KAPITEL 7 / *CHAPTER 7* [7]
GAME THEORY AS A TOOL FOR CHOOSING AN INNOVATIVE ENTERPRISE STRATEGY IN THE CONTEXT OF THE RUSSIAN-UKRAINIAN WAR

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Introduction

In today's dynamic market conditions, enterprises are forced to constantly look for new approaches to maintaining competitiveness and achieving long-term success. One of the key tools for ensuring a stable position in the market is an effective innovation strategy, which allows not only to respond to changes in the external environment, but also to get ahead of them. At the same time, the development of such a strategy is accompanied by a high level of uncertainty and risk, which requires a deep strategic analysis of the behavior of competitors, partners and other market participants. Game theory, as an interdisciplinary scientific approach that combines economics, mathematics and strategic thinking, provides a powerful tool for modeling the interaction between economic agents [1]. It allows you to predict the behavior of competitors, analyze possible scenarios and choose the most optimal strategies in conditions of limited information.

7.1 The Role of Game Theory in Choosing Innovation Strategies

Game theory methods should be used when choosing an enterprise's innovation strategy for the following reasons [2-7]:

1. High level of interdependence of decisions on the market. An enterprise's innovative activity almost always takes place in conditions of competition or cooperation with other players. Each decision regarding innovation – launching a product, investing in R&D, entering a new market – causes a corresponding reaction from other participants. Game theory allows you to model strategic interaction between enterprises, taking into account possible actions of competitors, partners or consumers.

[7] ***Authors:*** *Zhygalo Ivan Ivanovych*

2. Modeling strategies in situations of uncertainty and risk. Innovations are always associated with risk: economic, technological, market. Game theory methods allow an enterprise to consider different scenarios of events and find the optimal response in each of them. For example, the use of games with incomplete information allows you to take into account asymmetry in knowledge about the market or competitors' plans.

3. The choice between cooperation and competition. Often, a company has to choose: to develop innovations independently or in cooperation (for example, within open innovations, clusters, joint R&D projects). Game theory, in particular cooperative games, helps to analyze the benefits and risks of combining resources and efforts with other players, as well as to determine a fair distribution of profits.

4. Optimization of innovation spending strategies. Innovative projects require significant investments, so it is strategically important not only to invest, but to do it at the right time and in the appropriate form. Game-theoretic models make it possible to identify the best time to enter the market with an innovation, taking into account the actions of competitors (models such as "game to get ahead", "delay launch", etc.).

5. Facilitation of making informed management decisions. Game theory provides a quantitative and qualitative apparatus for analyzing strategies, allowing the company not to act intuitively, but to make rational and strategically justified decisions. This is especially important in conditions of market turbulence and high rates of technological change.

6. Increasing the flexibility of the innovation strategy. The use of game models helps to build not only a single "hard" strategy, but also a system of adaptive strategic decisions that can be adjusted in response to changes in the behavior of other players.

In the rapidly changing and competitive business environment, companies must constantly adapt and innovate to maintain their market positions [8]. However, choosing the right innovation strategy is rarely a straightforward decision – it often involves anticipating competitor actions, evaluating collaboration opportunities, and managing uncertainty. Game theory offers a powerful analytical framework to model such strategic interactions. By simulating competitive and cooperative scenarios, game-theoretic methods help companies make rational, forward-looking decisions

when developing and implementing innovation strategies [9]. The Table 1 presents a selection of typical situations where the application of game theory can enhance the strategic decision-making process in innovation management.

Table 1 – Examples of Applying Game Theory Methods in Choosing an Innovation Strategy for a Company

Situation	Type of Game / Method	Purpose of Application
Entering the market with a new product in the presence of competitors	Non-cooperative game (preemptive game)	Determine the optimal timing for launching an innovation
Joint development of technology with other companies	Cooperative game (coalitional)	Evaluate partnership feasibility and profit distribution
Investing in R&D under resource constraints and competition	Games with incomplete information	Assess risks and develop a strategy under uncertainty
Predicting competitors' response to innovation implementation	Game with multiple Nash equilibria	Choose a strategy that minimizes potential losses
Creating a consortium with universities or startups	Cooperative game with technology transfer	Define roles, intellectual property ownership, and investment sharing
Pricing an innovative product in a competitive market	Bertrand-type pricing game	Develop a pricing policy considering competitor reactions
Developing innovations for a niche market	Signaling games	Send strategic signals to the market or competitors
Launching an innovative project in response to a competitor's action	Sequential game (dynamic backward induction)	Anticipate future strategic moves and choose the best response
Deciding on licensing or franchising an innovation	Cooperative game with payoff distribution	Calculate a fair mechanism for revenue sharing
Managing the risk of innovation failure in the market	Zero-sum game (between company and market forces)	Model worst-case scenarios and minimize potential losses

Source: compiled by the author on the basis [10-13]

7.2 Applying Game Theory to Innovation Strategy Selection in Ukrainian Enterprises during Wartime Uncertainty

The following is a hypothetical example designed to illustrate how game theory methods can be applied to the selection of an innovation strategy for a company, particularly under complex and uncertain conditions. In this case, we consider Ukrainian enterprises operating amid the challenges of the ongoing Russian-Ukrainian war, where the risk of disruption to logistics channels critically affects strategic decision-making. This model demonstrates how multiple companies can evaluate different innovation strategies – such as production localization, digital transformation, supplier diversification, or maintaining the status quo – while accounting for risks of supply chain disruptions and competitive interactions. By applying game-theoretic reasoning, companies can better anticipate the outcomes of their strategic choices, optimize their innovation investments, and increase resilience in a turbulent environment.

Problem Setup:

Players: three Ukrainian companies – C1, C2, C3 – competing in the same industry.

Strategy options for each company:

S1: Localization of production (minimizing dependence on imports).

S2: Digital transformation (automation, remote work, new sales channels).

S3: Diversification of suppliers (finding new logistics routes and partners).

S4: Status quo (no significant innovations, minimal investments).

Additional Condition: probability of losing the main logistics channel (R) due to military actions:

R = 0.4 (40%).

1 – R = 0.6 (60%) – probability logistics remain stable.

Table 2 outlines the key assumptions used to evaluate the expected outcomes of different innovation strategies available to enterprises operating in the context of the Russian-Ukrainian war. Each strategy is assessed based on three critical dimensions:

its impact on logistics-related risk, the potential payoff in a stable environment, and the degree of losses that would occur if logistics infrastructure were disrupted due to wartime conditions.

Table 2 – Assumptions about the impact of strategies on risks and payoffs

Strategy	Impact on logistics risk	Base payoff if logistics stable	Losses if logistics lost (%)
S1	Maximum localization – minimal risk	8	10% (minimal losses)
S2	Digital transformation – medium risk	7	40% (significant losses)
S3	Diversification – risk reduced by 50%	6	25% (moderate losses)
S4	Status quo – maximum risk	5	50% (major losses)

Source: compiled by the author

The "Impact on logistics risk" column reflects how each strategy influences the company's vulnerability to supply chain interruptions. For example, Strategy S1 (Maximum localization) significantly reduces this risk by minimizing dependence on external supply routes, while S4 (Status quo) leaves the company fully exposed. The "Base payoff if logistics are stable" indicates the economic benefit (e.g., profit, operational advantage) a company can expect from each strategy under normal conditions, with no logistics disruption. The "Losses if logistics are lost (%)" represents the estimated reduction in payoff that would result if a supply chain disruption were to occur – expressed as a percentage of the base payoff.

Together, these assumptions form the basis for calculating expected payoffs under different strategic choices, enabling a comparison of their effectiveness in both stable and unstable environments. This allows decision-makers to integrate both potential gains and risks when formulating innovation strategies in wartime conditions.

Each company's payoff depends on the chosen strategy and logistics status:

$$W_i = (1 - R_i) \times B_i + R_i \times B_i \times (1 - L_i), \quad (1)$$

where: W_i – expected payoff for player i; B_i – base payoff if logistics stable (see

table above); L_i – percentage loss if logistics lost; R_i – effective risk of logistics loss, depending on strategy (see Table 3).

Table 3 – Effective Risk Coefficients Associated with Each Innovation Strategy

Strategy	Risk R_i
S1	0.1 × 0.4 = 0.04 (minimal)
S2	1 × 0.4 = 0.4 (full risk)
S3	0.5 × 0.4 = 0.2 (moderate)
S4	1 × 0.4 = 0.4 (maximum)

Source: compiled by the author

This table presents the effective probability of logistics disruption (Ri) for each strategic option considered in the model. These coefficients are calculated by combining the base probability of a logistics failure due to wartime conditions (assumed to be 40%) with the degree to which each strategy mitigates or ignores this risk:

– S1 (Localization) significantly reduces exposure to logistics disruption. Only 10% of the base risk applies, resulting in an effective risk of 0.04, the lowest among all strategies;

– S2 (Digital transformation) does not address logistics risks directly, so it inherits the full base risk of 0.4;

– S3 (Supplier diversification) reduces logistics vulnerability by half, leading to a moderate effective risk of 0.2;

– S4 (Status quo) assumes no protective measures are taken, so it also retains the maximum risk of 0.4.

These values (Ri) are later used to calculate the expected payoff of each strategy by integrating the likelihood of disruption into the model. This allows for a more realistic, risk-adjusted evaluation of strategic choices.

Considering competition effects: competition reduces each company's payoff by 10% for every competitor choosing a strategy with a higher payoff.

For example, if C1 chooses S1 (highest payoff) and C2 and C3 choose S2 or

lower, C2 and C3's payoffs are penalized due to competitive disadvantage.

Calculation of expected payoffs (example for S1):

$W_{S1} = 0.96 \times 8 + 0.04 \times 8 \times (1 - 0.1) = 7.68 + 0.288 = 7.968$

Similarly for other strategies:

$W_{S2} = 0.6 \times 7 + 0.4 \times 7 \times 0.6 = 4.2 + 1.68 = 5.88$;

$W_{S3} = 0.8 \times 6 + 0.2 \times 6 \times 0.75 = 4.8 + 0.9 = 5.7$;

$W_{S4} = 0.6 \times 5 + 0.4 \times 5 \times 0.5 = 3 + 1 = 4$.

The Table 4 illustrates a simplified example of how three competing companies (C1, C2, and C3) might select different innovation strategies in wartime conditions and how these choices influence their expected payoffs. Each company's initial payoff is based on the previously calculated expected value of the chosen strategy, without considering market interactions. To account for competitive dynamics, a competition penalty is introduced: companies choosing strategies with lower expected returns relative to their rivals incur a proportional reduction in payoff. This reflects the idea that less competitive strategies may result in lost market share, lower customer confidence, or reduced investment attractiveness. The final payoff for each company thus represents a risk-adjusted and competition-sensitive outcome, providing a more realistic view of how strategic decisions play out in a competitive, high-risk environment such as wartime Ukraine.

Table 4 – Example strategy choices and payoffs for three companies

Company	Chosen strategy	Payoff without competition	Competition penalty	Final payoff
C1	S1	7.968	0	7.968
C2	S2	5.88	-0.1	5.29
C3	S3	5.7	-0.1	5.13

Source: compiled by the author

In the context of the ongoing Russian-Ukrainian war, Ukrainian enterprises face unprecedented challenges that heavily impact their innovation strategy choices. The model presented highlights the critical role of risk management related to logistics

disruptions, which are highly probable due to the military conflict. Among the four considered strategies – localization of production, digital transformation, diversification of suppliers, and maintaining the status quo – the localization strategy clearly emerges as the most advantageous. This approach minimizes dependence on vulnerable import channels, thereby significantly reducing the risk of supply chain interruptions and ensuring greater operational stability.

The quantitative analysis demonstrates that the expected payoff for localization not only surpasses other strategies under stable logistics conditions but also remains robust when accounting for the probability of logistics failure. Digital transformation and supplier diversification provide moderate benefits and risk mitigation, but their expected payoffs are noticeably lower compared to localization, especially when factoring in competitive pressures. Maintaining the status quo yields the lowest payoff, reflecting the dangers of inaction in such a volatile environment [14].

Competition further complicates strategic decision-making. Companies that adopt higher-payoff strategies tend to gain a competitive advantage, while those lagging behind face a reduction in their effective payoffs. This dynamic incentivizes firms to invest in stronger, more resilient innovation strategies rather than settling for less adaptive approaches [15]. Additionally, while combining strategies could potentially balance risk and reward, the model underscores that production localization remains the foundational pillar for maintaining business continuity in wartime conditions.

The application of game theory in this setting provides a rigorous and systematic framework for understanding the complex interplay between innovation strategies, risk factors, and competitive dynamics in a volatile environment. By formalizing strategic interactions, it allows managers to model various decision scenarios, predict competitors' responses, and identify stable outcomes where no participant has an incentive to deviate from their chosen strategy [16]. This approach enhances the precision of strategic planning by quantifying potential risks and payoffs, thus enabling companies to anticipate the likely moves of competitors, evaluate their own exposure to uncertainty, and make more informed, evidence-based decisions.

Moreover, game theory facilitates the development of adaptive strategies that

balance short-term resilience with long-term growth objectives. It helps enterprises determine when cooperation with competitors or partners may yield mutual benefits and when competition is the optimal path. Under wartime conditions, where resource scarcity, logistical instability, and regulatory volatility prevail, such analytical tools become indispensable for shaping strategies that ensure flexibility and sustainability. As the conflict persists, the integration of game-theoretic modeling into managerial decision-making provides Ukrainian enterprises with a vital mechanism not only to survive immediate disruptions but also to position themselves for innovation-driven recovery and long-term success amid persistent uncertainty.

Summary and conclusions.

The Russian-Ukrainian war has fundamentally reshaped the economic environment for Ukrainian enterprises, creating unprecedented challenges in strategic decision-making under conditions of uncertainty, instability, and risk. Businesses are forced to operate in a volatile context where market predictability is low, supply chains are disrupted, and investment resources are limited. In such an environment, the ability to anticipate competitors' actions, assess geopolitical and economic threats, and choose the most resilient and adaptive innovation strategies becomes not only a matter of competitiveness but also of survival. Strategic flexibility and analytical foresight are therefore critical components of modern management in wartime conditions.

This research demonstrates that game theory provides a powerful, structured, and quantitative framework for modeling strategic interactions among enterprises, particularly within high-risk and rapidly changing environments. It enables managers to simulate possible decisions of market participants, analyze mutual dependencies, and identify equilibrium points that balance risks and rewards. By incorporating variables such as logistics disruptions, changes in demand, and the behavior of rival firms, game theory supports the development of robust decision-making models that account for both cooperation and competition.

The analysis confirms that production localization is the most effective innovation

strategy under current wartime conditions, as it reduces dependence on vulnerable supply chains and enhances operational stability. Digital transformation and supplier diversification serve as important complementary strategies that strengthen resilience and flexibility, though they may not fully offset logistics and energy risks if applied separately. Overall, the findings highlight the need for integrated strategic modeling, where the use of game theory combined with real-time data supports adaptive, forward-looking decisions that foster sustainable recovery and strengthen post-war competitiveness.

Ultimately, the application of game theory in this context enables more rational, evidence-based strategic planning, helping enterprises navigate uncertainty and competition with greater confidence. It serves not only as an academic tool but as a practical instrument for business leaders seeking to align innovation efforts with the realities of conflict-driven risk.