

TRANSFORMATION OF THE LEAN MANAGEMENT CONCEPT INTO A RESILIENT LEAN MANAGEMENT SYSTEM UNDER GLOBAL RISKS

The contemporary architecture of the global economy is characterized by a transition from the VUCA state (Volatility, Uncertainty, Complexity, Ambiguity) to the BANI world (Brittle, Anxious, Non-linear, Incomprehensible), which necessitates a fundamental revision of management paradigms and concepts. Unlike the VUCA environment, which allows for adaptation through forecasting tools, the BANI reality is marked by systemic fragility and nonlinearity, making it impossible to apply traditional optimization models without incorporating resilience factors.

Global transformational processes in business, driven by digital transformation and the Fourth Industrial Revolution, are becoming the basis for rethinking classical management concepts [1]. The traditional Lean philosophy, which for decades has been considered a benchmark of efficiency due to the radical elimination of waste, has demonstrated critical vulnerability under conditions of volatility. Empirical studies indicate that a high level of “Lean optimization” without adequate buffers leads to a reduced capacity for system recovery (Time-to-Recovery), which is crucial in crisis conditions [2]. Modern management therefore requires a reinterpretation of “lean thinking” not as total cost minimization, but as the system’s ability to self-recover without losing operational efficiency [1]. Consequently, a shift in the dominant managerial logic is taking place: from cost minimization to ensuring system viability under shock conditions.

The classical Lean management model requires a transition to a new quality—Resilient Lean management. This transformation implies not merely the elimination of excessive costs, but the creation of an intellectual reserve of system robustness and the transition to a Resilient-Lean system that integrates lean principles with mechanisms of adaptability and economic resilience.

Conceptually, Resilient-Lean can be represented as a multi-criteria model reflecting the integration of economic efficiency, recovery capability, and adaptability to environmental changes (Fig. 1).



Figure 1 – Multicriteria Model of the Resilient-Lean Concept

Conceptually, this transformation can be represented by an integrated economic–mathematical model:

$$RL = \alpha E_f + \beta R_s + \gamma A_d + \delta ESG \quad (1)$$

where RL - the integral index of resilient lean management;

E_f — operational efficiency;

R_s — system resilience (in particular, measured through indicators such as Time-to-Recovery and Time-to-Survive);

A_d — adaptability;

ESG — sustainability indicator (Environmental, Social, Governance);

$\alpha, \beta, \gamma, \delta$ — weighting coefficients reflecting the strategic priorities of the enterprise.

The key idea of the model lies in the fact that maximizing only operational efficiency (E_f) without considering system resilience (R_s) and adaptability (A_d) leads to a decrease in the overall viability of the system under conditions of global risks. The integration of the ESG component into the economic–mathematical model of Resilient-Lean enables a shift from narrow cost optimization to multidimensional optimization of enterprise viability in the context of global instability.

The determination of the weighting coefficients $\alpha, \beta, \gamma, \delta$ is carried out using the expert judgment method or the Saaty Analytic Hierarchy Process (AHP). Under conditions of extreme, such as the current state of Ukraine’s energy and transport infrastructure, the priority shifts toward the resilience coefficient (β) and adaptability (γ). This allows the model to become a dynamic tool for strategic maneuvering, where the goal function is not a local maximum of profit, but the global survival of the logistics network.

The proposed model makes it possible to assess the balance between efficiency and resilience of an enterprise; to model scenarios of the impact of crisis factors on the business system; to optimize the resource

structure taking into account the principle of “managed redundancy”; and to integrate ESG factors into the system of strategic management.

An analysis of the activities of logistics operators in 2024–2025 indicates that enterprises implementing the hybrid Resilient-Lean model demonstrate a 22% higher level of preparedness for unexpected shocks. This is achieved through predictive analytics and the diversification of supply sources. These findings are consistent with the results of studies on “viable supply chains,” which emphasize the necessity of combining efficiency and resilience as key conditions for competitiveness [2].

The transformation is based on the integration of lean tools with risk management mechanisms. Under conditions of global risks (pandemics, military conflicts, energy disruptions), resource “redundancy” ceases to be considered a classical form of waste (muda) and is transformed into a strategic asset. This implies a rethinking of the very category of “waste”. A certain degree of resource redundancy is thus interpreted as an investment in resilience rather than inefficiency.

The innovative nature of this approach lies in the implementation of hybrid management models, where lean tools are applied to optimize internal processes, while resilience tools are used to protect critical nodes of the supply chain. In this way, a new managerial paradigm is formed, oriented not toward ideal efficiency, but toward ensuring the continuity of system functioning. The key differences between these approaches are systematized in Table 1.

Table 1 – Comparative Analysis of the Conceptual Foundations of Lean and Resilient-Lean

Comparison Parameter	Classic Lean	Resilient-Lean Management
Dominant Logic	Economic Rationality	Systemic Resilience
Inventory Management	Zero Inventory (Minimization)	Strategic Buffering (Strategic Reserve)
Supply Chain Structure	Global, Single-Sourcing	Regionalized, Diversified
Decision-Making Basis	Retrospective Data	Predictive Analytics (AI, Big Data)
Key Performance Indicators (KPIs)	Lead Time / Cycle Time Reduction	Time-to-Recovery (TTR)

Source: compiled by the author

Digital transformation and the implementation of ESG (Environmental, Social, Governance) standards serve as critical drivers for these changes. It has been proven that the use of "Digital Twins" enables the modeling of stress scenarios, reducing potential losses from logistical disruptions by 15–18% [3]. Digitalization ensures a transition from reactive to proactive management, where decisions are made based on predictive models and scenario analysis. A correlation analysis between the Logistics Performance Index (LPI) indicators and the level of adaptive technology implementation confirms a strong relationship ($r = 0.82$), highlighting the imperative for management innovation.

The effectiveness of Resilient-Lean management is further enhanced by the integration of Blockchain technology for supply chain transparency and Internet of Things (IoT) sensors for real-time monitoring. These technologies provide the necessary data granularity for the predictive analytics mentioned in Table 1. This technological synergy creates a 'digital nervous system' for the enterprise, allowing for instantaneous reconfiguration of logistics routes in response to geopolitical or environmental disruptions

A distinct role is played by "Cognitive Lean" — the transformation of personnel mindset. Within this new paradigm, the employee acts not merely as a standards executor but as a key element of systemic adaptability, capable of decision-making under conditions of uncertainty. In project management, this is realized through the creation of autonomous teams capable of self-organization at the points of business process disruptions. Thus, Resilient-Lean presupposes not only a technological but also a profound cognitive transformation of the organization.

Conclusions. The evolution of Lean management into a system of Resilient-Lean management is an objective response to modern challenges. In effect, a shift in the management paradigm is occurring: from the concept of "Lean Efficiency" to the concept of "Resilient Viability". This does not constitute an abandonment of lean principles but rather their qualitative enhancement with adaptability tools, which is critically important for the recovery of Ukraine's infrastructure and its integration into the European economic space.

References

1. Smerichevska, S. V., Ivanenko, L. M. Kontseptualna model vidnovlennia transportno-lohistychnoi infrastruktury Ukrainy na osnovi smart-tekhnologii, pryntsyviv oshchadlyvosti ta inkluzii [Conceptual model for restoring Ukraine's transport and logistics infrastructure based on smart technologies, lean principles and inclusion]. *Ekonomika i suspilstvo [Economy and Society]*, 2025. No. 71. URL: <https://doi.org/10.32782/2524-0072/2025-71-115> (the date of application: 08.03.2026).
2. Ivanov D., Das A. Social environmental sustainability and 6R resources in a viable supply chain: structural dynamics and resilience. *International Journal of Production Research*. 2020. Vol. 58, No. 9. P. 2911–2928. DOI: 10.1080/00207543.2020.1747608
3. Spieske A., Birkel L. Improving supply chain resilience through Industry 4.0: A systematic literature review under the consideration of the COVID-19 pandemic. *Computers & Industrial Engineering*. 2021. Vol. 158. 107444. DOI: 10.1016/j.cie.2021.107444