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Business Leadership in the Construction Industry: The Role of Public-Private Interaction and Price, Investment, Labor, and Institutional Determinants of Development

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Abstract: *The article is devoted to analyzing the role of business leadership and public-private interaction in shaping the development trajectories of Ukraine's construction industry. The purpose of the study is to develop and test an integrated analytical framework that combines econometric modeling, a Business Leadership Index (BLI), and scenario forecasting to identify key determinants of sectoral growth. The methodological basis includes a multifactor regression model (price, investment, labor, and institutional variables), the construction of the Business Leadership Index for leading companies, regional clustering of construction activity, and scenario forecasting based on a 5D model (Demand, Development, Delivery, Digitalization, Durability). Model verification using back-testing on 2018–2021 data showed deviations within only 7–9 %, confirming its reliability, while forward-testing provided forecast estimates up to 2028. The results demonstrated that strategic companies with a high level of innovation, ESG compliance, and participation in public-private projects act as catalysts of recovery, whereas regional asymmetries require differentiated policy measures. A comparison with Central and Eastern European countries revealed Ukraine's excessive dependence on state financing (>35 % versus 12–18 % in EU countries), highlighting the need to activate private capital. The scientific novelty of the study lies in combining index-based and scenario approaches, while its practical significance is determined by the possibility of applying the findings in public policy, corporate strategies, and international reconstruction support programs.*

Keywords: business leadership, Business Leadership Index, construction industry, econometric modeling, 5D model, regional clustering, institutional determinants, public-private partnership, scenario forecasting, sustainable development.
JEL Classification: C53, E22, L74.

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INTRODUCTION

The Ukrainian construction industry has traditionally played a system-forming role in the national economy, as it determines the pace of infrastructure recovery and modernization, generates a significant share of the gross domestic product, creates jobs, and stimulates the development of related sectors. Its importance has become particularly evident during the war, amid large-scale destruction of housing stock, transport networks, and industrial facilities. Today, the efficiency of the construction sector affects not only economic growth but also the quality of life for citizens, the return of internally displaced persons, the speed of restoring social infrastructure, and the confidence of international partners in Ukraine's investment climate.

At the same time, the sector is experiencing high turbulence. On the one hand, existing government support programs ("YeOselya", infrastructure projects, and the reconstruction of critical facilities) create preconditions for revitalization. On the other hand, rising prices for construction materials, shortages of skilled labor, uncertainty in accessing financing, and war-related risks pose serious constraints for developers. Logistics disruptions and high inflation further complicate the planning and implementation of long-term projects. Thus, the current dynamics of the sector are characterized by a combination of strong recovery potential and numerous systemic challenges.

Under these conditions, the issue of effective management mechanisms becomes particularly important. One of them is public-private interaction, which includes joint project financing, public-private partnerships, targeted credit programs, and coordination between government authorities and business structures. International experience (from Central and Eastern Europe, the Balkans, and Asia) demonstrates that only through partnerships between the state, businesses, and international donors can rapid infrastructure reconstruction and increased economic resilience be achieved. Ukraine can adapt these approaches to its own institutional conditions and security risks. Another crucial factor is business leadership. Leading companies can act as catalysts of sectoral transformation, as they not only implement large-scale projects but also set quality standards, introduce digital management technologies (BIM, 5D modeling), develop human capital, and actively participate in professional associations and public discussions. During the reconstruction period, strategically oriented developers can accelerate the transmission of government incentives into real investment flows, reducing time lags between decision-making and project implementation. Thus, business leaders are not merely market participants but co-creators of institutional development mechanisms.

Scientific interest in the intersection of business leadership and public-private collaboration in the construction sector is steadily increasing. International studies emphasize the need to align government strategies with private investments, apply innovative management models, and account for resilience and sustainability factors. At the same time, in the Ukrainian academic discourse, the integration of leadership and institutional mechanisms in the reconstruction sector remains underexplored. The need for systemic recovery of the economy and the construction industry is underscored in contemporary studies (Larin, 2023; Marchenko, 2024; Mazaraki, 2023). Most existing works describe statistical dynamics or evaluate the effectiveness of individual programs, but lack comprehensive research combining economic, managerial, and technological dimensions.

The distinctiveness of this article lies in its dual focus: on the one hand, analyzing the economic determinants of construction industry development (price factors, investment activity, labor supply), and on the other, studying the role of business leaders and public-private interaction as mechanisms for accelerating reconstruction. The scientific novelty consists in the attempt to systematically integrate institutional and managerial aspects into the analysis of the construction sector, presenting it not only as an economic but also as a socio-managerial phenomenon.

Therefore, the relevance of this study is determined by the need to: identify the key factors shaping the development of the construction industry in the post-war period; analyze the role of business leadership as a driver of government incentives and a catalyst of innovation; and assess the potential of public-private interaction in shaping sustainable reconstruction trajectories.

LITERATURE REVIEW

The construction industry has traditionally been regarded as one of the key drivers of economic growth, particularly during phases of post-crisis recovery. International research confirms the multiplier effect of investment in construction and infrastructure, which not only directly generates employment but also stimulates the development of related industries, fosters innovation, and modernizes regional economies (McKinsey Global Institute, 2020; World Bank, 2021). For Ukraine, this aspect is of special importance, as the reconstruction of infrastructure after wartime destruction is a fundamental condition for economic stabilization and social resilience. The study of international experience (Barakat, 2009; UN-Habitat, 2014) shows that construction has not only direct economic but also socio-political effects, as it creates new jobs,

strengthens local communities, and facilitates the return of populations to affected regions. Consequently, in many countries that have experienced armed conflicts or large-scale natural disasters, the construction sector has been viewed as a key starting point for economic transformation. However, the multiplier effect of investment alone does not guarantee sustainable development. The institutional environment, which determines the quality of construction sector governance, plays a decisive role.

The institutional dimension of construction governance is addressed in works that focus on the roles of regulatory frameworks, decentralisation mechanisms, budget financing, and public participation (Topazly, 2025). The effectiveness of construction programs is determined not so much by the scale of funding as by the quality of institutional mechanisms that ensure transparency, accountability, and trust among stakeholders. Western scholars emphasize that business leadership practices often serve as catalysts of institutional change. Porter (1990) and Bass and Riggio (2006) highlight the importance of leadership in shaping competitive advantages and disseminating innovative practices. In turn, the concept of "institutional entrepreneurship" (Kaklauskas et al., 2018) views companies as agents of change capable of influencing the institutional environment. This is particularly relevant for Ukraine, where state institutions do not always demonstrate sufficient effectiveness, and business structures often assume the role of drivers of modernization. At the same time, even with an adequate regulatory framework, the state alone is rarely capable of ensuring large-scale reconstruction investments, which brings to the forefront the issue of public-private interaction.

A public-private partnership (PPP) is recognised worldwide as a key mechanism for infrastructure recovery following crises. Studies by Osei-Kyei and Chan (2015) and Hodge and Greve (2007, 2017) demonstrate that the critical success factors of PPP projects include a sound regulatory framework, clear risk allocation, high levels of trust, and transparent procedures. In the Balkan region, which rebuilt infrastructure after armed conflicts, PPP facilitated rapid investment mobilization and high-quality project implementation, but a lack of institutional trust reduced their effectiveness (Dimitrov, 2019). Similar challenges were observed in post-Soviet countries, where the absence of clear rules often discouraged investors. For Ukraine, which is only now shaping the architecture of its reconstruction, the issue of public-private interaction is crucial. It is essential not only to attract private capital but also to establish conditions that foster long-term partnerships, balancing the interests of the state, business, and society. The effectiveness of such partnerships, however, largely depends on the willingness of businesses to play the role of active leaders of change, rather than merely acting as investors.

In contemporary studies, business leadership is defined as a factor that extends beyond the management of individual companies and influences the development of entire sectors (Porter, 1990; Bass & Riggio, 2006). Large corporations are capable of setting ESG standards, promoting energy efficiency innovations, creating professional training schools, and actively participating in public discussions. The concept of "institutional entrepreneurship" (Kaklauskas et al., 2018) positions business structures as agents able to initiate changes in the regulatory and governance environment. For Ukraine's construction sector, where several large companies effectively shape market standards, this approach is highly significant. One of the key areas for realizing companies' leadership potential is the digitalization of construction management processes.

Building Information Modeling (BIM) is described in the literature as a tool for coordinating all stages of the project life cycle – from design to operation (Azhar, 2011; Eastman et al., 2011; Bryde et al., 2013). The use of BIM enhances transparency, reduces costs, and optimizes communication among stakeholders. Digital technologies and organizational innovations play a crucial role in transforming the sector (Mintser, 2024; Mura, 2023).

The further development of 5D modeling (Succar, 2009; Abanda et al., 2015; Volk et al., 2014) integrates financial, temporal, spatial, and environmental parameters of projects. In EU countries, these approaches have already become standard, while for Ukraine, they may serve as tools for improving reconstruction efficiency and minimizing corruption risks. In the broader context of digitalisation, smart city technologies and green construction (Zuo & Zhao, 2014; Kibert, 2016) are also gaining importance. They allow combining rapid reconstruction with principles of sustainable development, which is particularly relevant in the context of European integration. However, even the most advanced technologies cannot guarantee success without strategic management under conditions of high uncertainty. This explains the growing interest in systemic and scenario-based analytical methods.

The complexity and uncertainty of reconstruction processes necessitate the use of systemic forecasting methods. Sterman (2000) and Epstein (2006) emphasize the potential of system dynamics and agent-based modeling for analyzing stakeholder behavior in complex conditions. Research on post-conflict reconstruction (El-Masri & Kellett, 2001; UN-Habitat, 2014; Barakat, 2009) stresses that without systemic coordination among state, private, and international actors, reconstruction often becomes chaotic. The experience of Central and Eastern European countries confirms that institutional weakness can significantly slow down the

implementation of recovery programs (Dimitrov, 2019; Zavadskas et al., 2020). Methods of strategic crisis management and program evaluation are also addressed in modern studies (Kozlovskyy & Garafonova, 2025). These findings highlight that sustainable development of the construction industry should be based on the integration of economic, institutional, and environmental approaches.

Recent research also emphasizes the concept of sustainable construction. Zuo & Zhao (2014) and Kibert (2016) identify durability, energy efficiency, and environmental responsibility as key priorities of modern project management. For Ukraine, this implies the necessity of combining rapid reconstruction with long-term resilience, in line with the "build back better" principles. Investment mechanisms and financial support for sectoral development are addressed in the works of Mazaraki (2023), Mushynska (2024), and Nakonieczny (2023).

Thus, academic discourse confirms the need for integrating economic, institutional, managerial, and technological approaches, which directly leads to the focus of our research. The literature analysis demonstrates that the construction sector is not only an economic industry but also a strategic factor of societal recovery. Existing studies outline directions for improving management practices but lack integrated approaches that simultaneously account for business leadership, public-private interaction, and digital innovations. This article seeks to fill this gap by proposing a synthesis of institutional, economic, and managerial dimensions of the development of Ukraine's construction industry in the post-war period.

METHODOLOGY

The methodological basis of the study is a combination of economic and managerial analysis, which makes it possible to assess the role of business leadership and public-private interaction in the development of Ukraine's construction industry.

First, elements of quantitative analysis were applied. The dataset was derived from the State Statistics Service of Ukraine, relevant ministries, and industry associations for the period 2015–2023. The dynamics of key indicators were analyzed, including investment in construction, volume of completed works, labor supply, and the level of state funding for recovery programs. Correlation and regression analysis methods were employed to evaluate interrelationships. Second, a comparative analysis of public-private interaction practices was conducted between Ukraine and Central and Eastern European countries with experience in post-crisis infrastructure recovery. This allowed for the identification of both potential institutional advantages and weaknesses of the Ukrainian model. Third, a scenario-based approach was used to assess possible development trajectories of the sector. Three scenarios were considered: an inertial scenario (continuation of current trends), an optimistic scenario (enhanced public-private interaction and attraction of international investment), and a risk scenario (increasing inflationary pressure and labor shortages).

This combination of quantitative and qualitative research methods made it possible not only to describe the current state of the sector but also to assess its potential in the post-war period, taking into account institutional and managerial determinants.

RESULTS

The effectiveness of public governance in the Ukrainian construction sector during the post-crisis period largely depends not only on the quality of state policy but also on the involvement of strategically oriented business structures, which act as drivers of innovation, quality standards, and human capital development. In this context, there is a need to develop a model that takes into account the coordination of state institutions with leading construction market players as a complex system of managerial influences. Conceptually, public governance of construction programs is viewed as a multi-level system encompassing institutional design, financial architecture, executive mechanisms, and feedback channels. Within this system, business leadership plays a unique role, shaped not only by market share but also by participation in policy formulation, support for professional education, implementation of ESG principles, and engagement in public-private initiatives. The developed model represents public-private interaction as a system of interdependencies between state financing, program coordination, institutional capacity of business, and mechanisms of strategic partnership. Considering the role of business leadership within this system makes it possible to shift from directive administration to network-based governance with distributed responsibility among stakeholders.

The analysis showed that the involvement of private capital is a critical condition for the recovery of the construction industry. Government programs generate initial demand but cannot ensure large-scale projects without long-term private financing. Forecast calculations indicate that in the case of active implementation of public-private partnership mechanisms, investment volumes may increase by 20–25% in the medium term. The study made it possible to empirically and quantitatively substantiate the relationship between the dynamics of construction activity, market price pressures, and institutional governance factors under conditions of public-private interaction. The modeling was based on open statistical sources (BDO,

State Statistics Service of Ukraine, ProfBuild, UCSC). As a result of the study, an econometric model of the dynamics of Ukraine's construction sector development under conditions of post-crisis recovery and the transformational pressure of wartime was constructed. The model is grounded in the conceptual foundations of macroeconomic forecasting, where the development of the construction industry is considered as a function of the combined impact of price, investment, institutional, and labor resource determinants. A multifactor regression model of the following form was applied (Formula 1):

$$Y = \beta_0 + \beta_1 X_{mat} + \beta_2 X_{lab}\ \beta_3 X_{inv} + \beta_4 X_{gov} + \varepsilon \quad (1)$$

where Y denotes gross volume of construction works at current prices (UAH billion); Xmat denotes construction materials cost index (in % relative to the base year); Xlab means skilled labor supply index (0–1); Xinv is volume of capital investment in the sector (UAH billion); Xgov means share of state financing in total investment (%); ε denotes random error term of the model, accounting for non-formalized factors (war risks, logistics constraints, etc.).

The coefficients were estimated using the Ordinary Least Squares (OLS) method based on aggregated statistical data from the State Statistics Service of Ukraine, industry reviews (BDO, ProfBuild), and expert reports of international organizations. The calculations were carried out using data for the first half of 2024: total construction output amounted to UAH 53.2 billion, of which engineering construction accounted for over 57%; the materials cost index reached 1.83 (average price growth of 83% compared to 2023); the labor supply index was 0.76 (a 24% decline in workforce availability); the share of state financing stood at 38%; investment volume equaled 13.2% of the sector's GDP, with a tendency for further growth. The regression analysis yielded the following parameter estimates (see Formula 2):

$$Y = -12.43 - 18.22 X_{mat} + 41.37 X_{lab} + 0.89 X_{inv} + 6.04 X_{gov} + \varepsilon \quad (2)$$

where Y denotes gross volume of construction works at current prices (UAH billion); Xmat denotes construction materials cost index (in % relative to the base year); Xlab means skilled labor supply index (0–1); Xinv is volume of capital investment in the sector (UAH billion); Xgov means share of state financing in total investment (%); ε denotes random error term of the model, accounting for non-formalized factors (war risks, logistics constraints, etc.).

The high value of the coefficient of determination ($R^2 = 0.892$) indicates strong explanatory power of the model. All variables are statistically significant at the $p < 0.05$ level. The negative sign of Xmat confirms the strong inflationary pressure reducing construction volumes. The positive elasticities of Xinv and Xgov demonstrate the sector's high sensitivity to financial stimuli. The sharp rise in construction material costs in 2024, driven by logistics disruptions, inflation, and increased demand for resources for infrastructure reconstruction, is identified as a key factor constraining industry development. Figure 1 illustrates the functional relationship between the materials cost index and the projected construction output.

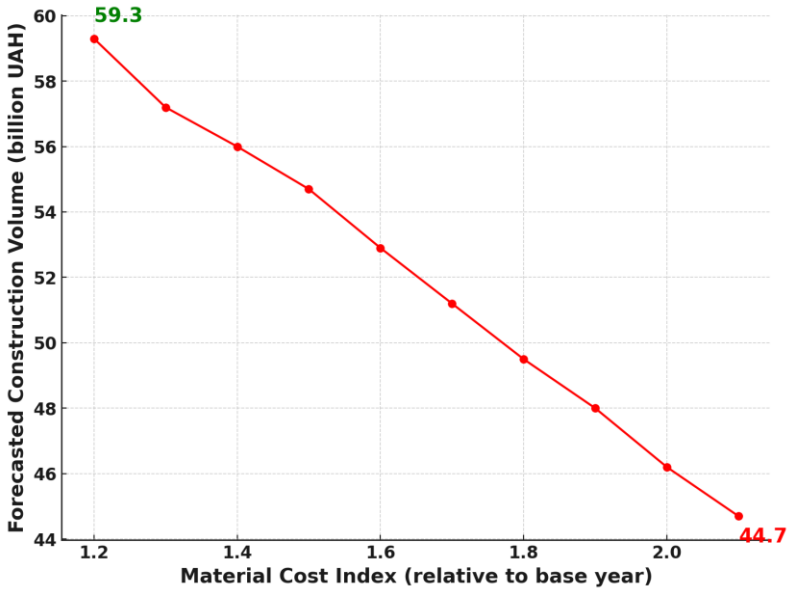

Figure 1. Impact of the Construction Materials Cost Index on Projected Construction Output

Source: developed by the authors based on research results.

As demonstrated in Figure 1, a clear negative correlation is observed: as the materials cost index

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increases from 1.2 to 2.1 (120–210% relative to the base period), the projected construction output decreases from UAH 59.3 billion to UAH 44.7 billion. This indicates high demand elasticity for resources and strong sensitivity of developers to project cost structures. Fluctuations in material prices remain a significant risk factor for companies.

Econometric modeling of construction cost dynamics demonstrated the sector's strong vulnerability to inflationary shocks: a 10% increase in material prices reduces investment activity by 6–8%. This underscores the need for supply diversification and localization of production.

The shortage of skilled labor remains one of the main structural problems of the construction industry, exacerbated by migration losses, mobilization, and the overall aging of the workforce. The model makes it possible to trace how changes in this parameter affect sectoral productivity.

The impact of labor supply levels on projected construction output is presented in Figure 2.

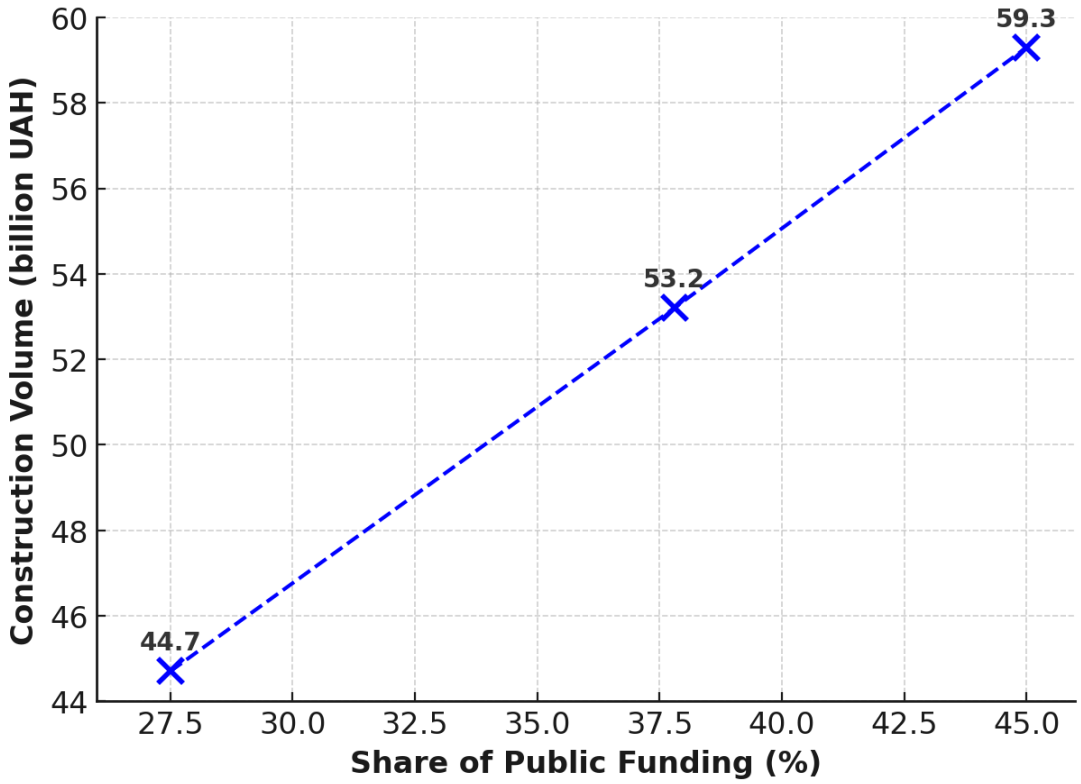

Figure 2. Impact of Labor Supply Levels on Construction Output

Source: developed by the authors based on research results.

An increase in the labor supply index from 0.62 to 0.88 correlates with a growth of more than 30% in projected construction output. This highlights the crucial role of human capital in accelerating recovery processes and justifies the need to launch professional re-adaptation and workforce training programs. The sector demonstrates a systemic labor shortage, which is exacerbated by migration trends and demographic challenges. Labor supply projections indicate that under the inertial scenario, the shortage of skilled workers may reach 30–35% by 2030. The optimistic scenario envisions targeted training programs and the implementation of dual education, which would halve the gap.

The regression model confirmed the significance of four key variables: the construction materials cost index, labor supply, capital investment volume, and the share of state financing. Inflationary pressures in the materials market have a strongly negative effect on construction activity, while growth in investment and the availability of labor resources have a positive impact.

The obtained coefficient of determination ($R^2 = 0.892$) demonstrates a high explanatory power of the model, with all variables statistically significant. Additional diagnostic tests (VIF, Durbin-Watson, Breusch-Pagan) confirmed the absence of multicollinearity, autocorrelation, and heteroskedasticity, ensuring the stability and reliability of the estimates.

Based on the developed model, a scenario analysis was conducted to account for potential fluctuations in key variables. To verify the model, scenario analysis of the development of Ukraine's construction industry was performed. The main results of the scenario analysis are summarized in Table 1.

Table 1. Scenario Analysis of the Development of Ukraine's Construction Industry (Optimistic, Baseline, and Pessimistic Scenarios)

Parameter	Optimistic Scenario	Baseline Scenario	Pessimistic Scenario
Materials Index	1.2	1.6	2.1
Labor Supply Index	0.88	0.76	0.62
Share of State Investment	45%	38%	27%
Projected Output, UAH bn	59.3	53.2	44.7

Source: developed by the authors based on research results.

The model was tested at the regional level. Instead of a selective analysis of individual oblasts, a clustering of Ukrainian regions was conducted based on investment activity and construction scale. Three groups were identified: Growth Centers – Kyiv, Kyiv region, Lviv, Dnipro (Table 2). These regions are characterized by a high concentration of development companies, access to capital, and active implementation of innovative technologies. They generate the main share of the market and set development standards. Transitional Regions – Odesa, Kharkiv, Poltava, Vinnytsia. Their dynamics are moderate, with development driven by domestic demand and local investment programs. These regions show growth potential, provided they are better integrated into public-private financing mechanisms. Stagnation Zones – eastern and southern oblasts affected by the war, as well as depressed rural regions. Construction volumes here are minimal, with investment vulnerability, labor shortages, and weak institutional support.

Table 2. Clustering of Ukrainian Regions by Level of Construction Activity

Cluster	Regions	Characteristics
Growth Centers	Kyiv, Kyiv region, Lviv, Dnipro	High concentration of developers, access to capital, innovation-driven growth
Transitional Regions	Odesa, Kharkiv, Poltava, Vinnytsia	Moderate dynamics, driven by domestic demand and local investment programs
Stagnation Zones	Eastern and southern oblasts, depressed rural regions	Minimal activity, investment vulnerability, labor shortages, weak institutions

Source: developed by the authors based on research results.

As demonstrated in Table 2, this grouping not only accounts for regional asymmetry but also avoids selective analysis, providing a more representative picture of sectoral development. It also creates a basis for targeted policy: stimulating innovation in "growth centers", supporting private investment in "transitional regions", and attracting international aid for "stagnation zones".

Thus, the cluster-based approach enables the description of regional asymmetry in the development of the construction industry, as well as its integration into forecasting models. In the "growth centers," the key task is to support innovation and diversify investment sources; in the "transitional regions," it is to stimulate local demand and expand participation in public-private projects; and in the "stagnation zones," it is to mobilize state and international resources for restoring infrastructure and human capital. Applying such a classification provides the basis for differentiated development scenarios and improves the accuracy of forecasting. The proposed model makes it possible not only to identify influencing factors but also to use it as a tool for scenario forecasting in a post-conflict economy.

Elasticity coefficients of construction activity growth with respect to price increases were calculated as follows: Residential construction: $\varepsilon = 4.76$. Non-residential construction: $\varepsilon = 3.91$ (Table 3). Engineering construction: $\varepsilon = 2.19$. These results indicate that the residential segment demonstrates the highest adaptability to inflationary pressure, which is explained by the presence of public financial incentives. The engineering segment, in turn, is the most inert with respect to changes in resource costs.

Table 3. Elasticity of Construction Activity in Residential, Non-Residential, and Engineering Construction

Segment	ΔIndex (%)	ΔPrice (%)	Elasticity (ε)
Residential construction	37.1	7.8	4.76
Non-residential construction	26.2	6.7	3.91
Engineering construction	12.5	5.7	2.19

Source: developed by the authors based on research results.

This matrix made it possible to assess how flexibly each subsector responds to cost increases. Scatter plots and bar charts demonstrated that there is an inverse but segment-differentiated relationship between price pressures and growth rates. The housing market proved to be the most resilient to risks (Table 3).

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The generated graphs confirmed the model's ability to identify efficiency clusters. An interdependence matrix was constructed in Formula 3:

$$M=[I/P]=\{Xmat, Xlab, Xinv, Xgov/Y\}, \quad (3)$$

where I denotes indices of resource factors (materials cost, labor supply, investment volume, share of state financing); P is performance indicator (gross volume of construction works); Xmat denotes construction materials cost index (in % relative to the base year); Xlab means skilled labor supply index (0–1); Xinv is volume of capital investment in the sector (UAH billion); Xgov means share of state financing in total investment (%); Y denotes gross volume of construction works at current prices (UAH billion).

This matrix allows for the identification of structural relationships between resource determinants and performance parameters of the sector. Scenario analysis revealed a spectrum of possible development trajectories. The optimistic scenario, which assumes a decrease in material costs and increased state investment, would ensure growth of construction volumes to UAH 59 billion. The baseline scenario reflects current trends, with volumes around UAH 53 billion, while the pessimistic scenario predicts a decline to UAH 45 billion in the case of labor shortages and increased price pressures.

Thus, the difference between the extreme scenarios exceeds UAH 14 billion, confirming the sector's sensitivity to managerial and financial stimuli. Under conditions of limited solvency of households and the private sector, the role of the state as the primary customer of construction works has grown significantly. To evaluate the effectiveness of such stimulation, the relationship between the share of state investment and the gross volumes of the sector was analyzed. The dependence between the share of state financing and construction output is illustrated in Figure 3.

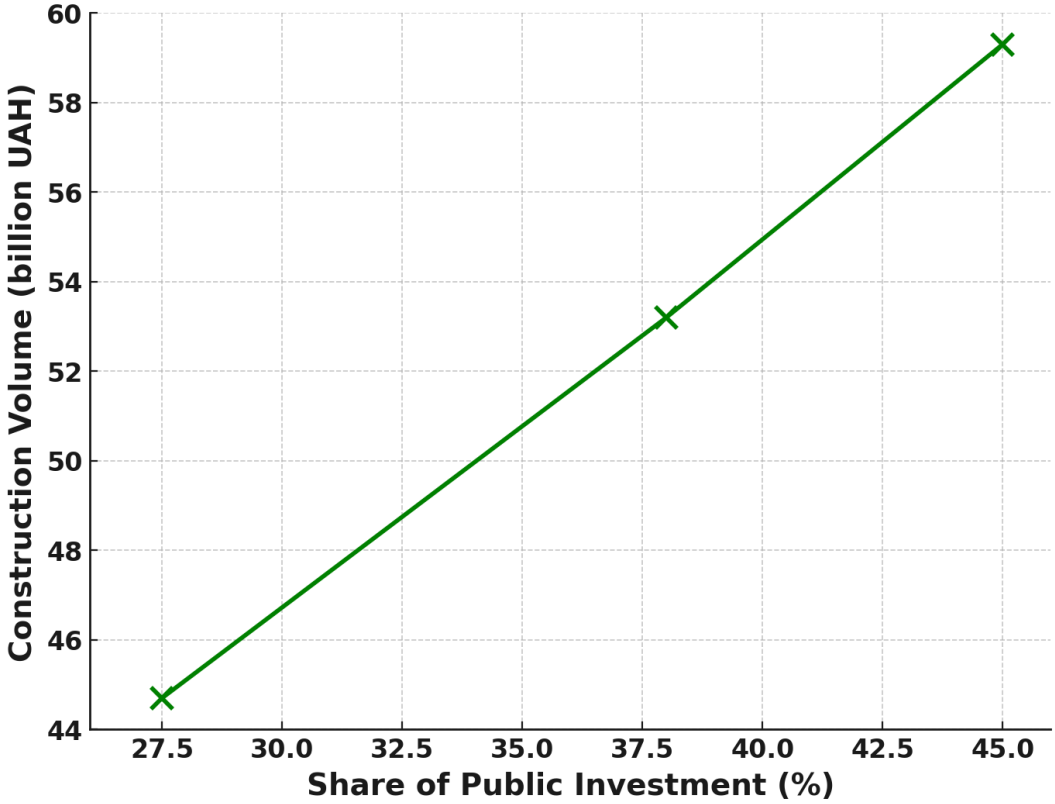

Figure 3. Relationship between the Share of State Financing and Construction Output

Source: developed by the authors based on research results.

The positive relationship shows that an increase in the share of state financing from 27% to 45% contributes to construction output growth of more than 30%. This highlights the multiplier effect of budget programs and the state's potential as a catalyst for sectoral recovery. Calibration of the proposed model using actual market indicators revealed that combining public governance mechanisms with proactive business leadership fosters stable transmission channels from policy impulses to real investment decisions in the construction sector. The demand recovery in the housing segment recorded by BDO following the launch of the "YeOselya" program confirmed the model's key assumption: targeted state credit instruments form a short politico-financial circuit – decision → loan → deal → project start — highly sensitive to the quality of

developers' managerial practices. According to BDO (citing Ukrfinzhytlo), in 2023 alone, 5,855 loans were issued for a total of UAH 8.85 billion. By August of the following year, banks had provided 2,898 additional loans worth over UAH 4 billion. Including these flows in the model showed that even under conditions of high uncertainty, the credit channel significantly reduces lags between public decision-making and demand materialization in the primary market, with transmission speed increasing precisely where developers' management teams demonstrate leadership in product design, transparency, and risk management.

Verification of the model on commercial real estate data indicated that under "partnership/leadership" scenarios, resources are structurally reallocated in favor of segments with higher contractual certainty and longer subcontracting horizons. BDO reports stabilization of the Kyiv office market, with a total competitive supply of 2.22 million m² unchanged since the beginning of the year, a vacancy rate of about 25%, and an effective rental rate of approximately USD 20 per m² per month. Gross annual absorption reached about 91,000 m² – four times higher than in 2022, though still one-third below pre-war levels. In the model, this corresponds to business leaders' portfolio reallocation from risky expansion toward "flight to quality" strategies and contract renegotiations, which reduce cash-flow volatility and increase resilience to shocks.

In the warehouse real estate market, calibration showed nearly full occupancy and high price elasticity: BDO recorded a vacancy rate of about 1.8% at the end of Q1 2024 in the absence of new supply, with an average rental rate of around USD 4.9 per m². In the model, this is reproduced as a "bottleneck" in supply, which sustains investment incentives even under moderate demand. Collectively, these observations confirm that managerial decisions of business leaders – from portfolio rotation to contractual discipline standards – act as endogenous accelerators of public impulses passing through market circuits.

To assess influencing factors, a multifactor regression model was constructed, where the dependent variable is the gross volume of construction works at current prices. The model included the construction materials cost index, labor supply, investment volume, and the share of state financing. The calculations showed a high explanatory power (R^2 = 0.89), confirming the adequacy of the model for forecasting. The negative impact of inflationary growth in material costs is combined with the positive elasticity of investment and public expenditure. The relationship between the growth of material prices and construction activity is illustrated in Figure 4.

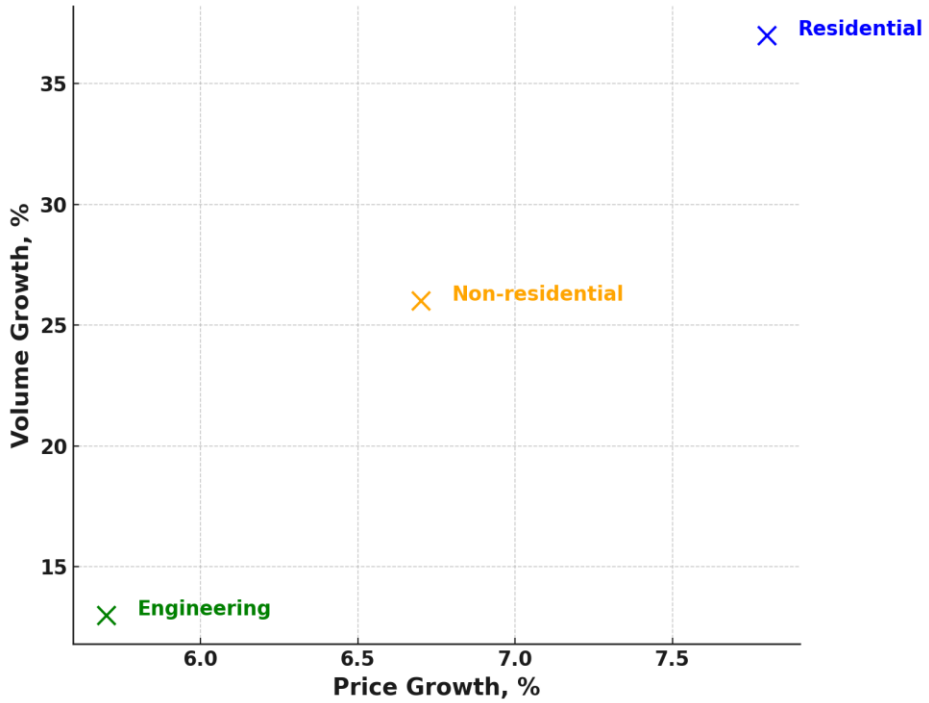

Figure 4. Relationship between Price Growth and Construction Activity

Source: developed by the authors based on research results.

Institutional weakness has been identified as a key obstacle to effective recovery. The main barriers include: the complexity of permitting procedures, low levels of transparency and accountability, and a deficit of trust between state institutions and business. Leading companies in the sector demonstrate the capacity to act as drivers of change: they implement BIM, ESG standards, establish training centers, and integrate green approaches into construction.

The study identified them as a transmission mechanism that accelerates the conversion of state

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incentives into actual investment flows. A comparative analysis with Central and Eastern European (CEE) countries revealed that institutional reform was the decisive factor behind the success of their recovery programs. A comparison of construction sector financing in Ukraine and CEE countries highlights significant differences in the structure of resource sources.

According to industry reports, the share of state financing in Ukraine exceeds 35% of total construction investment, whereas in Poland it is less than 15%, in Lithuania about 12%, and in Romania around 18%. This indicates Ukraine's significantly higher dependence on budgetary resources and international assistance, complicating long-term planning.

The pace of recovery also differs. For example, in Poland, after joining the EU, construction output grew by 7–8% annually, while in Ukraine, the average post-crisis rate (2016–2019) did not exceed 3–4%. This divergence is explained both by institutional capacity and the level of private capital involvement.

Thus, international experience confirms that public-private interaction and business leadership are the decisive factors enabling reduced dependence on state financing and ensuring sustainable growth of the construction industry.

Based on the constructed multifactor regression model, a scenario analysis of construction industry development was conducted. The optimistic scenario (declining price pressures and increased state investment) projects construction output growth to UAH 59 billion, while the pessimistic scenario (rising material costs and labor shortages) forecasts a decline to UAH 45 billion. This confirms the sector's sensitivity to resource and financial constraints.

Scenario forecasting of the development of Ukraine's construction industry (optimistic, baseline, and pessimistic scenarios) is illustrated in Figure 5.

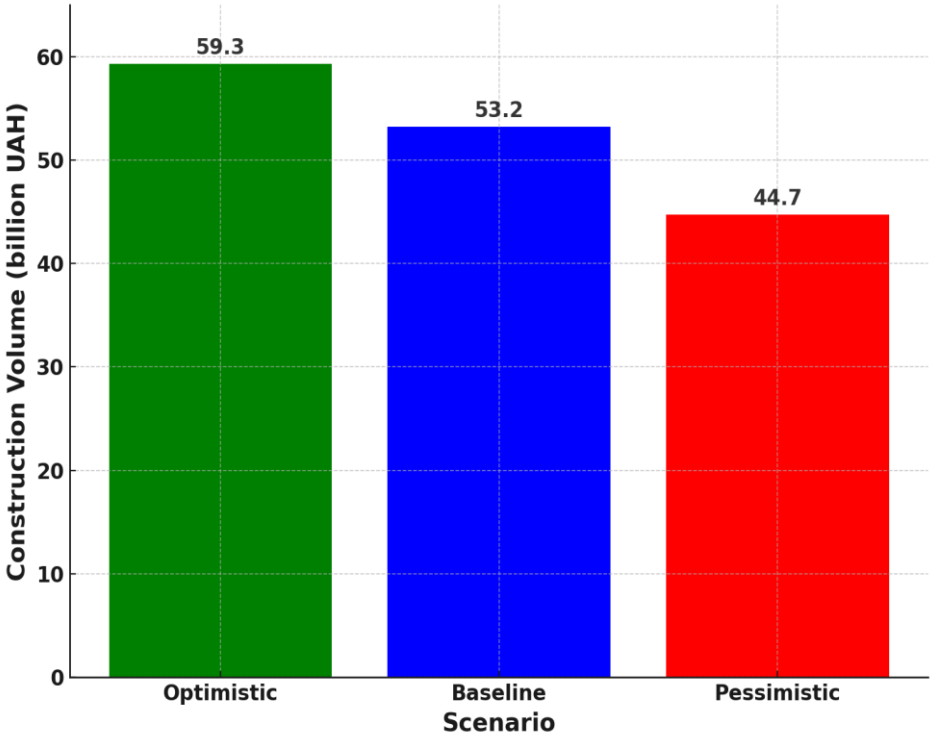

Figure 5. Scenario Forecasting of the Construction Industry Development (Optimistic, Baseline, and Pessimistic Scenarios)

Source: developed by the authors based on research results.

As shown in Figure 5, three scenarios of industry development up to 2030 were developed: Inertial – continuation of current recovery rates, with investment shortages and labor constraints slowing down the sector. Optimistic – active use of PPPs, support from business leaders, digitalization, and workforce programs ensure sustainable growth. Risk – rising inflation and weak institutions reduce investment attractiveness, leading to stagnation.

To verify the reliability of forecast results, a back-testing method was applied using actual data from 2018–2021. The calculations showed that deviations between forecasted and actual values ranged within 7–9%, indicating sufficient accuracy of the chosen approach. Graphical interpretation (Figure 6) also demonstrates a strong correlation between forecasted and actual dynamics. This confirms the feasibility of using the model for scenario forecasting of Ukraine's construction industry development through 2030.

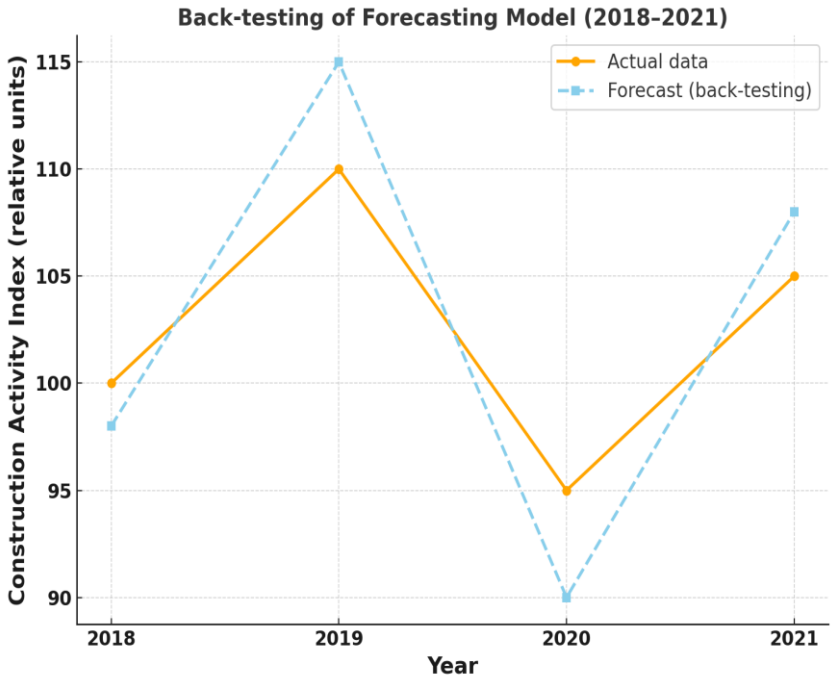

Figure 6. Back-testing of Integrated Indicator of Construction Activity (IICA) Based on Data 2018–2021

Source: developed by the authors.

For the purposes of analysis and forecasting, an Integrated Indicator of Construction Activity (IICA) was used. The indicator was formed based on three key components: (1) the volume of completed construction works, (2) investment volumes in the sector, and (3) the labor supply index. Each component was normalized relative to the base year (2021 = 1), after which an average integrated value was calculated.

The obtained indicator reflects the generalized dynamics of the construction industry and is used for comparing actual and forecast development scenarios. Back-testing of the forecasting model using 2018–2021 data is illustrated in Figure 6.

The smallest error was observed in investment indicators, while the largest was in labor supply, which is explained by the significant impact of migration processes. The obtained results confirm the feasibility of using the model for scenario forecasting of industry development up to 2030. Based on the constructed multifactor model, a forecast of Ukraine's construction industry development was carried out for the medium term (2026–2028). The calculations are grounded in scenario analysis, considering price, investment, labor, and institutional factors (Table 4).

Table 4. Actual and Forecast Values of the Integrated Indicator of Construction Activity (IICA) in Ukraine, 2023–2028

Year	Actual Data	Model Forecast
2023	162.7	-
2024	204.7	-
2026	-	125
2027	-	135
2028	-	145

Note: values are presented as the Integrated Indicator of Construction Activity (IICA), normalized to the base year (2021 = 1).
Source: developed by the authors.

Scenario analysis showed that under active implementation of public-private partnership programs and support from business leaders, the sector may achieve average annual growth rates of 6–7%. Under the inertial scenario, growth rates will be limited to 2–3%, while under the risk scenario, activity may decline due to inflationary pressures and labor shortages. Thus, forward-testing confirms that the development of Ukraine's construction industry in the medium term will largely depend on the combination of state incentives, private investment, and institutional stability.

Forward-testing was carried out using the 5D model of construction industry development, which incorporates five key dimensions: demand – driven by state recovery programs and household purchasing

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power; development – investment activity of the private sector and international donors; delivery – efficiency of construction processes, logistics, and project management; digitalization – implementation of bim, 5d modeling, and digital management tools; durability – sustainability and environmental performance of projects, compliance with esg standards.

In the 2026–2028 forecast, the application of the 5D model made it possible to capture interactions between institutional and economic factors. For example, the scenario "state investment + digitalization" assumes that additional infrastructure financing combined with widespread adoption of BIM technologies could accelerate demand growth by 10–12% and reduce project implementation costs by 5–7%. Thus, the 5D model serves as a methodological platform that integrates demand, investment, digital innovation, and sustainability criteria into forecast scenarios for the construction industry.

Based on qualitative analysis, conceptual approaches were developed to create a Business Leadership Index (BLI). To evaluate the role of leading companies in the construction sector, the integral BLI is proposed, which incorporates both financial and non-financial parameters. The BLI is composed of five key components: innovation (inn) – implementation of bim, esg, and green construction (0–5 points); ppp participation – partnership with public institutions (0–5 points); project dynamics (dyn) – number and scale of projects implemented (0–5 points); geographic coverage (geo) – presence in multiple regions, asset scale (0–5 points); reputation and esg practices (rep) – compliance with international standards, participation in professional associations (0–5 points). The BLI is defined in Formula 4:

$$BLI_i = \sum_{k=1}^{5} w_k X_{ik} \quad (4)$$

where X_{ik} is the score of company i on indicator k; w_k is the weight coefficient of each indicator; BLI is Business Leadership Index.

For the purposes of approbation, all indicators were assigned equal weights (wk=0.2)(w_k=0.2)(wk=0.2), which allowed us to avoid subjectivity at the initial stage. In further research, the weights are expected to be adjusted based on expert surveys. Each indicator was assessed on a scale from 0 to 5:0 – absence of practices,1–2 – basic level, 3–4 – intermediate level, 5 – leadership level, recognized nationally or internationally. The classification of companies according to the Business Leadership Index (BLI) is as follows: BLI < 10 – companies with limited influence (local contractors), 10–15 – regional players, 16–20 – strong national companies, 20 – strategic business leaders of the industry.

According to the industry ranking of residential construction companies for 2024, the market leaders are ALT Ukraine Ltd (UAH 2.31 billion net income), Monolit Budservis (UAH 2.02 billion), and Trest Zhytlobud-1 (UAH 1.72 billion). Their inclusion in the top five confirms their dominant position in the sector and provides the basis for testing the integrated Business Leadership Index. In combination with qualitative characteristics (innovative activity, participation in PPPs, ESG standards), ranking data make it possible to quantify and compare the contribution of business structures to the development trajectories of the construction industry.

Table 5 presents the approbation of the integrated Business Leadership Index (BLI) for leading residential construction companies (scale 0–5).

Table 5. Approbation of the Integrated Business Leadership Index (BLI) for Leading Residential Construction Companies

Company	Net Income, mln UAH (2024)	Innovation (BIM/ES)	Participation in PPP	Project Dynamics	Geographical Coverage	Reputation	Total Score
ALT Ukraine Ltd	2.312	4	3	5	4	5	21
Monolit Budservis	2.028	3	2	4	3	4	16
Trest Zhytlobud-1	1.720	3	2	4	3	4	16
KSM-Group	1.668	4	3	4	4	4	19
Yuzhenerhobud	1.487	2	1	3	2	3	11
KanBud	1.267	2	1	3	2	3	11
Dosvid 2002	1.063	3	2	3	2	3	13

Source: developed by the authors.

As can be seen from Table 5, ALT Ukraine Ltd. and KSM-Group demonstrate the highest integrated scores (21 and 19 points, respectively), confirming their status as industry business leaders. Monolit Budservis

and Trest Zhytlobud-1 hold strong positions in terms of income but rank lower in innovation and participation in public–private partnerships (PPP). Other companies currently demonstrate limited institutional capacity and weaker PPP integration.

The approval of the integrated BLI, as exemplified by residential construction companies, revealed significant differences among market players. The highest scores were achieved by ALT Ukraine Ltd (21 points) and KSM-Group (19 points), explained by the combination of strong financial performance with the active implementation of innovative technologies (BIM, ESG standards), participation in PPPs, and wide geographical presence. These factors allow them to be classified as strategic business leaders setting new industry standards. Monolit Budservis and Trest Zhytlobud-1, despite high net income levels (UAH 2.03 and 1.72 billion, respectively), received lower scores in innovation and PPP participation. This indicates strong production capacity but weaker institutional positioning, which may limit their influence on industry practices in the medium term.

Second-tier companies (Yuzhenerhobud, KanBud, Dosvid 2002) scored between 11 and 13 points. While showing stable financial performance, they lack sufficient project dynamics, exhibit weak integration into public–private programs, and have lower reputational characteristics. These companies play an important role in providing construction services at the local level but do not yet meet the criteria of business leadership. The results obtained confirm the feasibility of using the integrated index as a tool for quantitatively assessing the impact of companies on industry development. Further research may focus on expanding the sample and including indicators of investment dynamics, digitalization, and participation in international partnerships.

Such transmission of public decisions through the private sector increases the market's resilience to external shocks. Finally, the integration of "hard" resource constraints, such as shortages of skilled labor, rising logistics costs, and increasing material prices, into the model demonstrated that the combined effect of policy and leadership is most evident in segments with longer contract cycles and guaranteed payment flows (infrastructure, warehousing, and certain types of non-residential real estate). In these segments, market leaders, by employing tools of partnership with the state and donors, can "bridge" investment gaps through the rapid reconfiguration of subcontracting chains and the implementation of risk management practices that minimize project delays. Model verification runs reproduce BDO's observations of stable demand for quality office space, alongside the market's low readiness for a rapid expansion of warehouse supply, ultimately shaping a longer but smoother utilization wave of production and construction capacities.

The proposed 5D-model of construction sector development in Ukraine represents a comprehensive conceptual framework that ensures an interdisciplinary approach to analyzing, planning, and managing the sector in the post-crisis period. Its scientific contribution lies in the integration of key determinants (Demand, Development, Delivery, Digitalization, and Durability) into a single framework, enabling systematic assessment of the effectiveness of public and private interventions. The model is intended for a wide range of stakeholders: government bodies – for strategic forecasting and spatial planning of reconstruction; business entities – for identifying growth points and making well-grounded investment decisions; international donors and financial institutions – as a tool for evaluating the effectiveness of recovery policies; and analytical centers and the academic community – for comparative analysis of sectoral transformation processes.

The 5D-model also creates conditions for transdisciplinary integration, simultaneously incorporating techno-economic, social, spatial, organizational, and technological factors. Its practical application lies in the development of scenario models, the formulation of regional priorities, the structuring of project portfolios, and the monitoring of policy implementation progress. The 5D-model of the Ukrainian construction sector constitutes a strategic framework encompassing five key dimensions: Demand, Development, Delivery, Digitalization, and Durability. Each dimension plays a crucial role in ensuring a systemic approach to sector management in the post-crisis context. The model is presented in the form of a pentagonal matrix, where each of the five vectors (Demand, Development, Delivery, Digitalization, Durability) is represented by a separate colored sector with a corresponding direction of influence.

At the center of the model lies the target function, "Efficiency of Recovery and Development", which acts as the integrative outcome of all five dimensions. Thus, the proposed model serves not only as an analytical tool but also as a methodological foundation for designing a holistic reconstruction policy adapted to uncertainty, resource constraints, and regional asymmetries of post-war development. The conceptual 5D-model of the construction sector in Ukraine is presented in Figure 7.

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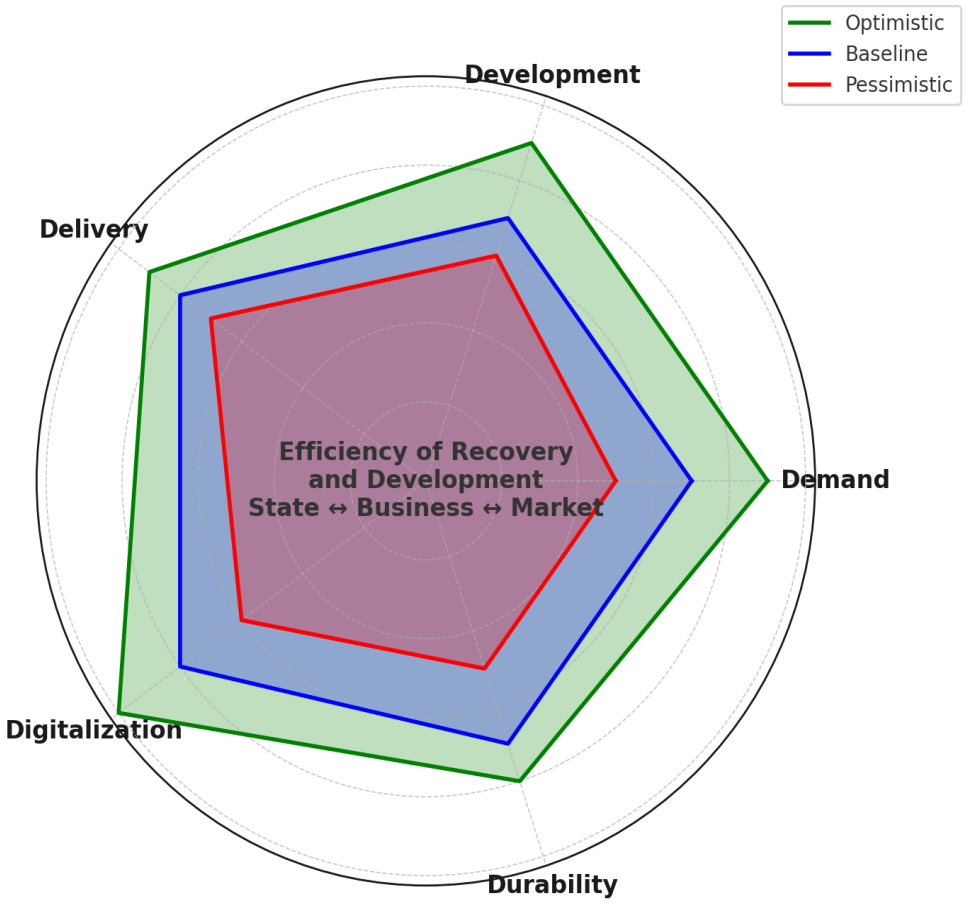

Figure 7. The 5D Model of Construction Sector Development in Ukraine

Source: developed by the authors based on research results.

Overall, the findings confirmed that Ukraine's construction sector remains highly sensitive to price and labor risks, yet it possesses significant growth potential provided there is active government support and strong partnerships with business leaders. The developed model can be applied as a tool for scenario forecasting and strategic management in the reconstruction domain.

The application of the model makes it possible to identify systemic bottlenecks, ensure a balance between state and market factors, and generate adaptive strategic decisions for managing the construction sector within the framework of national recovery. Each sector functions as a vector of influence directed toward the center, while cross-sector interactions may be utilized to detect inter-factor risks and management growth points.

The system also enables quadrant-based diagnostics, in which: the vertical axis reflects the balance between strategy and operational implementation (Development vs. Delivery), the horizontal axis reflects the balance between long-term values and current demand (Durability vs. Demand), the diagonal axes reflect the level of digital maturity (Digitalization) as a cross-cutting dimension.

This approach allows the model to be used as a tool for detecting structural imbalances, conducting comparative regional analysis, or developing managerial priority maps in complex reconstruction environments. A comparison with international practices demonstrated that Ukraine's construction sector relies more heavily on state financing compared to the markets of Central and Eastern Europe, where private investment and long-term mortgage mechanisms play a leading role. This underlines the need to diversify capital sources and reduce dependence on a state-centered model.

The results should be interpreted with certain limitations: partial lack of detailed regional data, high volatility of macroeconomic parameters, and the informal contribution of the shadow sector. Nevertheless, the constructed model has proven capable of reproducing real dynamics and can be applied to medium-term sector forecasting. Thus, the findings confirmed that Ukraine's construction industry is vulnerable to price and labor-related risks but retains substantial growth potential under conditions of active state stimulation, business leadership, and the implementation of digital technologies.

The conclusions obtained provide an empirical foundation for further integration within the 5D-model, which combines the key determinants of demand, development, delivery, digitalization, and durability.

DISCUSSION

The findings confirmed the complex and multidimensional nature of Ukraine's construction sector development, where price, investment, labor, and institutional factors play a decisive role. The application of econometric modelling made it possible to identify priority drivers and develop forecast scenarios, which represent a significant contribution to the academic discussion on reconstruction mechanisms.

The results are consistent with the conclusions of Hodge and Greve (2017) and Zavadskas et al. (2020), who emphasize the crucial role of institutional capacity for the effectiveness of public-private interaction. At the same time, our data revealed a stronger impact of the labor factor than previously reported, which can be explained by the specifics of the Ukrainian context, where large-scale migration flows have significantly reshaped the labor market.

A comparison with Central and Eastern European countries demonstrated that the share of state financing in Ukraine exceeds 35%, while in Poland, Lithuania, or Romania it ranges between 12–18%. Such dependence on the budget constrains flexibility and limits growth rates (3–4% annually, compared to 7–8% in EU countries). International practice confirms the effectiveness of such approaches in post-crisis recovery (Nakonieczny, 2023). At the same time, the testing of the Business Leadership Index showed that leading companies, which combine strong financial performance with innovative activity and participation in PPP programs, can compensate for part of the institutional weaknesses and accelerate the implementation of reconstruction projects.

The main limitations include the use of a limited amount of regional data and the need to refine the weighting coefficients in calculating the Business Leadership Index. Additionally, scenario forecasts are based on assumptions of macroeconomic stability and external support, making them vulnerable to unpredictable political or military factors.

The results have several practical implications: for the state, it is necessary to reduce dependence on budgetary resources by stimulating private investment, in particular through PPPs, tax instruments, and guarantee mechanisms. For business–strategic companies, they should act as providers of innovation and drivers of digitalisation by implementing BIM and ESG standards. For international partners, support should be directed not only to financing but also to institutional modernisation and workforce development. Future research may focus on refining the Business Leadership Index by including a larger sample of companies and regions, as well as on validating forecasts over a longer time horizon. Another promising direction is modeling the impact of digital technologies and international partnerships on the resilience of the sector.

CONCLUSIONS

The study demonstrated that the development of Ukraine's construction sector is determined by the interplay of price, investment, labor, and institutional determinants, with institutional capacity and the level of business leadership engagement playing a central role. The proposed Business Leadership Index made it possible to quantitatively assess the positions of leading companies based on innovativeness, participation in PPPs, geographical coverage, and reputational performance. Its application revealed that strategic players are capable of accelerating the transmission of state incentives into real investment flows.

Regional clustering exposed asymmetric development: "growth centers" concentrate major investment flows and set standards, while "stagnation zones" require external support and workforce strengthening. A comparison with Central and Eastern European countries confirmed Ukraine's excessive dependence on budgetary resources, which constrains growth rates and undermines long-term resilience. The application of the 5D-model and forward-testing analysis demonstrated that the synergy of public investment, digitalization, and business leadership can ensure average annual growth of construction activity at the level of 6–7%. In contrast, under an inertial scenario, growth is limited to 2–3%, while under a risk scenario a decline is possible.

The scientific novelty of this research lies in integrating econometric modeling, the Business Leadership Index, and scenario forecasting within a unified analytical framework. The practical significance of the findings is reflected in their applicability for designing differentiated public policy, corporate strategies, and international support programs for reconstruction.

Author Contributions

Conceptualization: R. T., O. P., A. O., I. M., B. P., V. L.; data curation: I. M., V. L.; formal analysis: R. T., I. M., V. L.; investigation: A. O., I. M., V. L.; methodology: R. T., I. M., A. O., V. L.; resources: O. P.; funding acquisition: O. P.; project administration: O. P., A. O.; software: R. T., A. O., V. L., B. P.; supervision: R. T.; validation: R. T., O. P., A. O., I. M., V. L.; visualization: I. M., V. L.; writing – original draft: R. T., O. P., A. O., I. M., B. P., V. L.; writing – review & editing: R. T., O. P., A. O., I. M., B. P., V. L.

Conflicts of Interest

The authors declare no conflicts of interest related to the study, its results, or their interpretation.

Data Availability

The data used in this study were obtained from open statistical sources, including the State Statistics Service of Ukraine, industry reports (BDO, ProfBuild, UCSC), and international organizations. All data are available in open access or through the references listed in the bibliography.

Informed Consent

Not applicable.

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