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PROJECT-BASED APPROACH TO QUANTITATIVE ASSESSMENT OF THE EPN EFFECTIVENESS ON THE EXAMPLE OF KAZAKHSTAN INDUSTRIAL HOLDINGS

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Abstract. *Relevance.* In the context of a growing instability and complexity of the business environment (the VUCA world), entrepreneurial partnership networks (EPNs) are becoming a key factor of competitiveness. The aim of this article is to develop and test a new methodological framework, based on a project-management approach, for the quantitative assessment and comparison of EPN effectiveness.
Methodology. The study employs a two-stage research design. At the first stage, the relevance of the topic was confirmed through a survey of 28 Kazakhstani entrepreneurs using the author's "Engagement Index". At the second, main stage, the author's "Network Effectiveness Assessment Model" was applied. *Results.* The key result is a quantitative confirmation of differences in network effectiveness. It demonstrates the ability of the model to differentiate network performance depending on sectoral specifics and corporate structure. The survey results also confirmed a high level of motivation among entrepreneurs to participate in network interaction. The study contributes to theory and practice by proposing a reproducible quantitative methodology for assessing network effectiveness, enabling a transition from qualitative descriptions to objective measurement. For managers, the proposed toolkit may serve as a basis for auditing and benchmarking network structures in order to improve them. In addition, the article presents a "Comprehensive Project Structure Model" as a practical guideline for managing the formation and development of entrepreneurial networks.

Keywords: entrepreneurial networks, project management, VUCA, effectiveness assessment, Kazakhstan, case study, quantitative methodology

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ҚАЗАҚСТАНДЫҚ ӨНЕРКӘСІП ХОЛДИНГТЕРІ МЫСАЛЫНДА EPN ТИІМДІЛІГІН САНДЫҚ БАҒАЛАУДАҒЫ ЖОБАЛЫҚ ТӘСІЛ

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Аннотация. Өзектілігі. Өсіп келе жатқан тұрақсыздық пен бизнес-ортаның күрделілігі жағдайында (VUCA әлемі) кәсіпкерлік серіктестік желілері (EPN) бәсекеге қабілеттіліктің негізгі факторына айналуда. Бұл мақаланың мақсаты – EPN тиімділігін сандық бағалау және салыстыру үшін жобаны басқару тәсіліне негізделген жаңа әдістемелік базаны әзірлеу және сынау. Әдістеме. Зерттеуде екі сатылы зерттеу дизайны қолданылады. Бірінші кезеңде, тақырыптың өзектілігі автордың «Қатысу Индексін»пайдалана отырып, 28 Қазақстандық кәсіпкерге жүргізілген сауалнама арқылы расталды. Екінші, негізгі кезеңде, автордың «Желілік тиімділікті бағалау моделі» қолданылды. Нәтижелер. Негізгі нәтиже – желі тиімділігіндегі айырмашылықтарды сандық растау. Бұл модельдің салалық ерекшеліктерге және корпоративтік құрылымға байланысты желінің өнімділігін саралау қабілетін көрсетеді. Сауалнама нәтижелері сонымен қатар кәсіпкерлердің желілік өзара әрекеттесуге қатысуға деген ынтасының жоғары деңгейін растады. Зерттеу сапалы сипаттамалардан объективті өлшеуге көшуге мүмкіндік беретін желінің тиімділігін бағалаудың қайталанатын сандық әдістемесін ұсына отырып, теория мен практикаға өз үлесін қосады. Менеджерлер үшін ұсынылған құралдар жиынтығы оларды жетілдіру мақсатында желілік құрылымдарды тексеру және салыстыру үшін негіз бола алады. Сонымен қатар, мақалада кәсіпкерлік желілерді қалыптастыру мен дамытуды басқарудың практикалық нұсқауы ретінде «Жобалық құрылымның кешенді моделі» ұсынылған.

Түйін сөздер: кәсіпкерлік желілер, жобаларды басқару, VUCA, тиімділікті бағалау, Қазақстан, кейс-стади, сандық әдістеме

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ПРОЕКТНЫЙ ПОДХОД К КОЛИЧЕСТВЕННОЙ ОЦЕНКЕ ЭФФЕКТИВНОСТИ EPN НА ПРИМЕРЕ КАЗАХСТАНСКИХ ПРОМЫШЛЕННЫХ ХОЛДИНГОВ

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Аннотация. Актуальность. В условиях растущей нестабильности и сложности бизнес-среды (VUCA-среда) сети предпринимательских партнёрств (EPN) становятся значимым фактором повышения конкурентоспособности компаний. Цель. Целью статьи является разработка и апробация новой методологической базы, основанной на проектном подходе, для количественной оценки и сравнения эффективности EPN. Методология. Исследование проводилось в два этапа. На первом этапе актуальность темы была подтверждена на основе опроса 28 казахстанских предпринимателей с использованием разработанного автором «Индекса вовлечённости». На втором, основном этапе была применена авторская «Модель оценки эффективности сети». Результаты. Основным результатом исследования стало количественное подтверждение различий в эффективности предпринимательских сетей, что демонстрирует возможность предложенной модели дифференцировать показатели эффективности в зависимости от отраслевой специфики и корпоративной структуры. Опрос также выявил высокий уровень мотивации предпринимателей к участию в сетевом взаимодействии. Исследование вносит вклад в теорию и практику сетевого менеджмента, предлагая воспроизводимую количественную методику оценки эффективности, позволяющую перейти от качественных описаний к объективным измерениям. Для руководителей предприятий разработанный инструментарий может служить основой для аудита и сравнительного анализа сетевых структур с целью их оптимизации. В дополнение представлена «Модель комплексной структуры проекта» как практическое руководство по управлению формированием и развитием предпринимательских сетей.

Ключевые слова: предпринимательские сети, управление проектами, VUCA, оценка эффективности, Казахстан, тематическое исследование, количественная методология

Introduction. The modern economic environment is characterized by an unprecedented level of volatility, uncertainty, complexity, and ambiguity,

summarized by the acronym VUCA (Volatility, Uncertainty, Complexity, Ambiguity) (Bennett & Lemoine, 2014; Zhurynov, 2023). Globalization, digitalization, and the acceleration of technological cycles determine conditions in which traditional hierarchical models of strategic planning, based on long-term forecasting, are rapidly losing their relevance (Millar et all, 2018). Under these conditions, the ability to adapt quickly, flexibly reconfigure business processes, and effectively mobilize resources becomes not simply a competitive advantage, but a strategic imperative for survival and development.

One of the most effective responses to the challenges of the VUCA world has been the formation of entrepreneurial partnership networks (EPNs). In contrast to a closed model of doing business, where a company relies solely on internal resources, the network approach allows firms to optimize resource use, diversify risks, and gain access to new technologies, competencies, and markets (Asaul et all, 2004; Watson, 2007). Thus, EPNs cease to be a purely tactical tool and transform into a key element of strategic management that ensures organizational resilience and innovation potential in a turbulent environment. This issue is particularly relevant in the context of the economy of the Republic of Kazakhstan, where, within the framework of state programs for diversification and reduction of raw-material dependence, the development of network forms of innovative entrepreneurship is recognized as one of the national priorities (Talimova, 2022).

Despite their strategic importance and governmental support, the potential of partnership networks in Kazakhstan's economy remains largely underutilized. In practice, many network structures, especially in large industrial sectors, face systemic problems, including a low level of coordination, insufficient integration of business processes, and weak synergy between participants. A central reason for these challenges is the absence of transparent and objective mechanisms for assessing the effectiveness of network interaction. Executives and stakeholders do not possess reliable tools that would allow them to measure the performance of partnerships in quantitative indicators, identify bottlenecks, and make informed managerial decisions on network development (Kaygorodtsev & Bordianu, 2016).

Thus, an acute practical problem emerges: there is a gap between the declared need for network development and the lack of scientifically grounded tools for managing this process in a targeted way. Without the ability to measure current effectiveness objectively, it is impossible to design a strategy for its improvement, which leads to inefficient resource allocation and "freezing" of the potential of network interactions. Solving this problem requires the creation and testing of a new methodological framework capable of providing a quantitative assessment of complex inter-firm linkages.

Despite the obvious practical need for network management tools, an analysis of the academic literature reveals several important gaps that hinder the effective implementation of network models. First, most studies are predominantly descriptive or qualitative in nature, focusing on the benefits of networks but not offering specific

metrics for measuring their effectiveness. Second, existing quantitative assessment models, such as those proposed by Egorova N.E. (Egorova, 2006), often rely on hard-to-obtain or weakly formalized data (for example, the number of informal social ties), which makes their application in real business structures–particularly large, closed holdings–virtually impossible. Third, the process of creating and developing a network is rarely considered through the lens of project management. The literature usually analyzes the network as an already formed phenomenon, overlooking the fact that its formation is a complex project with its own stages, resources, risks, and key performance indicators.

Accordingly, a key scientific gap arises: there is no comprehensive, quantitatively oriented and practically applicable methodology for assessing the effectiveness of existing entrepreneurial networks and for managing their creation as a structured project, especially in the context of large industrial holdings.

Aim and Objectives of the Study

The aim of this article is to address the aforementioned gap by developing and empirically testing a comprehensive methodology for the quantitative assessment of the effectiveness of entrepreneurial partnership networks.

To achieve this aim, the following objectives were set:

1. To develop a system of quantitative indicators that makes it possible to assess various aspects of network interaction (density, coordination, financial returns, etc.) based on available corporate reporting.

2. To test the developed methodology on the example of two system-forming holdings of the Republic of Kazakhstan (JSC "NC KazMunayGas" and JSC "NAC Kazatomprom"), to conduct a comparative analysis and to identify key differences in the effectiveness of their networks.

3. On the basis of the analysis performed and the principles of project management, to propose a conceptual "Comprehensive Project Structure Model" that can be used as a practical tool for planning and managing the development of entrepreneurial networks.

Theoretical Foundations and Literature Review

Traditional approaches to strategic management, based on long-term planning and forecasting, have proved inadequate under VUCA conditions. For effective adaptation to a constantly changing environment, organizations require flexibility, speedy decision-making, and the capacity for rapid mobilization of resources that often extend beyond the boundaries of a single firm. In this context, project management offers a set of tools and principles that can be extrapolated to more complex organizational tasks. Project management views any temporary activity aimed at creating a unique product, service, or result as a managed process with defined objectives, stages, resources, and risks (Wysocki & McGary, 2003).

On this basis, the present article proposes a conceptual framework in which the process of creating and developing an entrepreneurial partnership network is considered not as a spontaneous or organic phenomenon but as a complex, purposeful

project. This approach makes it possible to apply systematic methods of planning, coordination, monitoring, and control to network formation. Modern methodologies such as Agile, Scrum, or PRINCE2 are successfully used to manage complex products and processes within organizations. However, these methodologies were developed primarily for intra-firm tasks (for example, software development) and do not contain a specific toolkit for managing inter-organizational interaction, whose key features include the coordination of independent stakeholders, the building of trust, and the alignment of divergent interests. Therefore, existing project approaches must be adapted and supplemented to address the unique challenge of building an effective entrepreneurial network.

Classification and Essence of Entrepreneurial Partnership Networks (EPNs)

To evaluate the effectiveness of networks, it is first necessary to define their nature and diversity. Within this study, an entrepreneurial partnership network (EPN) is understood as a form of integrative interaction between legally independent, but economically interlinked entities that unite on the basis of trust, common interests, and mutual benefit for the joint implementation of business projects, exchange of resources (production, financial, informational), and attainment of collective competitive advantages (Sheresheva, 2010). The key attributes of EPNs are voluntary participation, the presence of a common goal, and mutual interdependence among participants.

EPNs are not monolithic and can be classified along multiple dimensions. The literature, for example, distinguishes between "hard" networks (holdings, concerns), characterized by strong formal ties and control, and "soft" networks (associations, consortia) with a predominance of flexible and informal relationships (Kulik & Shabarina, 2018). For a more complete and systematic analysis, this study uses a multi-criteria classification that structures EPNs according to the following characteristics:

- **By mode of formation:** formalized (based on contracts); non-formalized (based on personal ties).
- **By relation to the environment:** external (open), internal (closed), virtual.
- **By organizational structure:** vertical (hierarchical), horizontal (peer-to-peer).
- **By form of interaction:** hard, soft.
- **By type of activity:** commercial, non-commercial.
- **By scale:** global, national, regional, local.

Such a detailed typology allows for more precise positioning of the object of study and for accounting for the multidimensional nature of network structures when developing an assessment methodology. In this article, the primary focus is on large, formalized, vertically integrated commercial networks operating at national and global levels.

Analysis of Existing Assessment Methodologies

Objective management of network effectiveness requires relevant assessment tools. The academic literature presents several approaches, each with its strengths and limitations.

One of the most comprehensive approaches is that of N.E. Egorova, who proposes a system of indicators that includes network density, degree of centralization, strength and closeness of business ties (Egorova, 2006). The strength of this methodology lies in its comprehensiveness; however, its practical application is difficult. The calculation of such indicators as the "number of informal (social) ties" requires in-depth sociometric studies inside companies, access to which is usually impossible in large corporate structures.

Another approach, proposed by S.P. Kushch and A.A. Afanasyeva, is based on expert evaluation of qualitative factors such as network formation goals, trust level, long-term nature of interaction, and the degree of mutual dependence of firms (Kushch & Afanasyeva, 2004). This method is valuable in that it captures key informal aspects of partnership, but its main drawback is subjectivity. Results obtained from expert opinions are difficult to verify and compare over time, which reduces their objectivity and reproducibility.

O.O. Zorina proposes a combined approach that divides indicators into quantitative (economic, social) and qualitative (assessment of trust, business reputation) (Zorina, 2017). She also introduces a formula for calculating business reputation, which is a step toward quantification. Nevertheless, the proposed model remains fragmented and does not aggregate indicators into a single integral measure, making it impossible to obtain a holistic picture of network effectiveness.

Thus, an analysis of existing methodologies shows that no universal, quantitatively oriented, and practically applicable toolkit has yet been proposed that would rely on accessible data (for example, financial reports) and enable comparative assessment of the effectiveness of different networks.

Research Methodology

Research Design

To address the research objectives, a two-stage mixed-methods research design was developed, combining elements of a quantitative survey and comparative case study.

- **Stage 1: Preliminary study.** At this stage, the degree of involvement of Kazakhstani entrepreneurs in network interaction was assessed to confirm the practical relevance of the topic in the national context. For this purpose, the author's "Engagement Index" was developed and tested based on a quantitative survey.
- **Stage 2: Main study.** At the second stage, a quantitative comparative case study was conducted to empirically test the proposed "Network Effectiveness Assessment Model". As the units of analysis, two of the largest system-forming entrepreneurial networks in Kazakhstan operating in the form of vertically integrated holdings were selected: JSC "National Company KazMunayGas" (hereinafter – KMG) and JSC "National Atomic Company Kazatomprom" (hereinafter – KAP).

This design not only allows for testing the applicability of the methodology but also enables identification of sectoral particularities of network interaction based on objective data.

Stage 1: Methodology for Assessing Entrepreneurial Engagement

The purpose of this stage is to obtain empirical confirmation of the motivation and active participation of Kazakhstani entrepreneurs in EPNs. For this purpose, the "Engagement Index" was developed, based on three key parameters identified in the literature:

- **P1: Quantitative characteristics of participation** (number of networks in which the enterprise participates; their national/international status; participation in virtual networks).
- **P2: Temporal characteristics of participation** (duration of participation in networks and frequency of using network interactions).
- **P3: Motivational characteristics of participation** (the impact of participation on decision-making, reputation, profit, risk reduction, and other business indicators).

To measure these parameters, a questionnaire of 12 statements was developed. Respondents were asked to choose one of three answer options: "Yes", "No", "Difficult to answer" (Table 1). The sample consisted of 28 entrepreneurs from different regions of Kazakhstan who met two criteria: participation in at least one EPN and business age of more than 2 years. Responses were coded and evaluated on a three-point scale, which allowed the calculation of an individual Engagement Index for each respondent in the range from 1 to 36, where a higher value corresponds to a higher degree of engagement.

Table 1. List of Statements in the Engagement Assessment Methodology

Statement
First parameter (P1)
1. Your enterprise participates in more than one entrepreneurial network?
2. Your enterprise participates in both national and international entrepreneurial networks?
3. Your enterprise is a participant in virtual entrepreneurial networks?
Second parameter (P2)
4. Your enterprise has participated in at least one EPN for more than one year?
5. You use your participation in EPNs more than once per quarter?
Third parameter (P3)
6. Participation in EPNs helps you make optimal managerial decisions?
7. Participation in EPNs has a positive impact on the reputation of your enterprise (business)?
8. Participation in EPNs positively affects the profit of your enterprise?
9. Participation in EPNs reduces your business risks?
10. Participation in EPNs allows you to find new partners?
11. Participation in EPNs enables you to scale your business?
12. Participation in EPNs increases your costs?

(Compiled by the author.)

Stage 2: Methodology for Assessing Network Interaction Effectiveness

Case Selection

To empirically test the developed methodology, a comparative case study method was used. Two key entrepreneurial networks for Kazakhstan's economy, functioning in the form of vertically integrated holdings, were selected as objects of analysis:

- **JSC "National Company KazMunayGas" (KMG):** the largest national holding in the oil and gas industry, with an extensive network of subsidiaries, dependent organizations, and joint ventures (JSC "National Company KazMunayGas", 2022);
- **JSC "National Atomic Company Kazatomprom" (KAP):** the national operator for uranium exports and the world's largest producer of natural uranium, also having a complex structure of subsidiaries and associated companies (JSC "National Company KazMunayGas", 2022).

These companies were chosen due to their comparable status as national holdings and system-forming role in the economy, which implies the presence of developed partnership networks. At the same time, their belonging to different strategic sectors (oil and gas vs. nuclear) makes it possible to test the universality of the proposed methodology and to identify sector-specific features of network interaction.

Indicator Development and Data Collection

Based on a critical analysis of existing approaches and considering the key requirement of practical applicability (reliance on publicly available data), the author developed a system of seven indicators for assessing the effectiveness of EPNs (Table 2). For obtaining an overall assessment, an **integral indicator of network interaction effectiveness** (I_{integr}) is calculated as the sum of the values of all seven indicators:

$$I_{интегр} = \sum_{i=1}^{7} I_i.$$

Table 2. Author's System of Indicators for Assessing EPN Interaction Effectiveness

Name	Indicator	Description	Calculation formula
Network density	I_1	Ratio of the number of actual (pairwise) interactions to the number of potential interactions.	$I_1 = \frac{I_r}{I_p}$
Degree of network coordination	I_2	Shows the extent to which the activities of network agents are coordinated from a single center.	$I_2 = \frac{D_c}{D_g}$
Duration of business contacts	I_3	Ratio of average contract duration to the total lifetime of the network.	$I_3 = \frac{t}{T}$
Strength of business ties	I_4	Reflects the presence of joint or cross-ownership that shapes ties and personal contacts of management teams.	$I_4 = \frac{S}{N}$

Closeness of business ties	l_5	Reflects the presence or absence of permanent partners (number of transactions with the same partners over a given period).	$I_5 = \frac{B}{D}$
Share in profit	l_6	Ratio of the share in the profit of joint ventures and associated companies to the total profit of the corporation.	$I_6 = \frac{V_2}{V_1}$
Degree of formalization of ties	l_7	Ratio of the number of informal ties to the number of formal ones.	$I_7 = \frac{F}{C}$

where:

- I_r – number of real network interactions;
- I_p – number of potential (possible) interactions;
- D_c – number of units coordinated from a single center;
- D_g – total number of employees in these units;
- t – average contract duration;
- T – lifetime of the network;
- S – number of ties due to joint ownership;
- N – total number of elements in the network;
- B – number of transactions with permanent partners over a given period;
- D – total number of transactions;
- V_1 – corporation's share in the profit of joint ventures and associated companies;
- V_2 – total profit of the corporation;
- F – number of formal ties;
- C – number of informal ties.

Data for calculating the indicators were collected from the official annual and financial reports of KMG and KAP for 2021, as well as from sustainability reports. Data for calculating indicator I_7 (degree of formalization), which requires assessing the ratio of formal to informal ties, were obtained and validated through a series of structured interviews with mid-level employees of both companies responsible for partnership interactions.

Research results

Assessment of Entrepreneurial Engagement in Network Interaction

The survey of 28 Kazakhstani entrepreneurs conducted at the first stage made it possible to calculate the Engagement Index for each respondent. Summary data are presented in Table 3.

The analysis showed that the majority of respondents (21 out of 28, or 75%) demonstrated a high level of engagement, scoring 30 or more points out of a possible 36. The average Engagement Index for the sample was 32.4. This indicates that entrepreneurs in Kazakhstan not only actively participate in various forms of EPNs but also evaluate their impact on business highly, viewing network interaction as an important resource for development. Thus, the high practical relevance of the research topic for the national business community was empirically confirmed.

Table 3. Summary Results of Entrepreneurial Engagement Assessment

No	Parameter			Engagement Index
	P_1	P_2	P_3	
1	6	4	15	**25**
2	6	6	18	**30**
3	9	5	20	**34**
4	7	5	17	**29**
5	9	5	18	**32**
6	9	6	20	**35**
7	6	6	20	**32**
8	9	5	21	**35**
9	7	6	18	**31**
10	9	6	21	**36**
11	9	6	20	**35**
12	5	4	15	**24**
13	6	5	17	**28**
14	5	5	17	**27**
15	9	5	18	**32**
16	5	6	18	**29**
17	9	6	20	**35**
18	9	6	21	**36**
19	9	5	20	**34**
20	9	5	21	**35**
21	6	6	20	**32**
22	6	4	16	**26**
23	7	6	18	**31**
24	9	6	21	**36**
25	6	6	18	**30**
26	9	5	18	**32**
27	9	6	21	**36**
28	9	5	18	**32**
Compiled by the author based on survey results				

Comparative Analysis of the Effectiveness of KMG and KAP Networks

At the second stage, the effectiveness of the networks of KMG (EPN_1) and KAP (EPN_2) for 2021 was assessed using the author's methodology. Calculations were performed for all seven indicators presented earlier. The summary results of the comparative analysis are shown in Table 4 (Zaheer, 2010).

Table 4. Summary Results of Comparative Analysis of EPN Effectiveness in JSC "NC KazMunayGas" (EPN_1) and JSC "NAC Kazatomprom" (EPN_2), 2021

Indicator name	EPN_1 (KMG)	EPN_2 (KAP)	Comparison
I_1 Network density	0.75	0.67	$EPN_1 > EPN_2$
I_2 Degree of coordination	0.64	0.50	$EPN_1 > EPN_2$
I_3 Duration of contacts	0.125	0.214	$EPN_1 < EPN_2$
I_4 Strength of business ties	n/a	n/a	n/a
I_5 Closeness of business ties	n/a	n/a	n/a
I_6 Share in profit	0.64	0.21	$EPN_1 > EPN_2$
I_7 Degree of formalization	0.24	0.22	$EPN_1 > EPN_2$
I_{integr} Integral indicator	2.395	1.814	$EPN_1 > EPN_2$

Note: calculations for indicators I_4 and I_5 were not carried out due to the lack of data in public reporting.

The key result is the significant difference in the final integral indicators: the effectiveness of the KMG network (I_{integr} =2.395) turned out to be 32% higher than that of KAP (I_{integr} = 1, 814). This demonstrates that, despite their similar status, the structure and performance of their partnership networks differ substantially. A visualization of the results for each indicator is given in the radar chart (Figure 1). The chart clearly shows that EPN1 (KMG) outperforms EPN_2 (KAP) on most parameters, especially network density, degree of coordination, and share in profit from joint ventures. At the same time, KAP shows a higher value for the duration of business contacts, which may indicate greater stability of partnership relations.

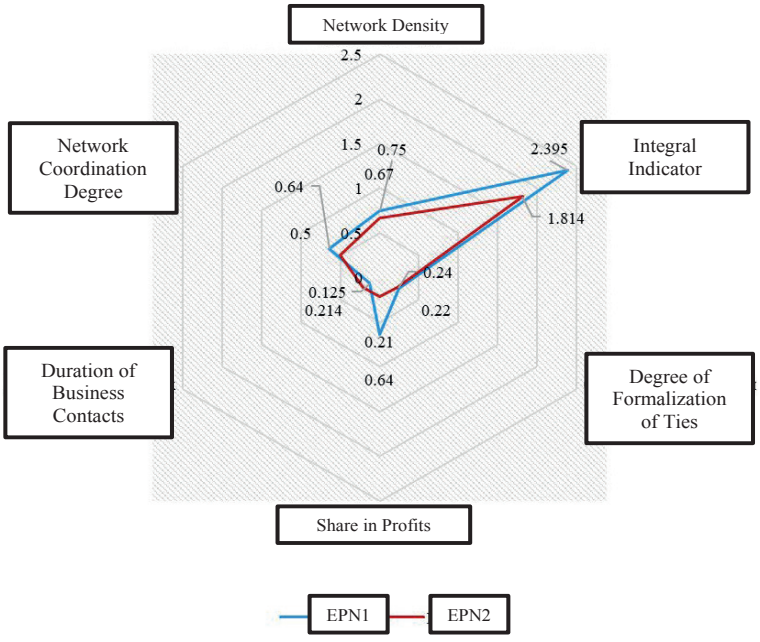

Figure 1. Results of the comparative analysis of KMG and KAP network effectiveness

Results Discussion

Interpretation of Comparative Analysis Results

The obtained results not only confirm the validity of the proposed methodology as a tool for comparative analysis but also reveal deep structural differences in the organization of partnership networks of the two leading industrial holdings of Kazakhstan. The higher integral effectiveness indicator of the KMG network (I_{integr} =2.395) compared to that of KAP (I_{integr} =1.814) is due to KMG's advantage in several key indicators and likely reflects the adaptation of network strategies to the unique conditions of their respective industries.

First, KMG's significant advantage in network density (I_1) and degree of coordination (I_2) indicates a more extensive and at the same time more centrally managed structure. This can be explained by the complex nature of the oil and gas industry, where the entire value chain - from exploration and production to transportation and processing requires tight coordination of a large number of contractors, suppliers, and joint ventures. A high density of ties here is not an end in itself but a necessary condition for managing a complex, multi-level production system in a volatile market (Zhurynov & Tsekhovoy, 2025).

Second, the most striking difference is observed in the "Share in profit" indicator (I_6), where the KMG figure (0.64) is three times higher than the KAP figure (0.21). This implies that KMG's strategy relies heavily on financial returns from joint ventures and associated companies. Such a model presupposes deep financial integration with partners and active participation in their capital. In contrast, the lower KAP value may indicate that its network strategy focuses more on operational and technological synergy rather than directly extracting profit from equity participation.

Third, the only indicator in which KAP outperforms KMG is the "Duration of business contacts" (I_3). The higher value of this indicator (0.214 vs. 0.125 for KMG) indicates greater stability and long-term nature of partnership relations in the nuclear industry. This is logical, given the extremely long technological cycles, high entry barriers, and stringent requirements for safety and technological continuity. Under such conditions, the formation of stable, long-standing alliances with a narrow circle of highly specialized partners becomes a key success factor (Kushch & Afanasyeva, 2004; Zhurynov & Tsekhovoy, 2025).

Thus, the comparative analysis makes it possible to identify two different archetypes of network strategy. The KMG network can be characterized as a "dynamically integrated" archetype, oriented towards breadth of coverage and financial returns. The KAP network, by contrast, represents a "stable-conservative" archetype, where the priority is the depth and reliability of long-term technological partnerships.

Theoretical and Practical Contributions

The results of this study provide a multifaceted contribution to the academic discussion and managerial practice.

From a theoretical perspective, the article proposes and empirically tests a new quantitative methodology for assessing the effectiveness of entrepreneurial networks. The proposed model occupies a niche between purely qualitative, descriptive studies and complex social network analysis (SNA) methods that require hard-to-obtain data. It enables objective, reproducible, and comparative assessments based on publicly available data, thereby opening the possibility of conducting large-scale cross-country and cross-sectoral studies of network structures. Furthermore, conceptualizing the network formation process as a project contributes to the integration of strategic management and project management theories, offering a new perspective on inter-firm cooperation.

From a practical perspective, the study provides executives and stakeholders with a specific toolkit for diagnosing and managing their partnership networks. Use of the proposed system of indicators transforms network management from an "art" into a data-driven, manageable process. Managers can:

1. Conduct network audits. By regularly measuring indicators, it is possible to identify bottlenecks and areas for growth. For example, a low I_3 (duration) combined with a high I_1 (density) may indicate that the network is dynamic but unstable, signalling a need to strengthen key long-term partnerships.

2. Carry out benchmarking. Compare their network's effectiveness with that of competitors or industry leaders, thereby setting realistic development goals.

3. Make evidence-based decisions. Evaluate potential partners or decide on the restructuring of existing alliances based on objective data rather than relying solely on intuition.

Comprehensive Project Structure Model for EPN Development

The analysis confirms that creating and developing an effective entrepreneurial network is a complex managerial task requiring a systematic approach. To move from spontaneous to targeted management of this process, the article proposes using a project-management-based conceptual framework. On this basis, the "Comprehensive Project Structure Model for EPN Development" (Figure 2) was developed as a practical tool for managers.

The model is a set of interconnected structural decompositions that enable systematic planning and control of all key aspects of a project for creating or developing a network. It includes the following main elements:

- **Work Breakdown Structure (WBS).** Decomposition of the project's main goal (for example, "create an industry network") into specific sub-goals, tasks, and measurable outcomes.
- **Project Network Diagram.** Determining the sequence and interdependency of activities over time, identifying the critical path and project milestones.
- **Resource Breakdown Structure (RBS).** Planning and allocation of necessary resources (human, financial, material) across project tasks.
- **Cost Breakdown Structure (CBS).** Project budgeting by estimating the cost of each work package and forming a consolidated budget.

- **Risk Breakdown Structure (RBS for risks).** Identification, analysis, and planning of responses to potential project risks (managerial, organizational, technical, external).
- **Responsibility Assignment Matrix (e.g., RACI).** Allocation of roles and responsibilities among project participants.

The use of this comprehensive model transforms the network development process from a set of fragmented activities into a manageable and transparent project, significantly increasing the probability of successful implementation within specified time and budget constraints.

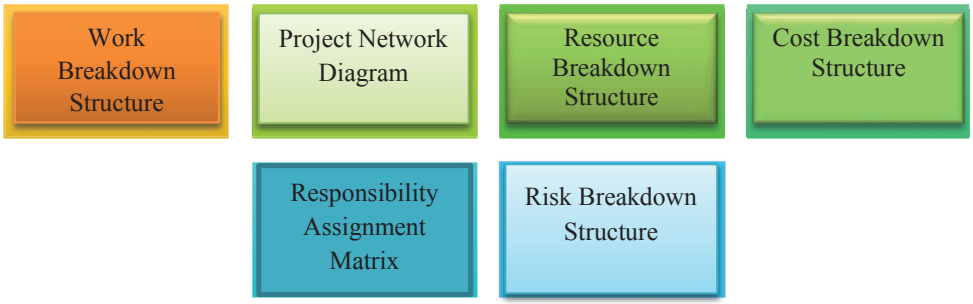

Figure 2. Comprehensive Project Structure Model for the Development of Entrepreneurial Partnership Networks

Conclusion

Despite the results obtained, this study has a number of limitations that must be taken into account when interpreting the findings and that outline directions for future research.

1. Limited external validity. The main study focuses on two large, vertically integrated holdings with state participation. Therefore, the conclusions may not be fully applicable to other types of entrepreneurial networks, particularly networks of small and medium-sized enterprises or horizontal alliances in the private sector, which require separate investigation.

2. Small sample size in the preliminary stage. The sample for assessing the Engagement Index consisted of 28 entrepreneurs. While sufficient to confirm the relevance of the topic, these results cannot be statistically generalized to the entire population of entrepreneurs in Kazakhstan.

3. Incomplete data. When collecting information to calculate effectiveness indicators, it was not possible to obtain reliable public data for indicators I_4 ("Strength of business ties") and I_5 ("Closeness of business ties"), as they require access to confidential commercial information. This limitation underscores the problem of corporate information opacity and indicates the need to adapt the methodology or use expert assessments for these parameters in future research.

4. Static nature of the analysis. This study is a cross-sectional analysis, using data for a single calendar year (2021). To understand the dynamics of network

development and to assess the impact of managerial decisions on their effectiveness, longitudinal studies are required that track changes in indicators over several years.

These limitations do not diminish the value of the proposed methodology as a first step toward quantitative assessment of EPNs but highlight the need for its further validation and development in other organizational and sectoral contexts.

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