JEL: B41; C69; M21

Sahaidak Mykhailo
Doctor of Science in Economics, Professor,
Head of the Department of Management
Kyiv National Economic University named after Vadym Hetman
Ukraine
ORCID: 0000-0001-6526-1170

Perekytsai Maksym
PhD student, State University of Economics and Technology
Ukraine
ORCID: 0009-0008-8830-5381

https://doi.org/10.60022/sis.3.(02).4

NETWORK GOVERNANCE IN THE SMART ECONOMY: A NOVEL FRAMEWORK FOR INTEGRATED PERFORMANCE ASSESSMENT

Abstract. *The rapid transformation of global economic systems under the influence of digitalization, platformization, and emerging Industry 6.0 technologies has intensified the need for advanced tools to evaluate the effectiveness of network governance. Traditional assessment approaches, which focus primarily on organizational performance at the firm level, are no longer sufficient for capturing the complexity, connectivity, and dynamic interactions inherent in modern networked enterprises. This study proposes a novel integrated framework for assessing the performance of network governance within the smart economy, combining structural, relational, institutional, strategic, and resilience-oriented perspectives.*

The research develops the S–Q–I–T–R model, which includes five key dimensions: network structure (S), interaction quality (Q), institutional maturity (I), strategic and innovation outcomes (T), and resilience capacity (R). The methodological foundation of the framework integrates Social Network Analysis, multi-criteria decision-making methods (AHP, entropy weighting, hybrid MCDM), Data Envelopment Analysis (including Network DEA), TOPSIS, and normalization procedures. This hybrid, multidimensional design enables both a comprehensive and analytically rigorous evaluation of network performance.

The proposed methodology offers a scalable and adaptable tool for studying business networks, service networks, entrepreneurial ecosystems, platform-based organizations, and cross-sectoral alliances. By addressing trust mechanisms, digital governance structures, innovation synergy, and resilience to disruptions, the framework is well aligned with the demands of smart and cyber-physical economic environments.

The findings contribute to the advancement of network governance theory and provide practitioners with a robust analytical instrument for diagnosing effectiveness, identifying weaknesses, and enhancing the strategic capacity of networked enterprises in the era of digital transformation and Industry 6.0.

Keywords: *network governance, smart economy, Industry 6.0, integrated performance assessment, resilience index.*

1. Introduction

The rapid transformation of the global economy, the digitalization of business processes, the active spread of platform models and the acceleration of innovation cycles are fundamentally changing the nature of entrepreneurial activity. In such conditions, flexibility, the ability to self-organize and the formation of horizontal connections that ensure rapid adaptation to external changes become key. It is these properties that are inherent in modern network business structures, which are increasingly considered as the basic form of organizing entrepreneurship in the conditions of the smart economy.

The smart economy, which is formed at the intersection of digital technologies, innovative mechanisms of cooperation and sustainable development, defines new requirements for the tools of enterprise management. In it, not only traditional factors of production play a key role, but also intellectual resources, interaction of participants in economic systems, the speed of information flows, the intensity of knowledge exchange and synergy between network entities. Entrepreneurship in such conditions takes on new forms, among which network structures — business ecosystems, platforms, franchise models, groups of enterprises — become the core of innovative and economic development.

Smart economy is an economic paradigm in which digital technologies, intelligent platforms, big data and horizontal interactions between enterprises create new value. According to Forrester forecasts, the global digital economy will grow to 16.5 trillion US dollars by 2028 to cover approximately 17% of global GDP [1]. This underlines the growing importance of digital networks and platforms in economic development. At the same time, mobile technologies and their impact on global connectivity generate additional value: according to estimates by GSMA Intelligence, digital transformation and expanded connectivity could add 11 trillion US dollars to global GDP by 2030, which will be about 8.4% of the economy [2]. At the same time, the global digital platforms market in 2024 was estimated at about 45.6 billion US dollars in the e-commerce platform segment alone, and by 2033 it is expected to grow at a CAGR of over 20% [3].

Another important component of the network economy is the creator economy: It's a $250 billion global force reshaping how brands build loyalty, drive engagement and grow their businesses. Once viewed as a playground for influencers, today's creator economy is at the center of serious business strategies — and it's only getting bigger. Goldman Sachs predicts it could nearly double to $480 billion by 2027, according to their 2023 Creator Economy report [4].

These data confirm the fundamental importance of network structures in modern economic development. In this context, entrepreneurship does not simply use digital tools, but is transformed: business networks, platforms, ecosystems become key actors in the economy. They create new value not only through products and services, but also through interaction, knowledge exchange, and synergy of participants.

At the same time, network business structures, which have a high potential for scalability, innovation, and flexible adaptation, face a number of challenges related to managing complex interdependencies between network participants. This necessitates the creation of new methodological approaches to assessing the effectiveness of management of such structures. Traditional tools applied to individual enterprises do not take into account the specifics of network interaction: multi-actor, lack of rigid hierarchy, information asymmetry, multi-level institutional maturity, distributed nature of resources, multi-channel communications, and dynamism of management circuits.

Existing methods in economic science for assessing the effectiveness of network systems are fragmentary and mainly focused on individual aspects of network functioning — structural characteristics, management relations, indicators of economic performance or the level of institutional interaction. A significant part of these methods was formed before the digital era and does not take into account modern factors — digital management platforms, the speed of information dissemination, the intensity of communications, the virtualization of part of interactions, the strategic flexibility of networks or their resilient nature. That's why, within the framework of the smart economy, the formation of a new, integrated methodology for assessing the effectiveness of network structure management, capable of taking into account the complexity and multidimensionality of modern business networks, is becoming particularly relevant. Such a methodology should provide a combination of structural, behavioral, institutional, strategic and sustainability parameters, which in the complex determine the network's ability to adapt to changes, ensure innovative growth and maintain competitiveness.

In the context of entrepreneurship, network structures are not just a form of business organization, but a mechanism for creating new value through cooperation, partnership and integration of complementary competencies. In the smart economy, network business models have become the foundation for the development of startups, service platforms, e-commerce, hotel and tourism networks, logistics clusters, digital marketplaces and innovation ecosystems. They form a new type of competitiveness — collective, based not only on products, but on connections, flows, integrated services and cross-functional competencies.

In this context, assessing the effectiveness of network structure management is a critically important condition for:

– strategic business development;
– identification of growth points and nodes of inefficiency;
– optimization of resource flows;
– increasing resilience to external shocks;
– strengthening innovation potential;
– forming competitive positions in the long term.

However, a comprehensive, methodologically coherent model for assessing network structure management has not yet existed. This gap is filled by the proposed improved methodology, which is based on the synthesis of network analysis (SNA), Data Envelopment Analysis (DEA), multi-criteria decision-making (MCDM) methods, entropy weighting, trust indicators, interaction intensity and innovation synergy. Its uniqueness lies in the introduction of a new block — the resilience index (R) [5; 6; 7], which is key for the smart economy and entrepreneurship in conditions of instability, in particular military and post-war challenges.

From the point of view of the issues of modern scientific journals focused on entrepreneurship, innovation and the smart economy, the proposed methodology integrates several key thematic areas that are in the focus of international academic discussion:

– development of business networks and business ecosystems as drivers of economic growth;
– digital transformation of management systems;
– formation of adaptive business models in crisis conditions;
– increasing the resilience and innovativeness of business structures;
– use of quantitative and combined methods of assessing efficiency;
– combination of economic, behavioral and institutional theory in the study of network systems;
– construction of new analytical models for decision-making in the smart economy.

All this makes the improved methodology not just an assessment tool, but a conceptually new approach to understanding the effectiveness of business management in its modern network format. Unlike enterprises with a traditional structure, network systems are characterized by a multiplicity of interdependent elements, complex relationships, cross-functional roles and digital information flows. This requires a different management logic based on synergy, coordination, partnership, flexibility and adaptability, as well as modern methods of quantitative diagnostics of network interactions.

The proposed methodology allows for a comprehensive assessment of the network structure through five dimensions — structural, behavioral, institutional, strategic-innovative and resilience. It forms a holistic view of the network system, allows you to identify hidden nodes of inefficiency, determine the level of integration and coherence of interactions, assess the innovative ability of the network and its strategic position compared to other market players.

Thus, the improved methodology for assessing the effectiveness of network structure management is relevant not only in theoretical but also in practical terms. It can be applied to the analysis of enterprise groups, industry networks, hotel and tourism network associations, innovation clusters, franchising structures, and digital platforms.

2. Materials and Methods

This study is based on a combination of conceptual, analytical, and empirical methodological approaches designed to develop an integrated framework for assessing the effectiveness of network governance within the smart economy paradigm. The research relies on three groups of materials: (1) theoretical sources, (2) analytical tools for quantitative and qualitative evaluation of networks, and (3) conceptual models of networked enterprise systems.

1. Theoretical materials. The methodological foundation of the study draws on modern scientific literature related to network theory [8; 9], network governance [10; 11], smart economy concepts [12], entrepreneurial ecosystems [13; 14], digital platforms [15; 16; 17], and inter-organizational cooperation models [18]. Special attention is paid to theories addressing network coordination, trust-based interactions, and multi-actor decision-making in complex socio-economic systems. These materials serve as the conceptual basis for identifying the core dimensions of network effectiveness and forming the structure of the improved assessment methodology.

2. Methodological basis and analytical tools.

The methodological apparatus of the research is grounded in a multidisciplinary approach, which integrates:

Social Network Analysis (SNA) — to identify structural characteristics of networks, including density, centrality, connectivity patterns, and interaction intensity.

Multi-Criteria Decision-Making (MCDM) — to determine the relative importance of assessment dimensions. Methods such as AHP, entropy weighting, and hybrid approaches are used to obtain balanced and objective weights.

Data Envelopment Analysis (DEA) and Network DEA — to evaluate the efficiency of network nodes and multi-stage processes within networked enterprises.

TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) — for comparative assessment and ranking of network systems by their proximity to an ideal performance profile [19; 20].

Normalization techniques (min–max) — to ensure comparability of heterogeneous indicators.

Resilience assessment models — incorporating redundancy, recovery speed, and diversity metrics as key components for evaluating adaptive capacity within network structures.

These methods form the analytical foundation of the proposed framework and enable a structured, quantitative assessment of network governance effectiveness.

3. *Conceptual integration and model development.*

The methodological design also includes a conceptual synthesis approach. This involves integrating structural (S), interactional (Q), institutional (I), strategic/innovation (T), and resilience (R) dimensions into a unified assessment model. The S–Q–I–T–R framework is developed through systematic comparison of existing evaluation approaches, critical analysis of gaps in previous methodologies, and adaptation of network governance principles to the conditions of a smart economy.

4. *Algorithmic formulation*. The methodological section incorporates the development of a step-by-step assessment algorithm that includes indicator selection, data normalization, weight determination, aggregation of sub-indices, computation of the integrated performance index, and interpretation of results. This stepwise approach ensures replicability and transparency of the proposed assessment model.

In Figure 1 we demonstrate methodological framework for the author's integrated assessment of network governance in the smart economy.

Overall, the study uses a combination of theoretical systematization, comparative methodological analysis, and quantitative modeling approaches, which together create the foundation for the improved integrated methodology presented in the Results and Discussion section.

3. Results and Discussion

The improved methodology proposed below is based on the development of M. Bosovska's ideas [21] and supplements them with the tools of network analysis, multi-stage efficiency assessment, multi-criteria decision-making methods, entropy weighting, formalized trust indices and interaction intensity, as well as a new block — the resilience index, which is critically important for ensuring the stability of networks in conditions of turbulence and crisis phenomena.

The key task in improving the methodology was to expand M. Bosovska's aggregated index into a multilayer, dynamic methodology that integrates network topology (SNA metrics), multi-stage DEA (Network-DEA) for multi-component nodes, MCDM with objective (entropy/ML) weighting, stability/resilience metrics, and a real-time KPI dashboard for Industry 6.0 / services.

We propose to make certain conceptual changes to the methodology of M. Bosovska by adding the following components:

Index layers — it is necessary to divide each group (S, Q, I, T) into sublayers: structural, behavioral, operational, digital. This gives the most detailed dynamic assessment and preserves the aggregated index.

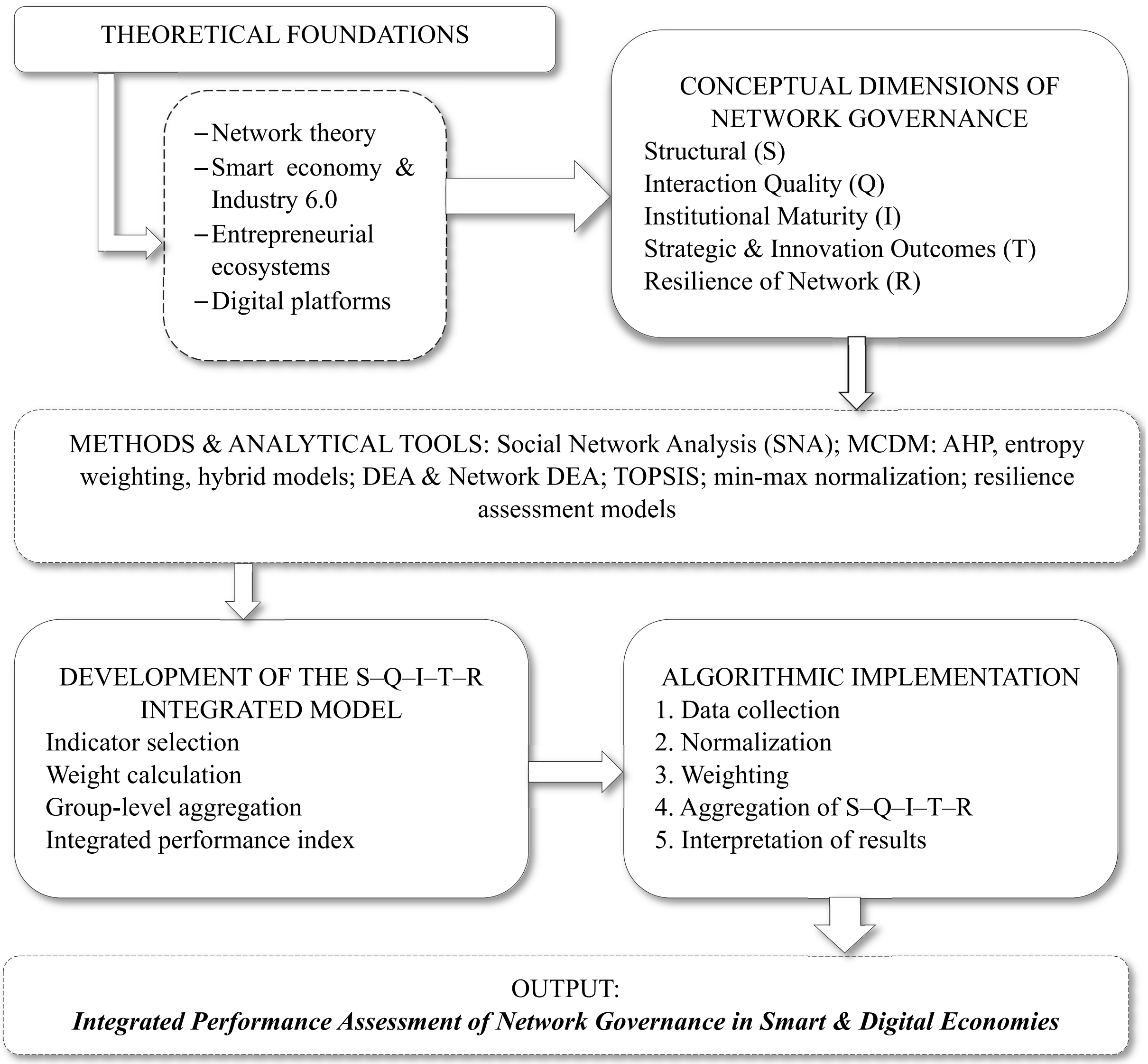

Figure 1. Methodological Framework for the Integrated Assessment of Network Governance in the Smart Economy
Source: created by authors

Integration of SNA metrics (centrality, betweenness, density, clustering coefficient) as a component of S, because the network structure determines the efficiency of coordination and diffusion of innovations. European cluster studies actively use SNA metrics.

Network-DEA (NDEA) instead of classic DEA: allows you to evaluate multi-stage DMUs (nodes with internal subprocesses) and measure the internal efficiency of the network. This is especially important for service platforms and industry 6.0, where DMUs are multifunctional nodes.

Dynamic / time component: the index should be calculated over time (quarterly/monthly) — add Δ-metrics (growth rates III, TI, ISI). In this context, it is advisable to use KPI frameworks with a time component.

Objective weighting: combine expert weights with the entropy method to reduce subjectivity (entropy and TOPSIS practices).

Resilience/stability (R) as a separate multicriteria in T or a separate layer (measures the speed of recovery from a shock, resource redundancy, supplier diversification). Industry 6.0 emphasizes the resilience and circularity of the economy.

Based on the above, we present the author's vision of a multilevel formula for the aggregate index.

$$I_{net}\left(t\right)=\sum_{g\in\left\{S,Q,I,T,R\right\}} W_g\cdot\tilde{M}_g\left(t\right), \quad (1)$$

g — group of indicators (S — scale/structure, Q — quality of interaction, I — institutions, T — strategic results, R — resilience);

W_g — global group weights (interact as $\sum W_g=1$); these weights are defined as a combination of AHP (expert) and entropy method (objective information weight):

$$W_g=\alpha W_g^{AHP}+\left(1-\alpha\right)W_g^{entropy}, \alpha\in\left[0,1\right], \quad (2)$$

$\tilde{M}_g\left(t\right)$ — normalized aggregate group indicator g at time t, which itself consists of submetrics (S has *S_{topo}, S_{scale}, S_{III}* etc.).

Sub-measure normalization: Each indicator x is normalized to [0,1] (min–max or z-score->sigmoid) to avoid scale.

Let's consider the indicators in the middle of each group in more detail.

Group S (Structure / Network scale and structure):

$$\tilde{M}_S=\beta_1 S_{scale}+\beta_2 S_{density}+\beta_3 S_{central}+\beta_4 S_{III}, \quad (3)$$

S_{scale} — network scale (number of active nodes involved in the interaction);

$S_{density}$ — network density (degree of network connectivity: ratio of real connections to the maximum possible);

$S_{central}$ — average centrality (shows how much the network depends on key nodes);

S_{III} — interaction intensity index (average number of transactions/interactions per active participant);

β_i — sub-indicator weights (determine the importance of each indicator in group S).

Group Q (Quality / Quality of interaction):

$$\tilde{M}_Q=\sum\gamma_j Q_j, \quad (4)$$

Q_j — trust index, stability of cooperation or quality of information flow (calculation of a specific index depends on the context of the task);

γ_j — sub-indicator weights (determine the contribution of each Q-indicator).

Group I (Institutions / Institutional maturity):

$$\tilde{M}_I=\sum\delta_k I_k, \quad (5)$$

I_k — degree of formalization, digital maturity, contractual quality (calculation of a specific index depends on the context of the task);

δ_k — weights that determine the significance of each indicator.

Group T (Strategic results):

$$\tilde{M}_T=\sum\theta_m T_m, \quad (6)$$

T_m — innovation synergy index, economic result or market effect (calculation of a specific index depends on the context of the task);

θ_m — weighting factors that determine the importance of strategic outcomes.

Group R (Resilience / Resilience of network):

$$R=\varphi_1\cdot Redundancy+\varphi_2\cdot\frac{1}{T_{recovery}}+\varphi_3\cdot Diversity. \quad (7)$$

Redundancy — redundancy, availability of reserve resources/suppliers;

$T_{recovery}$ — recovery time (speed of system return to normal after a crisis);

Diversity — diversity, diversification of partners, resources, markets;

φ_i — weighting factor of strategic importance of sustainability parameters.

Economic interpretation

- *Redundancy:* the more reserves, the more stable the network.
- $\frac{1}{T_{recovery}}$: the sooner the network is restored, the better.
- *Diversity:* the more diverse the network, the less it depends on individual nodes.

Normalization is used to ensure comparability of values min–max:

$$x_{ij}^{norm}=\frac{x_{ij}-\min_i x_{ij}}{\max_i x_{ij}-\min_i x_{ij}} \quad (8)$$

This formula is used to bring different indicators to a single scale from 0 to 1.

All network parameters have different units of measurement:

- number of transactions — tens of thousands;
- level of trust — 0…10;

– innovations — pieces;
– institutional quality — points;
– density — from 0 to 1.

In order to correctly aggregate them, they need to be normalized.

x_{ij} — actual value of the j indicator for the i participant/network;

$min_i x_{ij}$ — the minimum value of the indicator j among all objects;

$max_i x_{ij}$ — the maximum value of the indicator j among all objects;

x_{ij}^{norm} — normalized value of the indicator in the interval [0;1]

This formula allows to: compare networks of different scales; integrate qualitative and quantitative indicators; create composite indices (S, Q, I, T, R).

The weights of the indicators are determined using the entropy model (the entropy approach avoids the subjectivity of expert assessments):

$$p_{ij} = \frac{x_{ij}^{norm}}{\sum_i x_{ij}^{norm}}$$

$$e_j = -\frac{1}{1\text{n}\, n}\sum_{i=1}^{n} p_{ij} 1\text{n} p_{ij}, d_j = 1 - e_j \tag{9}$$

$$w_j^{entropy} = \frac{d_j}{\sum_j d_j}$$

x_{ij}^{norm} — normalized indicator value j;

p_{ij} — fraction of the value of indicator j for object i;

e_j — entropy of the index j — a measure of chaoticity;

d_j — coefficient of information utility of the indicator j;

$w_j^{entropy}$ — objective weight of the indicator j;

If $e_j \approx 1 \to$ all values are almost the same $\to$ indicator is not very informative $\to$ low weight.

If $e_j \approx 0 \to$ indicator varies greatly $\to$ significant $\to$ high weight.

In network structures, this has a very strong effect, for example: trust indicators (TI) can have low variation $\to$ small weight, and interaction intensity (III) and ISI usually have high variation $\to$ high weight.

The entropy method determines objective weights of indicators without the participation of experts. If the variation of the indicator is low, it is uninformative $\to$ lower weight. If the variation is high, the indicator "distinguishes" objects $\to$ higher weight.

To balance objective and subjective approaches, group weights are determined by the formula:

$$W_g = \alpha W_g^{AHP} + (1-\alpha) W_g^{entropy} \tag{10}$$

W_g^{AHP} — weight established by experts;

$W_g^{entropy}$ — weight established based on the entropy method;

α — method mixing ratio.

As noted above, for network structures, we propose to integrate the *Network DEA (NDEA) method* into the proposed methodology to assess the efficiency of nodes:

$$E_j = \frac{\sum_r u_r \sum_a y_{rj}^a}{\sum_i v_i \sum_a x_{ij}^a} \tag{11}$$

x_{ij}^a — inputs of node j at stage a;

y_{rj}^a — outputs of node j at stage a;

$u_r,\ v_i$ — weight;

a — internal node subprocesses;

E_j — node efficiency.

Finally, the *TOPSIS method* is used to compare alternatives:

Distance to the ideal (positive ideal):

$$S_i^+ = \sqrt{\sum_{j=1}^{k}(v_{ij} - v_j^+)^2}\ . \tag{12}$$

Distance to the anti-ideal (negative ideal):

$$S_i^- = \sqrt{\sum_{j=1}^{k}(v_{ij} - v_j^-)^2}\ . \tag{13}$$

Comprehensive rating:

$$C_i = \frac{S_i^-}{S_i^- + S_i^+}, \tag{14}$$

v_{ij} — normalized value of criterion j for the object i;

v_j^+ — ideal value (maximum);

v_j^- — anti-ideal value (minimum);

C_i — network/participant performance rating;

S_i^+ — distance to the ideal;

S_i^- — distance to the anti-ideal.

The final linear algorithm of our improved methodology for assessing the effectiveness of network structure management is shown in Fig. 2.

The improved methodology allows for a comprehensive assessment of the effectiveness of network structure management, taking into account their multicomponent nature, dynamism, and high sensitivity to external influences. The methodology integrates structural, behavioral, institutional, strategic, and resilience factors, as well as modern mathematical tools — SNA, Network DEA, MCDM, entropy weighting. Compared to others, the proposed approach provides a multi-layered, more accurate, and objective diagnosis of network systems, which forms its scientific novelty. Among the main limitations

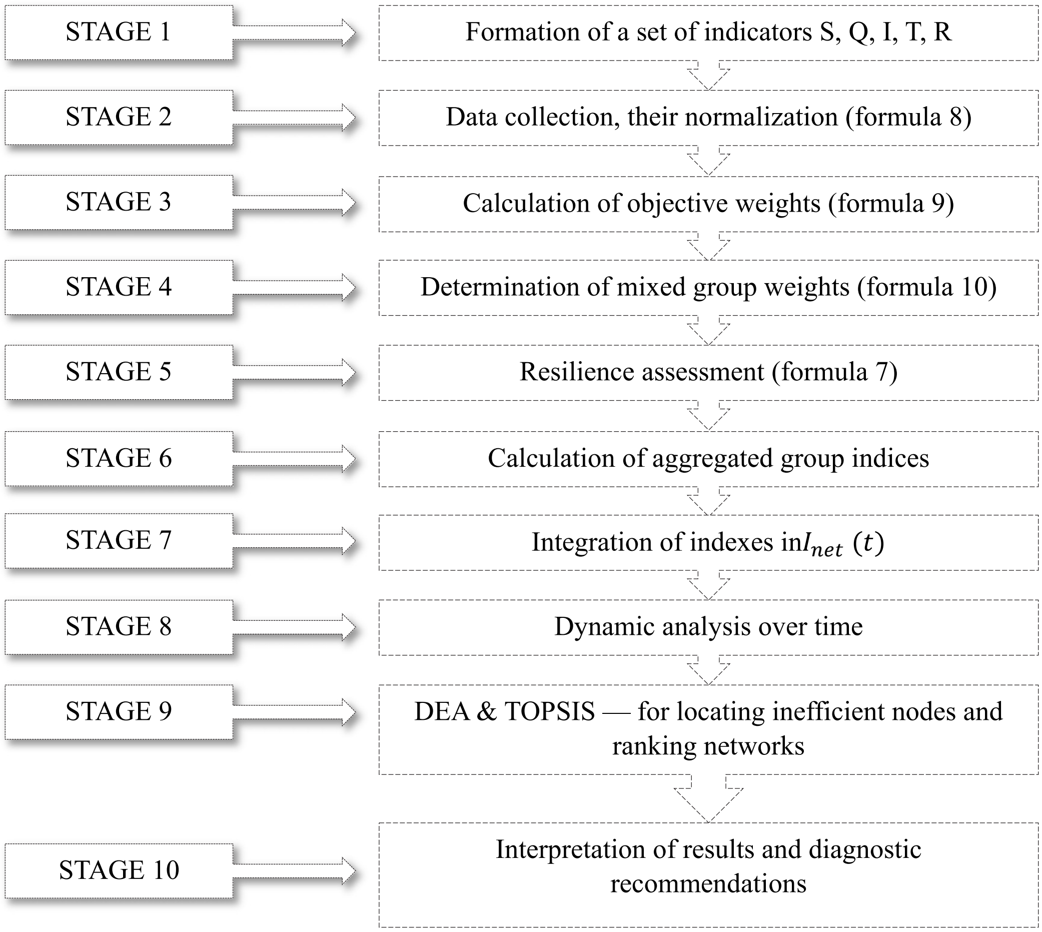

Figure 2. Linear algorithm of methodology for assessing the effectiveness of network structure management
Source: created by authors

and risks of the proposed approach, it is worth highlighting: the need for high-quality data; potential dependence on expert assessments; difficulty of implementation in networks with limited digitalization; the need for periodic updating of weights according to changes.

The use of modern mathematical tools, in particular entropy weighting, multi-criteria models (MCDM), network Data Envelopment Analysis (Network DEA) and TOPSIS tools, which ensure objectivity, accuracy and the ability to rank network systems, is an important advantage of the improved methodology. The introduction of trust indices, innovation synergy, interaction intensity and resilience allows us to take into account the latest trends in the development of network structures, including digitalization, cognitive aspects and adaptability mechanisms. Thus, the improved methodology provides a full, deep and dynamic assessment of the network system, allowing us to identify the strengths and weaknesses of the network, determine its strategic positions, innovation capacity, internal coordination efficiency and level of resilience to crisis impacts. This creates a methodological basis for the formation of sound management decisions on optimizing the configuration, developing interactions and increasing the resilience of network structures.

4. Conclusions

The present study provides a comprehensive and conceptually grounded methodological advancement aimed at improving the assessment of network governance effectiveness within the rapidly transforming landscape of the smart economy. As economic systems become increasingly shaped by digitalization, platformization, and the emergence of cyber-physical production and management architectures associated with Industry 6.0, traditional approaches to evaluating enterprise performance demonstrate clear methodological limitations. In this context, the research introduces an integrated, multidimensional framework — the *S–Q–I–T–R* model — that addresses the complexity, dynamism, and interconnectedness inherent in modern networked enterprise structures.

A central contribution of this work lies in recognizing that network governance can no longer be interpreted through the lens of isolated organizational units, linear managerial processes, or static resource flows. Instead, networked enterprises represent adaptive socio-technical ecosystems characterized by distributed decision-making, real-time digital interactions, high relational density, and constant recombination of competencies embedded within nodes and linkages. These characteristics necessitate a methodological shift toward models that capture systems-level behavior while maintaining analytical rigor and quantitative measurability. The proposed framework effectively responds to this requirement by combining conceptual, structural, behavioral, institutional, strategic, and resilience dimensions into a unifying assessment architecture.

The structural dimension (S) serves as the foundational layer of the framework, capturing the network's configuration, scale, connectivity, and intensity of interactions. Unlike traditional hierarchical or firm-centric models, the smart economy relies on fluid, scalable, and digitally mediated architectures that allow enterprises to expand or reconfigure in response to environmental dynamics. By incorporating Social Network Analysis tools, the methodology enables the evaluation of structural efficiency, centrality distribution, and communication pathways — factors that determine the agility and coordination capacity of network systems.

The interaction quality dimension (Q) expands the analytical lens toward relational mechanisms, including trust, communication quality, knowledge exchange, and cooperation intensity. In smart and digitally augmented environments, relational capital operates as a strategic asset, directly influencing innovation performance, resilience, and the sustainability of inter-organizational partnerships. The introduction of measurable trust and interaction indices contributes to bridging the gap between qualitative assessments and quantitative measurement.

The institutional dimension (I) reflects the growing importance of governance structures, standards, and digital management infrastructures. Industry 6.0 presupposes the coexistence of AI-driven decision systems, autonomous coordination mechanisms, transparent digital contract systems, and real-time monitoring technologies. The proposed framework therefore emphasizes institutional maturity as a critical driver of governance efficiency and systemic coherence, allowing researchers and practitioners to analyze the reliability, transparency, and regulatory alignment of network governance models.

The strategic and innovation dimension (T) captures the capacity of networked enterprises to generate, co-create, transfer, and commercialize innovations — activities that increasingly define competitive positioning in the smart economy. The introduction of the Innovation Synergy Index (ISI) provides a structured means to measure the degree of complementarity and shared value creation across the network. This focus aligns with contemporary research establishing that innovation is no longer the outcome of individual entities, but a product of collective actions embedded in ecosystems and entrepreneurial networks. Therefore, by measuring innovation intensity and market outcomes, the methodology offers a sound basis for strategic performance evaluation.

Perhaps the most forward-looking component of the framework is the resilience dimension (R), which positions adaptive capacity at the core of network effectiveness. In a world characterized by geopolitical shocks, digital disruptions, supply chain volatility, and market uncertainty, resilience determines whether networks sustain performance, adapt, or collapse. The introduction of a formalized Resilience Index — integrating redundancy, diversity, and recovery speed — represents an essential conceptual and methodological addition. It aligns the assessment framework with global trends emphasizing sustainable business models, adaptive governance, crisis-readiness, and long-term survivability.

From a methodological standpoint, the framework's strength lies in its hybrid analytical apparatus. By integrating MCDM methods (AHP, entropy weighting, and hybrid models), the methodology balances subjective expert knowledge with objective statistical variation. Network DEA expands the assessment beyond simple input-output efficiency, providing a nuanced view of multi-stage, interconnected processes characteristic of network enterprises. TOPSIS, as a comparative ranking tool, enhances decision-making by enabling the evaluation of each network's proximity to an ideal governance profile. Together, these methods ensure a rigorous, transparent, and replicable approach.

Furthermore, the methodological algorithm developed within the framework enhances its practical applicability. It outlines a step-by-step process — from indicator selection and normalization to aggregation, interpretation, and comparative evaluation — making the model accessible not only for academic analysis but also for managerial implementation. This increases its relevance for practitioners operating in service networks, hotel chains, franchising systems, digital platforms, entrepreneurial ecosystems, and industrial clusters.

From a broader perspective, the study contributes to the theoretical understanding of network governance by offering a holistic conceptualization aligned with the requirements of smart and cyber-physical economies. It shifts the focus from narrow operational metrics to a multidimensional perspective that captures the real complexity and potential of networked enterprises. By doing so, the research advances academic discourse in several areas: network theory, entrepreneurial ecosystems, digital transformation, innovation management, and organizational resilience.

The practical implications of the developed methodology are equally significant. It provides managers, policymakers, and analysts with a comprehensive instrument for diagnosing network performance, identifying structural vulnerabilities, assessing innovation potential, and formulating strategic interventions. In environments shaped by rapid technological change, the widespread deployment of AI, and growing interdependence among enterprises, the proposed framework offers an evidence-based foundation for strengthening governance mechanisms and enhancing competitiveness.

In conclusion, the S–Q–I–T–R integrated framework represents a substantial methodological advancement, tailored to the realities of networked enterprise systems in the smart economy and Industry 6.0. It offers a robust analytical tool capable of capturing structural complexity, relational dynamics, institutional maturity, strategic outcomes, and resilience — components that collectively define the success and sustainability of modern network governance. The proposed model not only enriches academic theory but also provides practical value for enterprises navigating the challenges and opportunities of a digitally enabled, innovation-driven economic landscape.

5. References

[1] O'Grady, M. (2024, July 23). The Global Digital Economy Will Reach $16.5 Trillion And Capture 17% Of Global GDP By 2028. https://www.forrester.com/blogs/the-global-digital-economy-will-reach-16-5-trillion-and-capture-17-of-global-gdp-by-2028

[2] O'Grady, M. (n 1)

[3] Statista (2025). eCommerce — Worldwide. https://www.statista.com/outlook/emo/ecommerce/worldwide

[4] Forbes (2025, Jube 16). How The Creator Economy Is Reshaping Modern Marketing — And Why Brands Are Paying Attention? https://www.forbes.com/sites/lowes-creator/2025/06/16/how-the-creator-economy-is-reshaping-modern-marketing — and-why-brands-are-paying-attention/

[5] Tang, K.T. (2006). Mathematical Methods for Engineers and Scientists 1 — Complex Analysis, Determinants and Matrices. Springer Berlin Heidelberg.

[6] Velten, K., Schmidt, D.M., & Kahlen, K. (2024). Mathematical Modeling and Simulation: Introduction for Scientists and Engineers. Wiley-VC H.

[7] Stokey, N.L., & Lucas, R.E. (1989). Recursive Methods in Economic Dynamics. Harvard University Press.

[8] Chakrabarti, A., Pichl, L., & Kaizoji, T. (2020). Network Theory and Agent-Based Modeling in Economics and Finance. Springer Singapore.

[9] Van der Leji, M.J. (2006). The Economics of Networks: Theory and Empirics. Rotterdam.

[10] Gaurav, A.K. (2024). Network governance: Concepts, theories, and applications: Naim Kapucu and Qian Hu. (1st ed.). New York, NY: Routledge, 2020. *Administrative Theory & Praxis,* 47(3), 269–272.

[11] Klijn, E.H., & Koppenjan, J.F.M. (2012), Governance network theory: past, present and future. *Policy and Politics*, 40 (4), 187–206.

[12] Apostol. D., Bălăceanu, C., & Constantinescu, E.M. (2015). Smart-Economy Concept — Facts And Perspectives. International Conference "European Perspective of Labor Market — Inovation, Expertness, Performance"), Institute for Economic Forecasting Conference Proceedings 141113, Institute for Economic Forecasting.

[13] Bejjani, M., Gocke, L., & Menter, M. (2023). Digital entrepreneurial ecosystems: A systematic literature review. *Technological Forecasting and Social Change*, 189, 122372.

[14] Fernández, M.T., Blanco Jiménez, F.J., & Cuadrado Roura, J.R. (2015). Business incubation: innovative services in an entrepreneurship ecosystem. *The Service Industries Journal*, 35(14), 783–800.

[15] Jin, G.Z., Leccese, M., & Wagman, L. (2025). The Role of Digital Platforms in Shaping Tech Venture Innovation. *NBER Working Paper,* 33370. https://doi.org/10.3386/w33370.

[16] De Reuver, M., Sørensen, C., & Basole, R. C. (2018). The Digital Platform: A Research Agenda. *Journal of Information Technology*, 33(2), 124–135. https://doi.org/10.1057/s41265-016-0033-3

[17] Nerbel, J.F., & Kreutzer, M. (2023). Digital platform ecosystems in flux: From proprietary digital platforms to wide-spanning ecosystems. *Electron Markets,* 33(6). https://doi.org/10.1007/s12525-023-00625-8

[18] Holm, C.G., & Kringelum, L.B. (2022). Intra-Organizational Business Model Implications of Inter-Organizational Collaboration. *Journal of Business Models*, 10(1), 1–10. https://doi.org/10.54337/jbm.v10i1.6827

[19] Tang, K.T. (n 5)

[20] Stokey, N.L., & Lucas, R.E. (n 7)

[21] Bosovska, M. (2015). Methodological approaches to assessing the performance of the networks based on multi approaches. *Investments: practice and experience*, 3, 23–26.

Received: 29/09/2025
Accepted: 05/11/2025
Published: 15/12/2025

Сагайдак Михайло
доктор економічних наук, професор,
завідувач кафедри менеджменту
Київський національний економічний університет ім. В. Гетьмана
Україна
ORCID: 0000-0001-6526-1170

Перекицай Максим
аспірант
Державний університет економіки і технологій
Україна
ORCID: 0009-0008-8830-5381

https://doi.org/10.60022/sis.3.(02).4

МЕРЕЖЕВЕ УПРАВЛІННЯ В РОЗУМНІЙ ЕКОНОМІЦІ: НОВА ОСНОВА ДЛЯ ІНТЕГРОВАНОЇ ОЦІНКИ ЕФЕКТИВНОСТІ

Анотація. *Швидка трансформація глобальних економічних систем під впливом цифровізації, платформізації та нових технологій Індустрії 6.0 посилила потребу в передових інструментах для оцінки ефективності мережевого управління. Традиційні підходи до оцінки, які зосереджені переважно на організаційній ефективності на рівні фірми, більше не є достатніми для врахування складності, зв'язності та динамічної взаємодії, властивої сучасним мережевим підприємствам. Це дослідження пропонує нову інтегровану основу для оцінки ефективності мережевого управління в рамках розумної економіки, що поєднує структурні, реляційні, інституційні, стратегічні та орієнтовані на стійкість перспективи.*

У дослідженні розроблено модель S–Q–I–T–R, яка включає п'ять ключових вимірів: мережева структура (S), якість взаємодії (Q), інституційна зрілість (I), стратегічні та інноваційні результати (T) та здатність до стійкості (R). Методологічна основа фреймворку об'єднує аналіз соціальних мереж, багатокритеріальні методи прийняття рішень (AHP, ентропійне зважування, гібридний MCDM), аналіз охоплення даних (включаючи мережевий DEA), TOPSIS та процедури нормалізації. Цей гібридний, багатовимірний дизайн дозволяє проводити як комплексну, так і аналітично ретельну оцінку ефективності мережі.

Запропонована методологія пропонує масштабований та адаптивний інструмент для вивчення бізнес-мереж, мереж послуг, підприємницьких екосистем, організацій на основі платформ та міжгалузевих альянсів. Розглядаючи механізми довіри, структури цифрового управління, синергію інновацій та стійкість до збоїв, фреймворк добре узгоджується з вимогами розумних та кіберфізичних економічних середовищ.

Результати дослідження сприяють розвитку теорії управління мережами та надають практикам надійний аналітичний інструмент для діагностики ефективності, виявлення слабких місць та підвищення стратегічного потенціалу мережевих підприємств в епоху цифрової трансформації та Індустрії 6.0.

Ключові слова*: управління мережами, смарт-економіка, Індустрія 6.0, інтегрована оцінка ефективності, індекс стійкості.*