

Anyalytic Hierarchy Process to Optimization of Strategic Resource Management in the Context of Innovative Development

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Abstract

The main purpose of the article is to optimize strategic resource management in conditions of innovative development and the intensification of crisis conditions as a result of the influence of war. For this purpose, the object of study is the resource provision of a modern enterprise. The research methodology involves the use of the BOCR method in combination with the AHP method, an expert analysis, which, using the Delphi method, made it possible to make the necessary comparisons. The article proposes a methodological approach that, through the BOCR method, allows for a holistic and multi-dimensional assessment of resource provision based on taking into account expected positive results, additional costs, new opportunities and possible risks. The modeling provided the necessary information basis for making and implementing management decisions in the conditions of innovative development and martial law in the country. Two possible options for adaptive strategies for enterprise development under martial law are assessed. Three forms of resource provision were identified for evaluation and compared with the components of BOCR to identify the optimal strategy. As a result, it has been proven that it is the dynamic development strategy that is most optimal in conditions of innovative development and the intensification of crisis conditions due to the influence of war.

Keywords: Management, Strategic Management, Resource, Crisis, Wartime, Innovative, Matrix Analysis, Adaptation

INTRODUCTION

In today's environment, enterprise resource management is a key aspect of achieving success. The effectiveness of this process determines a company's ability to achieve its goals, maintain competitiveness, and ultimately ensure its survival in the marketplace. Resource management covers a wide range of aspects - from financial and material resources to human and information resources, each of which plays a decisive role in the overall strategy of the enterprise. It should be noted that the very choice of the right resource management strategy is important due to the rapid changes that occur in the external business environment. Innovation, technological development, changes in consumer behavior and globalization require companies to be flexible and adaptable. The right strategy allows you to optimize the use of available resources, minimize costs and increase efficiency, which is the basis for ensuring sustainable development and growth. At the same time, effective resource management helps enterprises not only survive in difficult conditions, but also quickly respond to challenges and find new opportunities for development and innovation. This includes the ability to anticipate risks, allocate resources effectively to minimize them, and ensure continuous improvement of processes and products.

When choosing a strategy, it is important to take into account not only the current needs of the enterprise, but also to predict future trends and challenges. Adaptation to change, quick decision making and flexibility in resource management can be critical success factors. This is especially true in rapidly changing markets, where the ability to adapt can determine who stays afloat and who falls behind. Moreover, it is precisely in conditions of war or other crisis situations that the importance of resource management especially increases. Crises lead to a sharp increase in unpredictability, high risks and instability. Businesses faced additional challenges such as supply chain disruptions, loss of markets or limited access to resources. In such conditions, effective resource management becomes not just important, but critically necessary for survival. Consequently, crisis situations force enterprises to reconsider their strategies, look for new approaches to resource management, and be more

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innovative and flexible. The ability to quickly adapt, optimize the use of existing resources and find new sources ensures not only survival, but can become the basis for further development after the situation has stabilized. In war conditions, when the need for resources grows significantly, this becomes an integral part of strategic planning and management, which determines the ability of an enterprise not only to survive, but also to develop in new conditions.

The structure of the article involves a review of the literature, presentation of key research methods, coverage of key research results, their discussion and conclusions. The main purpose of the article is to optimize strategic resource management in conditions of innovative development and the intensification of crisis conditions as a result of the influence of war. For this purpose, the object of study is the resource provision of a modern enterprise.

LITERATURE REVIEW

This literature review synthesizes key findings from recent scholarly work that informs our study's approach to managing strategic resources effectively. Chlivickas et al. (2010) emphasize the strategic aspects of human resource management, arguing that human resources play a pivotal role in achieving business objectives through strategic management practices. Their insights lay the groundwork for understanding the significance of aligning resource management with strategic goals, a theme central to our research on optimizing resource provision in modern enterprises. The study by Alazzam et al. (2023) on developing an information model for E-Commerce platforms highlights the importance of digitalization in modern socio-economic systems. It underlines the need for legal compliance and the adoption of digital technologies to enhance the efficiency of e-commerce platforms. This perspective is vital for our research as it underscores the role of digitalization in strategic resource management amidst innovative development.

Kopytko et al. (2021) and Kuzior et al. (2023) address the management of security activities in innovative-active enterprises, offering insights into the challenges and strategies for ensuring security in a rapidly evolving business environment. This research aligns with our focus on managing resources in conditions of uncertainty, emphasizing the importance of security management as part of strategic resource planning. Alazzam et al. (2024) explore methodological approaches to business management strategy selection, particularly in the context of changes in commercial activities. Their findings contribute to our understanding of strategic decision-making in dynamic environments, highlighting the need for flexible and adaptable management strategies. Najah et al. (2022) discuss the development of human resources management in enhancing the quality of education, focusing on planning aspects. While their context is educational, the emphasis on planning and quality improvement is relevant to our study, illustrating the broader applicability of strategic human resources management.

Stachová et al. (2017) explore the efficient involvement of human resources in innovations through effective communication. Their research underlines the significance of integrating human resources into the innovation process, a concept that is pertinent to our study as we examine resource provision in the context of innovative development. Kumar and Anandan (2022) provide a comprehensive analysis of secured data storage and resource allocation in the cloud, aiming for performance enhancement. This study's focus on security and performance in data management offers insights into the technological aspects of resource optimization, relevant to our exploration of strategic resource management. Rushchyshyn et al. (2022) investigate the management of innovative development of enterprises considering their financial and resource opportunities within a security context. This research aligns with our thematic focus on managing resources innovatively and securely, especially under crisis conditions.

Sylkin et al. (2018) assess the financial security of engineering enterprises as a prerequisite for the application of anti-crisis management, while Kopytko and Sylkin (2023) model information support for combating corruption in economic security management. Both studies provide valuable perspectives on managing financial resources and security, contributing to our understanding of strategic resource management in challenging environments. Finally, Kopytko et al. (2022) focus on planning resource support for the management system to enhance competitiveness in socio-economic systems. Their approach to resource

planning and competitiveness offers methodological insights that enrich our study, particularly in assessing resource provision strategies under various external pressures.

The literature reviewed herein offers a multifaceted view of strategic resource management, encompassing human resources, digitalization, security, and financial planning. These studies collectively inform our research approach, highlighting the importance of an integrated and strategic framework for managing resources amidst innovative development and crisis conditions induced by war. Here some gaps in literature (Table 1).

Table 1: Key gaps in the literature in the context of the research topic

Gaps	Characteristics
Integration of strategic resource management with crisis and innovation dynamics	One significant gap in the existing literature is the comprehensive integration of strategic resource management practices within the dual contexts of innovative development and crisis conditions, especially those precipitated by war. While individual studies focus on aspects of innovation, crisis management, or strategic resource planning, there is a dearth of research that holistically combines these elements
Methodological approaches for adaptive strategy development under martial law	Another gap is the specific examination of how enterprises can develop adaptive strategies under martial law, a scenario that presents unique challenges to resource management and strategic planning. The existing literature provides limited guidance on the strategic management of resources in such extreme crisis conditions
Empirical validation of dynamic development strategies in war-affected contexts	There is also a notable gap in empirical research and validation of dynamic development strategies within the specific context of war and its impact on strategic resource management. While some studies may touch upon aspects of crisis management or innovation in challenging environments, the empirical examination of dynamic strategies as an optimal approach under the intensifying crisis conditions due to war is less explored

As a result of the analysis of the literature, we formed a scientific task in the form of identifying the most optimal adaptive resource management strategy in modern conditions.

METHODOLOGY

First of all, the AHP (Analytic Hierarchy Process) method was used in this study. This method identifies and solves complex multi-criteria problems by breaking them down into simpler components, then ranking them by importance and impact. In the context of our research, AHP is used as an expert analysis to compare and determine enterprise resource management strategies in conditions of innovative development and martial law. It helps to evaluate and compare possible solutions based on criteria of effectiveness and compliance with the objectives of the study. The method has a number of significant advantages that make it optimal for our research. The benefits of AHP include its ability to structure complex problems, incorporate expert opinions, and deliver clear results. This method makes it possible to systematize and harmonize different expert opinions on the importance of criteria and alternatives, which helps in determining optimal strategies for managing enterprise resources.

The BOCR method, which stands for Benefits, Opportunities, Costs, and Risks, forms the core of our analytical approach. It offers a structured framework for evaluating strategic decisions by systematically assessing their potential positive outcomes (Benefits), new possibilities they may unlock (Opportunities), associated expenditures (Costs), and possible downsides (Risks). This method is particularly suited to environments

characterized by high uncertainty and rapid change, such as those impacted by war. In our research, the BOCR method was applied to evaluate different strategies for managing resources under crisis conditions. This involved quantifying each strategy's benefits, opportunities, costs, and risks to ensure a holistic assessment of its viability and effectiveness. To enrich our understanding and ensure the relevance of our findings, we engaged in expert analysis. This involved consulting with a panel of specialists in strategic management, military affairs, and crisis response. These experts provided critical insights into the practical implications of our theoretical models, contributing depth and nuance to our analysis. The Delphi method was employed as a means of refining and validating our findings through expert consensus. This iterative process involved presenting our preliminary analysis to a panel of experts, who were then asked to provide feedback and suggestions for improvement. Multiple rounds of consultation were conducted, with the feedback from each round used to refine our analysis. This method helped mitigate individual biases and converge on a more accurate and comprehensive assessment of the strategic options under consideration.

RESULTS

To begin with, let's present two different strategies for adapting enterprise development under martial law and give them the symbol M1 and M2, respectively:

M1. Dynamic development strategy flexibility. The dynamic development strategy (M1) emphasizes agility, innovation, and flexibility. This approach involves continuously assessing the changing external environment and adjusting internal processes, resources, and strategies accordingly. Enterprises adopting this strategy aim to exploit new opportunities that arise from the crisis conditions, leveraging innovation to gain a competitive edge. This might include diversifying product lines, entering new markets, or adopting new technologies to improve efficiency and meet shifting consumer demands. In the context of martial law and war, a dynamic strategy could involve reallocating resources to essential operations, adapting supply chains to avoid disruptions, and maintaining a strong focus on research and development to stay ahead of the curve. The goal is to not just survive the crisis but to emerge stronger and more competitive.

M2. Static development strategy. On the other hand, the static development strategy (M2) takes a more conservative approach. It focuses on maintaining current operations with minimal changes, prioritizing stability and risk minimization over growth or innovation. Enterprises adopting this strategy may concentrate on preserving resources, such as capital and labor, and protecting existing market positions rather than seeking new opportunities. In scenarios of intensified crisis conditions, such as during war or under martial law, a static strategy might involve strengthening existing supply chains, focusing on core competencies, and avoiding investments in new ventures or technologies that could strain resources. This approach aims to ensure the enterprise's survival through the crisis by minimizing exposure to volatile markets and uncertain conditions.

We believe that M1 is the most optimal, and because of this, by involving experts, we will prove this hypothesis through BOCR comparing according to the following criteria:

B (Benefits). compliance with priority areas of security; compliance with the goals of the enterprise; provision of innovative potential (B1-B3).

O (Opportunities) consists of the following criteria: degree of novelty; the degree of novelty of the results; perspective (O1-O3).

C (Costs) consists of the following criteria: resource provision costs; for wages; on stimulation (C1-C3).

R (Risks) consists of such criteria as: risks of disclosure of confidential information (trade secrets); the risk of insufficient provision of resources; risk of insufficient qualification of personnel (R1-R3).

Comparing according to these criteria, we should also consider resource provision and determine the distribution of these resources in accordance with existing trends. Three options for resource provision were selected together with experts: proportional to income; in accordance with the need to eliminate the impact of key threats; with the allocation of the constant and variable part (P1-P3).

Now, based on the information described above, with the help of AHP method, we will build a hierarchical model of BOCR assessment of a dynamic adaptive strategy for innovative development of a modern Ukrainian enterprise (Figure 1).

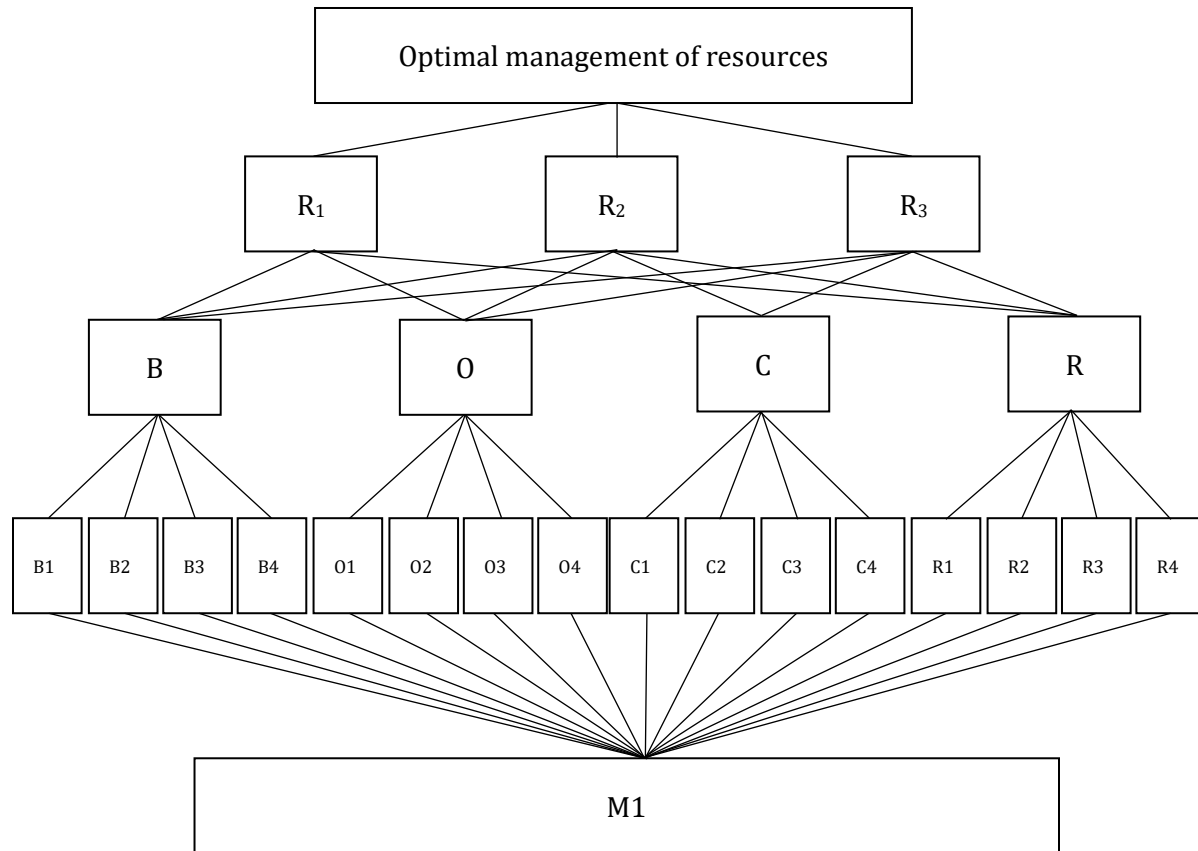


Figure 1: Hierarchical model of AHP-assessment of a dynamic adaptive strategy for innovative development of a modern Ukrainian enterprise

Next, it is necessary to carry out, according to our approach, a number of comparisons of resource provision options with the goal set by the M1 strategy, namely "Optimal management of resources", for this, equality (1) is fulfilled accordingly:

$$\frac{n*(n-1)}{2} \tag{1}$$

where n represents the number of cases at one level. As a result, we will construct the combined matrix (2):

$$A = \begin{pmatrix} 1 & 1/5 & 3 \\ 5 & 1 & 7 \\ 1/3 & 1/7 & 1 \end{pmatrix} \tag{2}$$

Next, the BOCR components of the proposed adaptive strategy should be compared with respect to options for resource provision through experts (3):

$$m = \frac{n*(n-1)}{2} \tag{3}$$

where m is the number of criteria, i.e. it is necessary to compare three pairs of objects of comparison (three forms of resource provision). To do this, we will build a corresponding matrix table (Table 2).

Table 2: Comparison of adaptive strategy with respect to options for resource provision

Variants of resource provision	The Results
P ₁	$\begin{pmatrix} 1 & 8 & 4 & 6 \\ 1/8 & 1 & 1 & 2 \\ 1/4 & 1 & 1 & 1 \\ 1/6 & 1/2 & 1 & 1 \end{pmatrix}$
P ₂	$\begin{pmatrix} 1 & 9 & 5 & 7 \\ 1/9 & 1 & 1 & 5 \\ 1/5 & 1 & 1 & 1 \\ 1/7 & 1/5 & 1 & 1 \end{pmatrix}$
P ₃	$\begin{pmatrix} 1 & 7 & 3 & 5 \\ 1/7 & 1 & 1 & 1 \\ 1/3 & 1 & 1 & 1 \\ 1/5 & 1 & 1 & 1 \end{pmatrix}$

It can be noted that we almost always place "1" on the diagonal. Within this method, the pairwise comparison matrix is formed in such a way that each matrix element represents the relative importance of the row element compared to the column element. Ones are always placed along the matrix diagonal because this reflects the comparison of an element with itself, and, naturally, each element is absolutely equivalent to itself, hence the importance is the same, which is expressed through 1. When a fraction in the form of "1/X" (where X is a number) is used in the matrix, it means the inverse importance compared to the direct comparison. If one element is considered X times more important than another in a direct comparison, then in the inverse comparison, the second element will be X times less important than the first, which is expressed through "1/X". This maintains consistency in the comparison, because if A is more important than B, then automatically B is less important than A, and this relationship is expressed through the inverse value.

Next, it is necessary to calculate the relative importance of the compared objects through expert analysis (4)

$$w_i = \frac{\sqrt[m]{a_{i1} \cdot a_{i2} \cdot \dots \cdot a_{im}}}{\sum \sqrt[m]{a_{i1} \cdot a_{i2} \cdot \dots \cdot a_{im}}} \tag{4}$$

where a_{ij} is the i element of the j row of the matrix of pairwise comparisons of the elements of the set.

For example, with respect to P1, we obtain the following result (5)

$$w_i = \frac{\sqrt[3]{1 \cdot \frac{1}{5} \cdot 3}}{\sqrt[3]{1 \cdot \frac{1}{5} \cdot 3} + \sqrt[3]{5 \cdot 1 \cdot 7} + \sqrt[3]{1 \cdot 3 \cdot \frac{1}{7} \cdot 1}} = 0.18 \tag{5}$$

The same is done for P2 and P3. As a result, we will get 0.74 and 0.08. Total is 1 as required according to the procedure.

We multiply the matrix of pairwise comparisons by the obtained estimate of the vector $A \times w_i$ and obtain a new vector of relative importance (6):

$$A * w_i = \begin{pmatrix} 1 & 1/5 & 3 \\ 5 & 1 & 7 \\ 1/3 & 1/7 & 1 \end{pmatrix} * \begin{pmatrix} 0.18 \\ 0.74 \\ 0.08 \end{pmatrix} = \begin{pmatrix} 0.577 \\ 2.239 \\ 0.248 \end{pmatrix} \quad (6)$$

To estimate the value of λ_{\max} , we divide the components of the product $A \times w_i$ component by component into the components of the vector of relative importance (7):

$$P_1=0.577/0.18=3.07; P_2=2.239/0.74=3.06; P_3=0.248/0.08=3.02 \quad (7)$$

Therefore, we obtain the following maximum eigenvalue (8)

$$\lambda_{\max} = \frac{3.07+3.06+3.02}{3} = 3.05 \quad (8)$$

Next, we calculate the consistency index (9):

$$J_p = \frac{\lambda_{\max} - m}{m - 1} \quad (9)$$

Therefore, the value of which is compared with the reference value. If J_p is less than 0.1, then the evaluation results are satisfactory. In our case, the benchmark will be 0.58, since we have 3 forms of resource provision. There is a generally accepted table of reference values of the consistency index for different numbers of objects being compared. This table makes it possible to determine the acceptable level of random discrepancies in estimates. If the real consistency index exceeds the reference value for a given number of objects, this may indicate an unacceptably high level of inconsistency in the estimates and the need to revise them. Thus, our J_p value is 0.028, and the standard is 0.58: $0.028/0.58=0.04$, i.e., the results obtained by experts are within the norm. Accordingly, we have the following system of equations for calculating the weights of BOCR components according to our dynamic adaptive strategy with respect to all forms of resource provision (10)

$$\begin{aligned} U_B &= w_1 \times u'_{11} + w_2 \times u'_{21} + w_3 \times u'_{31} \\ U_O &= w_1 \times u'_{12} + w_2 \times u'_{22} + w_3 \times u'_{32} \\ U_C &= w_1 \times u'_{13} + w_2 \times u'_{23} + w_3 \times u'_{33} \\ U_R &= w_1 \times u'_{14} + w_2 \times u'_{24} + w_3 \times u'_{34} \end{aligned} \quad (10)$$

Let's substitute the value for each BOCR criterion (4 together) and get skipping intermediate calculations:

$$UB=0.65$$

$$UO=0.125$$

$$UC=0.125$$

$$UR=0.1$$

M1's strength is significantly revealed through its flexibility and emphasis on innovation, as identified in the B (Benefits) criteria of the BOCR analysis. This strategy's dynamic nature allows enterprises to quickly adapt to changes in the external environment, capitalizing on new opportunities and mitigating emerging threats. The dynamic development strategy excels in optimizing resources, making it more attractive compared to static strategies. By continuously adjusting its resource allocation in response to changing circumstances, M1 ensures that the enterprise remains efficient and competitive. M1 proves optimal when resources are allocated proportionally to income, enabling the enterprise to invest in growth and innovation while maintaining financial stability. It also excels when resources are directed specifically towards mitigating key threats, ensuring that the enterprise can navigate through crises by focusing on critical vulnerabilities.

The dynamic development strategy (M1) is highly effective in a range of scenarios, particularly in times of crisis such as those induced by war or under martial law conditions. Its strength lies in its ability to adapt, innovate, and optimize resources, as highlighted by the B criteria.

DISCUSSION

This chapter draws comparisons between our results and those of recent studies, particularly focusing on digital technology applications in human resources management, institutional dynamics in regional development, e-business performance in tourism, crisis management in banking institutions, investment and innovative development in industrial enterprises, security management, and human resources management in Islamic educational institutions. Our study aligns with Urba et al. (2022) findings on the importance of digital technologies for managing resources in a modern enterprise. While Urba et al. focused on human resources within engineering enterprises, our research broadens the scope to strategic resources at large, advocating for a holistic approach that integrates digital technologies to enhance adaptability and resilience under crisis conditions. The methodological approach discussed by Bazyluk et al. (2019) provides insights into the comparative analysis of regional development, which complements our assessment of strategic resource management by highlighting the importance of understanding institutional dynamics. Our research takes this a step further by applying the BOCR and AHP methods to evaluate and optimize resource management strategies in a way that is sensitive to the dynamic external environment.

Krupa et al. (2023) evaluation of e-business performance echoes our emphasis on innovative development and the utilization of digital technologies. Our research contributes to this discussion by showcasing how such technologies can be strategically managed to support enterprise development under martial law, offering a broader application of digital innovations in crisis conditions. The focus on anti-crisis management in Mihus et al. (2020) study parallels our research's concern with managing resources in crisis conditions. Our results show that the dynamic development strategy is supported by a comprehensive BOCR analysis and the use of the AHP method, can offer valuable insights into enhancing economic security and resilience, which is crucial for the banking sector as well. Iastremska et al. (2019) investigation into the role of investment in fostering innovative development aligns with our emphasis on seizing new opportunities. Our study advances this by demonstrating how strategic resource management, informed by an optimal strategy identified through the BOCR and AHP methods, can facilitate sustained innovative growth even in crisis situations.

The security classification model proposed by Wu and Meng (2019) provides a framework for managing information resources securely. Our research complements this by offering a strategic management perspective that incorporates security considerations into the broader context of resource optimization, emphasizing the need for a multidimensional assessment of risks. While Julhadi and Ritonga (2023) focus on human resources management in a specific context, our research broadens the discussion to strategic resource management in enterprises facing crisis conditions due to war. Both studies highlight the critical role of adaptive strategies in maintaining competitiveness and resilience.

Rushchyshyn et al. (2022) focus on managing innovative development considering financial and resource opportunities resonates with our research's objective. We build on this by providing a methodological approach that allows enterprises to navigate the complexities of innovative development and security in a volatile external environment. The methodological approach to optimizing financial resources outlined by Kopytko et al. (2023) complements our study's focus on strategic resource management. Both emphasize the importance of adapting to dynamic external environments, with our research providing a comprehensive framework for assessing and implementing adaptive strategies.

CONCLUSION AND RECOMMENDATION

The primary objective of our research was to optimize the management of strategic resources under the dual pressures of innovative development and crisis conditions exacerbated by war. Through our comprehensive analysis utilizing the BOCR and AHP methods combined with expert analysis and the Delphi method, we have proposed a methodological approach designed to assess resource provision in a holistic and multi-dimensional manner. This approach factors in expected positive outcomes, additional costs, new opportunities, and potential

risks, providing a robust foundation for informed management decision-making in the face of innovative development and the exigencies of martial law. Our findings suggest that adopting a dynamic development strategy is the most effective course of action for enterprises navigating the complexities of innovation and crisis conditions precipitated by warfare. Through the AHP method, the selected resource management strategies were ranked based on their importance and impact on achieving the research objective. This strategy's superiority is evidenced by its alignment with the various components of the BOCR analysis—benefits, opportunities, costs, and risks—demonstrating its comprehensive nature and its potential to facilitate adaptive and resilient organizational growth. Moreover, our research assessed two possible adaptive strategies for enterprise development under martial law, identifying three distinct forms of resource provision for evaluation. By comparing these against the BOCR framework, we determined the optimal strategy for managing resources in such turbulent times.

Research has limits. So, our research focused primarily on the theoretical and methodological aspects, with less emphasis on empirical validation across various sectors and regions affected by conflict. Future research could benefit from incorporating case studies and real-world data to further validate and refine the proposed strategies. In conclusion, despite these limitations, our research contributes valuable insights into strategic resource management during times of innovation and crisis, offering a pathway for enterprises to navigate the challenges posed by war and conflict. Future studies are encouraged to build on this foundation, exploring diverse contexts and empirical evidence to enhance the robustness and applicability of the strategies proposed.

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