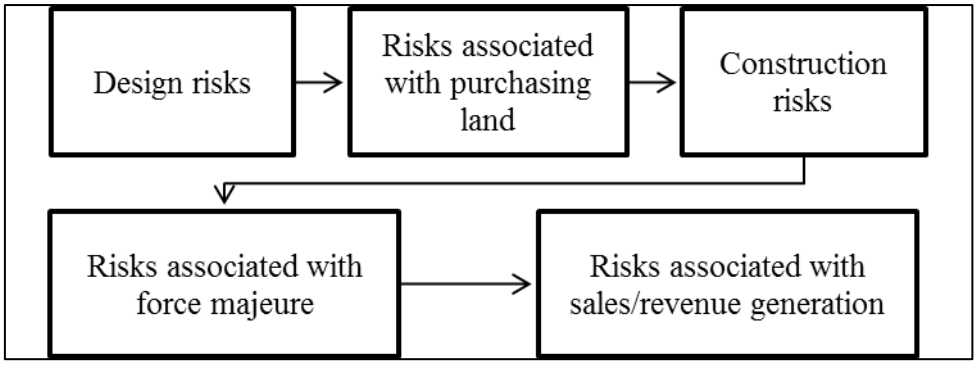

Figure 11: Risks Arising During the PPP Implementation

Risk management is the main task of PPP participants. The satisfaction of interests of all the parties involved and risk distribution is possible through project financing agreements. It is necessary to improve the regulatory framework and increase the transparency of conditions for participants, namely business and the state. Our analysis of the use of PPP resources in construction confirms the importance of all aspects of this process.

While public-private partnership (PPP) projects are often analyzed for their immediate impact on infrastructure development, it is equally important to consider their long-term effects on communities and economies. The success of PPPs goes beyond the completion of construction projects - it extends to the social and economic outcomes they create over time.

One of the most significant long-term effects of PPP building projects is the improvement of public services and infrastructure, which directly enhances the quality of life for local communities. For instance, transport infrastructure developed through PPPs can boost regional connectivity, reduce travel times, and increase access to essential services such as healthcare and education. PPP projects can stimulate local economies by creating jobs during both the construction and operational phases. Additionally, they often attract further private investment by improving the business environment. In the long term, well-executed PPP projects also contribute to fiscal stability by relieving the public sector of large upfront costs and spreading financial risks over time. This allows governments to allocate resources to other critical areas, such as education, healthcare, and social welfare. Furthermore, by involving private entities, governments can tap into expertise and innovation that might not be available through traditional public sector projects, ensuring that the infrastructure is built to last and can meet future demands. However, the long-term effects are not always positive. Poorly managed PPPs can lead to increased costs for users if the private partner prioritizes profitability over accessibility. Additionally, if risks are not adequately managed, communities may suffer from delays, cost overruns, or underperforming infrastructure. Therefore, it is crucial to implement strong governance frameworks and transparent monitoring systems to ensure that the long-term benefits of PPP projects are realized.

Conclusion

It is impossible to ensure the comprehensive development of public infrastructure without long-term interaction between the state and business. Businesses see prospects for the subsequent operation of the created facilities and/or their technical maintenance. PPP effectiveness is also determined by the possibility of attracting private investment and providing certain VAT benefits to concessionaires.

The PPP mechanism allows to create a healthy strategic partnership with the private sector while ensuring a rational combination of free competition under state regulation and strengthening the security of the socio-ecological sphere of the economy.

International experience in the application of the PPP mechanism stipulates the need for a clear legislative and legal framework, and strict budget discipline in the implementation of PPP projects. Various interaction schemes will ensure successful and effective competition between participants in this process. The "construction-operation-transfer" scheme protects the interest of businesses in the project and provides them with guarantees for long-term interaction.

The PPP mechanism and concession schemes allow to quickly cope with the tasks of improving road infrastructure, housing and communal services, healthcare, construction, etc., compensating for regional economic imbalances by minimizing state financial participation.

Abbreviations

PPP: Public-Private Partnership, RSCI: Russian Science Citation Index.

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Author Contributions

Aleksander Petrov: Conceptualization, methodology, project administration, writing—original draft preparation.

Anna Loseva: Data curation, formal analysis, validation, visualization, and writing—review and editing.

Lyubov Melnikova: Investigation, resources, supervision, and writing—review & editing.

Olga Antonova: Software, formal analysis, investigation, and writing—review & editing.

Conflict of Interest

Authors have no conflict of interest to declare.

Ethics Approval

Not applicable.

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