6.2. Innovative forecasting of changes in the management of socio-economic systems: challenges and perspectives

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The suggested approach to strategic planning of innovative changes allows for identifying development objectives for the subject of strategic planning, devising solutions for emerging strategic planning challenges, and establishing a set of indicators that enhance the optimization of plans for innovative changes. The methodology has been refined using an analytical indicator system, enabling the evaluation of the innovation activities of the economic entity in terms of the scientific and technical sophistication of innovations, the unique aspects of the innovation process, and various facets of assessing the effectiveness of innovation activities. The planning is customized based on the innovative behavior type and the status of the innovative potential of the socio-economic system.

1.The Issues of Planning Innovative Changes in the Development of Socio-Economic Systems

Key Characteristics of SES

Socio-economic systems (SES) are categorized as complex systems. In economics, intricate systems have a range of properties that need to be considered during their planning; otherwise, it's not feasible to discuss the appropriateness of the formulated plans. The key properties and their features are outlined in Table 1:

Table 1.

Characteristics of System Entities [1-3]

Properties	***Attributes of Complicated Systems within the Economic Context:***
Integrity	Alterations in any element of the system influence both the other components and the entire system. The system demonstrates cohesion among its elements, self-maintenance in substance, and self-replication in structure. A system demonstrating indications of self-organization enhances its stability and acquires the capability to evolve.
Hierarchy	The elements of the system follow a strict hierarchy, creating a systemic structure with levels of constituent parts. Every system can be viewed as an element within a higher-level system (supersystem) and also as a subsystem. Elements may be part of multiple subsystems due to interconnections.
Integrity or synergy	The system exhibits characteristics that do not exist in its individual components. The synergistic interactions among the elements lead to an

(emergence)	overall effect that surpasses the cumulative impact of the individual elements.
Openness	The system operates by exchanging flows of energy and information with other systems and its surroundings.
Dynamism	The system experiences alterations in its parameters and structure due to external influences. It possesses a purpose and functions that entail interactions with other systems and the environment, along with addressing internal contradictions.
Resilience and adaptability	The system has the ability to preserve its structure, functionality, and purposeful existence despite internal contradictions and external influences. However, the system's equilibrium is moderately stable, and substantial external influences may give rise to various centers of disequilibrium.
Fractality	The operation and evolution of the system remain unaffected by the scale of observation. Alterations in higher-level systems lead to comparable changes in the subsystems. The interconnection of component functions is crucial, and any disruption in functional complementarity can disturb the system's integrity.
Self-organization and self-development	The system possesses the capacity to alter its internal structure in response to internal or external factors. This phenomenon encompasses the creation of dissipative structures and the pursuit of dynamic equilibrium.
Non-linearity (randomness and uncertainty)	Complex systems display a probabilistic nature arising from the interplay of numerous external and internal factors. Economic and mathematical models, rooted in probability theory, are frequently employed for their analysis. The evolution of a system is marked by cyclic phases of advancement and decline. With heightened complexity, these systems may exhibit cross-cyclic phenomena, wherein the developmental stages of certain components coincide with the regression of others. Isolating and studying phenomena in their purest form within such systems proves challenging due to their interactions with the environment.

Innovation's Operational Aspect

Among the principal roles of innovations in socio-economic systems (SES) that should be considered in the planning process, we find it pertinent to encompass the following aspects:

Primarily, these encompass the functions of the innovation process within the system. Examining the role of management in implementing modernization processes, the primary functions of innovations in management can be classified as follows: innovations act as a conduit for incorporating the accomplishments of human intellect, post-industrial social practices, and outcomes of new information technologies into management practices, fostering the intellectualization of managerial activities, elevating its scientific content, and implementing intellectualization patterns in management; through innovations, the range of functions of governmental bodies expands, leading to enhanced quality in their execution, contributing to the fulfillment of individual and societal needs; innovations facilitate the attraction of new resources to management, executing managerial functions with reduced labor, resource, and time costs; the concentration of innovations in the management sphere helps align the structure and essence of state governance with the structure of social needs in a post-industrial society inherently characterized by innovation.

Secondly, these entail the functions of management significantly influenced by the innovation process, shaping the restructuring of the entire system. The core functions of management within innovative processes primarily involve:

- goal-setting functions: connected with the imperative of planning, forecasting, and programming socio-economic development. The primary objective is to create conditions that guarantee an enhancement in the quality of life. Goal-setting is achieved through the economic and social transformation of society and systemic reform of state governance.

- regulation functions: primarily implemented in a market economy and the social sphere. Regulation differs fundamentally from administrative management, both in terms of goals and technology, establishing a new functional imperative for the state economy in market conditions.

- stimulating functions: Implemented as a system of measures for differentially influencing state management on various aspects of societal life. The essence of stimulating functions lies in the purposeful impact of the management subject on socio-economic processes in the direction of realizing state and social interests.

Thirdly, these encompass the functions of government bodies related to the organization of innovations in the management sphere concerning their impact on society. The principal functions of state bodies in the innovation sphere include: accumulation of funds for scientific research and innovations; coordination of innovative activities of government bodies; stimulating innovation, introducing sanctions for their absence; creation of a legal framework for innovative processes in public management; personnel support for innovation activities; formation of scientific and innovation infrastructure; institutional support for innovative processes; ensuring a socio-centric and human-centric orientation of innovations; enhancement of the social status of innovative activities; regional regulation of innovative processes; study and implementation of international experience as a significant resource for managerial innovations.

During the process of innovation planning, a thoughtful selection is made regarding the primary directions of innovative activities. Although there are various definitions of strategy, they all converge on the idea that strategy is a deliberate and well-considered set of norms and rules that underlie the development and adoption of strategic decisions influencing the future state of the enterprise. It serves as a mechanism for connecting the enterprise with the external environment (Figure 1) [4,5].

Strategy entails the formulation of justified measures and plans (programs, projects) to accomplish established goals, considering the scientific, technical, and production potentials of the enterprise, as well as its market and sales opportunities. Concerning the management of the innovation process, its pivotal objective is the formulation and execution of the innovation strategy of the economic entity, aligned with the overall strategy. The innovation strategy establishes the goals of innovative activities, outlines the means to achieve them, and identifies sources for mobilizing these means.

In essence, the strategic dimension of innovation strategic planning can be illustrated by the diagram in the figure.

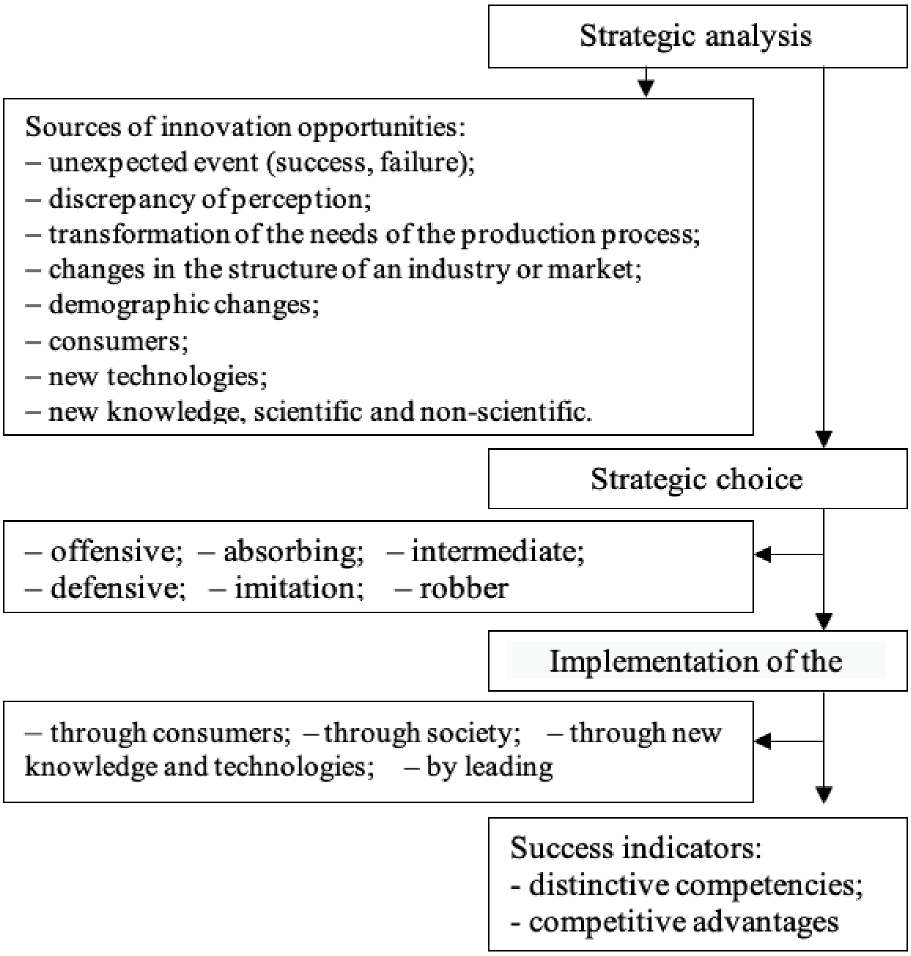

Figure 1. - Dimensions of strategic planning for innovation [5]

Almost any operational entity, irrespective of its level, involved in innovative pursuits, has the flexibility to employ diverse strategic approaches. The formulation of an innovative strategy hinges on the objectives of the endeavor, the theory of product life cycle, market positioning, and the adopted scientific and technical policies.

2. Influence of Innovations on the Planning Processes of Socio-Economic Systems

The general methodology for strategic planning of innovative changes enables the identification of development objectives for the subject of strategic planning, the formulation of approaches to address emerging challenges in strategic planning, and the establishment of a set of indicators that facilitate the optimization of strategic plans for innovative changes. Essentially, the plan for innovative strategic development always comprises a collection of innovative projects or a "portfolio" of projects. The primary focus is on selecting promising projects, reallocating resources to them, and determining the final outcomes in accordance with specific criteria for their achievement.

Projects involving innovative changes exhibit significant informational complexity and a high degree of uncertainty during the initial stages. To effectively manage such an innovative project, well-structured information about the upcoming work stages is imperative.

At this juncture, the necessity arises to establish acceptable sets of elementary processes and their combinations, leading to the emergence of innovative products of corresponding quality. Subsequently, a selection is made from the acceptable set of realized innovations, constituting an innovative change. If an individual enterprise is considered as the object at the primary level, upon transitioning to the next level, this enterprise becomes part of a higher-level aggregate with specific characteristics.

Categorization of Innovative Conduct

The attainment of innovative objectives by enterprises is significantly influenced by the efficiency of the innovator's organizational structure. The diversity in the innovative behavior of socio-economic systems allows for various classification criteria for analysis. L.G. Ramensky proposed a classification that distinguishes four types of enterprise innovative behavior based on their goals, namely: violents, commutants, patients, and explorers. Each stage (refer to Figure 2) aligns with specific characteristics of the socio-economic system's state, providing insights into the type and strategy of the innovative organization.

In accordance with this perspective, strategic conduct can be categorized into the following groups:

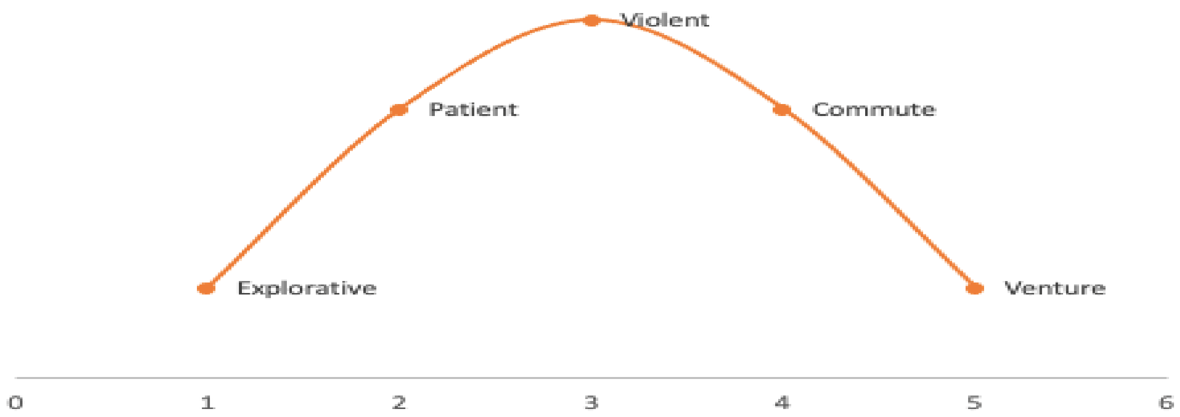

Figure 2. - States of the socio-economic system

First Stage - Exploratory: The establishment of an organization in a market-driven economic environment, shaping its initial structure. These are small-scale innovative companies distinguished by goal-directedness, commitment to ideas, high professional levels among employees and leaders, and substantial investments in research and development.

Second Stage - Patient: Patient firms, or "cunning foxes," may vary in size. The strategy involves product differentiation and concentrating efforts on a specific market segment. Patients leverage distinctions in product quality, service, and advertising. These firms must first identify the consumer value of their product and ensure its delivery. This type of firm can evolve in two directions: either experiencing stagnation or moderate growth within the occupied niche or changing its strategy and transitioning into a large, violent firm.

Third Stage - Violent: Large firms exhibiting innovative violent behavior have a considerable workforce, numerous branches and subsidiaries, and a diverse product range. They are known for substantial investments in research and development and extensive marketing networks. The products of violent firms exhibit exceptional quality due to high standardization, uniformity, and technological advancement, resulting in lower prices due to mass production. Typical representatives of this behavior type are transnational companies that establish an oligopolistic market.

Fourth Stage - Commutant: The potential for seeking a strategic partner is actualized through engagement with commutant firms. These small enterprises, catering to local, narrow-group, or even individual demands, thereby establish connections within the economy across space. They take on aspects that do not capture the interest of violent, patient, and exploratory firms, serving a unifying and connecting role, hence termed "commutants." On one hand, they facilitate the diffusion of innovation, and on the other, they standardize it. Small firms actively contribute to the promotion of new products and technologies, generating new services on a mass scale based on them. This expedites the innovation diffusion process.

Additionally, there is a ***venture type*** of behavior, typical for small firms with flexible and mobile structures. These organizations have an advantage in the speed of developing a new product, a capability that large enterprises cannot compete with. The distinctive feature of this organization is the production of goods. Moreover, they transfer developments to other firms. The number of employees is small, and the scale of the company is also modest.

Each of the company types (violents, commutants, patients, and explorers) has its characteristic features and varying degrees of strategy implementation for achieving competitiveness in the produced product (Table 2).

In order to remain competitive within a specific market segment when there's no possibility of technological advancements or reorganizing production, it's often necessary to lower the price of goods and reduce profit margins. Alternatively, businesses may transition to new enterprises and patents, maintaining production costs at the same level while enhancing the quality of manufactured goods through innovative practices. Companies adopting a strategy of innovation in technology, production organization, labor, and management tend to thrive. Those who fail to innovate timely in their products and processes face market expulsion as per the inherent competitive dynamics. Table 3 outlines the classification of innovative behaviors.

Table 2.

Analysis of innovative strategies [6, 7]

Type of innovative behavior	***Characteristic***	***Features***
Venture	Organizations characterized by flexible and mobile structures are active during the phases of increasing inventive activity. Their strength lies in the rapid development of new products, providing them a competitive edge over larger enterprises.	These entities do not engage in organizing product manufacturing but instead share their innovati
Explorative	Medium or small-sized systems that introduce an entirely innovative product, eventually establishing a new industry.	They stand out for their commitment, a high level of professionalism among employees and leaders, significant investments in research and development, resulting in the creation of innovative products and technologies.

Violent	Major systems engaged in mass production, introducing their own or acquired innovations to the market, outpace competitors through mass production and economies of scale. They exhibit forceful competitive and innovative behavior.	These systems are extensive, featuring a substantial workforce, numerous branches and subsidiaries, and a comprehensive product range. They incur significant expenses in research and development, production, marketing, and distribution networks. Their products are of high quality due to elevated levels of standardization and unification. Many violent entities are Transnational Corporations (TNCs) that establish an oligopolistic market.
Patient	Large, medium, and small systems engage in the creation or enhancement of products with distinctive features tailored to specific segments within a broad market.	In niche-oriented manufacturing, the product's competitiveness hinges on its consumer value and alignment with consumer expectations. A specific market niche should stand out due to distinctive technological expertise, a specialized distribution network, and the historical prestige associated with the brand..
Commute	Small systems facilitate the diffusion of innovations generated by other innovative entities, tailoring them to meet the demands of the local market.	Meeting the localized demands of regional markets or even individual requirements, these systems "connect the economy across space," fostering the spread of changes through imitation endeavors and the introduction of novel services built upon emerging technologies.

Table 3.

Attributes of businesses based on their approach to competition. [5,1]

Indicator	***Classification by L. G. Ramensky regarding the nature of competitive conduct.***			
	Violent	***Patient***	***Explorative***	***Commute***
1. Level of competition	Tall	Low	Middle	Middle
2. The novelty of the industry	Mature	New	New	Mature
3. Types of needs served	Bulk, standard	Massive, but non-standard	Innovative	Local
4. Production profile	Massive	Specialized	Experimental	Universal small

5. Company size	Large	Large, medium, small	Medium and small	Small
6. Stability of the company	Tall	Tall	Low	Low
7. Expenditure on R&D	Tall	Middle	Tall	Absent
8. Competitive advantage	High performance	Adaptation to a specific market	Leading the way in innovation	Flexibility
9. Dynamism of development	Tall	Middle	Tall	Low
10. Costs	Low	Middle	Low	Low
11. Product quality	Middle	Tall	Middle	Middle
12. Assortment	Middle	Narrow	Individual orders	Narrow
13. Type of R&D	Improving	Adaptive	Breakthrough	Absent
14. Sales network	Own or controlled	Own or controlled	Absent	Absent

The diverse range of corporate strategies and organizational structures among business entities generates numerous strategic positions and opportunities for selecting innovative competitive strategies. Effectively navigating this decision space requires a thorough assessment of the firm's market position and the identification of both the firm itself and the type of strategic competitive behavior it exhibits.

3. Determining the effectiveness of planning the innovation changes in socio-economic systems

The effectiveness of managing the innovative activities of business entities becomes apparent through the synergistic interaction of stages related to the development, implementation, and promotion of innovations, as well as stages associated with the transformation of the employee's mental resources. This involves the establishment of corporate culture, business image, a system of labor motivation for innovation development, and corporate social responsibility.

Six stages in the organization of innovative activities are outlined, aligned with the mechanism for developing and implementing investment projects: planning idea carriers; defining basic and functional strategies, along with a goal system for implementation; assessing innovative potential; establishing structure, regulations, and criteria for innovation implementation and control; developing and evaluating innovative projects; formulating an innovation program and budget, evaluating innovation effectiveness.

The success of an innovation project hinges on the interdependence between technology, operational costs, sales volume, and the price of the new product or service. This is reflected in the growth rates of economic value added and financial efficiency, contributing to society's overall reduction in resource intensity within the innovation program.

Table 4 provides a comprehensive grouping of analytical indicators within the developed system, allowing for the assessment of an economic entity's innovation activity in terms of scientific and technical innovation levels, the nuances of the innovation process, and various aspects of innovation effectiveness.

The research focused on the socio-economic system (SES) as its subject. Within the SES, adopting a multilevel approach, it's essential to distinguish: macro level -represents the country as a concept; meso-level- encompasses regions as a plan; micro-level - involves the enterprise as a program.

Creating a computer-mathematical model for innovation planning in computer science involves the application of optimization techniques. Optimization techniques are mathematical methods designed to identify the most favorable solution to a given problem by maximizing or minimizing a specific objective function.

Table 4.

The framework of analytical metrics designed to evaluate innovative endeavors [8]

Complex criterions (Кi)	Number of indicators	Of these, by stages of innovation		
		I	II	III
1. Scientific and technical level of innovation (K_1)	19	5	9	5
1.1. Progressiveness	7	2	4	1
1.2. Technicality	5	2	3	-
1.3. Competitiveness	1	-	-	-
1.4. Legal security	4	1	1	2
1.5. Manufacturability	2	-	1	1
2. Innovative process (K_2)	25	9	11	5
2.1. Innovative activity	2	-	-	2
2.2. Intensity	4	1	3	-
2.3. Saturation	7	2	4	1

2.4. Complexity	5	3	-	2
2.5. Duration	3	1	2	-
2.6. Completeness of coverage	4	2	2	-
3. Effectiveness of innovation activity (K_3)	16	1	1	14
3.1. Commercialization	1	-	-	1
3.2. Wide range and versatility of application	1	-	-	1
3.3. Financial	6	-	-	6
3.4. Investment	4	-	-	4
3.5. Incentives	3	-	-	3
All groups	60	15	21	24

One potential method for constructing a computer-mathematical model for innovation planning is to utilize linear programming. Linear programming entails maximizing or minimizing a linear objective function while adhering to a set of linear constraints. In the context of innovation planning, the objective function may be defined as the expected value or impact of a particular innovation, with the constraints representing the available resources and organizational limitations.

The comprehensive indicator R, serving as the quality index for the assessed program, is determined by summing the products of the values of complex criteria (K_i) with the weight characteristics representing the importance of each criterion (v_i), as expressed in the formula [9, 10].

$$R = \sum_{i=1}^{n} v_i \cdot K_i \tag{1}$$

where v_i - weight characteristics of the importance of complex criteria K_i;

i - is the number of the complex criterion;

K_i - values of complex criteria

Complex criteria K_i are, as a rule, the result of a certain mathematical operation on a group of p initial indicators b_{ij}, $j = 1, 2, \dots, p$, describing the tested object.

$$K_i = \sum_{j=1}^{p} w_{ij} \cdot b_{ij} \tag{2}$$

Let's select a set of comprehensive criteria to evaluate the alignment of programs or plans, utilizing a system of analytical indicators for assessing innovative activities (refer to Table 4). Subsequently, we'll ascertain the weight characteristics of importance for each comprehensive criterion, considering the number of indicators within each group. The outcome yields the following data.

K_1 - scientific and technical level of innovation, $v_1 = 0.317$;
K_2 - innovation process, $v_2 = 0.417$;
K_3 - efficiency of innovation activity, $v_3 = 0.266$;

For the chosen subset of assessment criteria, the shift from specific point evaluations to b_{ij} is implemented. Consequently, all initial parameters expressed in diverse measurement scales are unified onto a single dimensionless scale. Subsequently, mathematical operations can be applied to these values to derive an integrated indicator representing the state of the object.

To standardize the actual assessment based on the b_{ij} criterion, the formula used is:

$$b_{ij} = \frac{a'_{ij} - a_{(min)}}{a_{ij\,(max)} - a_{ij\,(min)}} \quad (3)$$

where a' - is an expert assessment set for the ij particular criterion for assessing b_{ij} on a point scale;

$a_{ij\,(max)}$ - is the maximum possible value of the expert assessment for a particular criterion for assessing b_{ij} on a point scale;

$a_{ij\,(min)}$ - is the minimum possible value of the expert assessment for a particular criterion for assessing b_{ij} on a point scale.

Weighting coefficients, denoted as w_{ij} re determined for specific evaluation criteria, considering their individual contributions to the overall assessment (refer to Tables 5).

The tabulation of specific criteria based on various innovative behaviors, accompanied by the assignment of relevant weighting factors, is detailed in table 6. Normalization of the obtained assessments was conducted through an expert method, as outlined in table 7. The comprehensive criteria values for different innovative behaviors are presented in table 8.

To evaluate the comprehensive coefficients of the criteria, the classification of the indicator system, outlined in table 9, is employed.

The complex coefficient values indicate that venture firms, violent firms, and explorers exhibit a notable scientific and technical innovation level (K_1), with violent firms outperforming all in the innovation process (K_2), Commutants have the lowest indicator for the innovation process, and the efficiency of innovation (K_3) shows the least significant variation across behavior types. The calculated overall indicators for different types of innovative behavior are presented in Table 10.

Table 5.

Evaluation framework for a comprehensive criterion. К

Weight coefficient w_{ij}	Private criterion b_{ij}	Essence of a particular criterion	The value of a particular criterion
$w_{11} = 0{,}368$	b_{11} Progressiveness	average performance	10
		dynamic reproduction	5
		steadiness	0
$w_{12} = 0{,}263$	b_{12} Technicality	average performance	10
		dynamic reproduction	5
		steadiness	0
$w_{13} = 0{,}053$	b_{13} Competitiveness	average performance	10
		dynamic reproduction	5
		steadiness	0
$w_{14} = 0{,}211$	b_{14} Legal security	average performance	10
		dynamic reproduction	5
		steadiness	0
$w_{15} = 0{,}105$	b_{15} Manufacturability	average performance	10
		dynamic reproduction	5
		steadiness	0
$w_{21} = 0{,}08$	b_{21} Innovative activity	average performance	10
		dynamic reproduction	5
		steadiness	0
$w_{22} = 0{,}16$	b_{22} Intensity	average performance	10
		dynamic reproduction	5
		steadiness	0
$w_{23} = 0{,}25$	b_{23} Saturation	average performance	10
		dynamic reproduction	5
		steadiness	0
$w_{24} = 0{,}2$	b_{24} Complexity	average performance	10
		dynamic reproduction	5
		steadiness	0
$w_{25} = 0{,}12$	b_{25} Duration	average performance	10
		dynamic reproduction	5
		steadiness	0
$w_{26} = 0{,}16$	b_{26} Completeness of coverage	average performance	10
		dynamic reproduction	5
		steadiness	0
$w_{31} = 0{,}0625$	b_{31} Commercialization	average performance	10
		dynamic reproduction	5
		steadiness	0
$w_{32} = 0{,}0625$	b_{32} Wide range and versatility of application	average performance	10
		dynamic reproduction	5
		steadiness	0
$w_{33} = 0{,}375$	b_{33} Wide range and versatility of application	average performance	10
		dynamic reproduction	5
		steadiness	0
$w_{34} = 0{,}25$	b_{34} Investment	average performance	10
		dynamic reproduction	5

		steadiness	0
$w_{34} = 0{,}1875$	b_{35} Incentives	average performance	10
		dynamic reproduction	5
		steadiness	0

Table 6.

Calculation of the assessment of private criteria

	Weight coefficient w_{ij}	Private criterion a_{ij}				
		Venture	Violent	Patient	Explorative	Commute
criterion K_1	0,368	10	10	5	10	0
	0,263	10	5	5	10	5
	0,053	10	5	5	0	5
	0,211	5	10	5	5	5
	0,105	10	5	5	10	0
criterion K_2	0,08	10	5	5	10	5
	0,16	10	5	5	10	0
	0,25	5	10	5	0	0
	0,2	5	10	5	5	0
	0,12	0	10	10	5	5
	0,16	0	10	5	5	5
criterion K_3	0,0625	5	10	10	10	5
	0,0625	0	10	5	0	5
	0,375	10	10	10	10	10
	0,25	10	5	5	10	0
	0,1875	5	0	0	5	5

Table 7.

Normalization of the obtained estimates

	Weight coefficient w_{ij}	Private criterion b_{ij}				
		Venture	Violent	Patient	Explorative	Commute
criterion K_1	0,368	1	1	0,5	1	0
	0,263	1	0,5	0,5	1	0,5
	0,053	1	0,5	0,5	0	0,5
	0,211	0,5	1	0,5	0,5	0,5
	0,105	1	0,5	0,5	1	0
criterion K_2	0,08	1	0,5	0,5	1	0,5
	0,16	1	0,5	0,5	1	0
	0,25	0,5	1	0,5	0	0
	0,2	0,5	1	0,5	0,5	0
	0,12	0	1	1	0,5	0,5
	0,16	0	1	0,5	0,5	0,5
criterion K_3	0,0625	0,5	1	1	1	0,5
	0,0625	0	1	0,5	0	0,5
	0,375	1	1	1	1	1
	0,25	1	0,5	0,5	1	0
	0,1875	0,5	0	0	0,5	0,5

Table 8.

Complex criteria values

K_i	Venture	Violent	Patient	Explorative	Commute
K_1	0,7895	0,737	0,4475	0,7365	0,2635
K_2	0,465	0,85	0,545	0,48	0,18
K_3	0,75	0,625	0,59375	0,78125	0,53125

The comprehensive indicator, representing the summative outcome of evaluating innovativeness levels, holds the utmost significance for violent firms and the least for commutants (Figure 3).

Table 9.

Criteria significance level classification

Significance level of the criterion	Complex criterion value
Absolutely significant	1-0,99
Significant in the long run	0,85-0,98
Significant in the medium term	0,75-0,84
Relatively significant	0,65-0,74
Insignificantly	< 0,65

Table 10.

Integral indicator

Venture	Violent	Patient	Explorative	Commute
0,6436765	0,754329	0,52706	0,641443	0,299902

In the realm of computer science, organizations have various key metrics to gauge the effectiveness of their innovation planning initiatives. One such metric is the quantity of new ideas or technologies generated. Monitoring this metric allows organizations to track the productivity of their innovation planning endeavors and determine whether they are producing a satisfactory volume of ideas. Another metric involves the success rate of new ideas or technologies. This provides insight into the quality of generated ideas, identifying areas for enhancement. Additionally, measuring the impact of new ideas or technologies on the organization constitutes another crucial metric. This encompasses evaluating the financial repercussions of innovations, as well as their effects on operational efficiency and customer satisfaction. Lastly, the level of employee engagement in the innovation process serves as a vital metric. Assessing employee involvement helps organizations gauge support for innovation efforts and identify potential obstacles. To summarize, organizations in the field of computer science can use key metrics such as the number of generated ideas, the success rate of those ideas, the impact on the organization, and employee engagement to measure the effectiveness of their innovation planning. By monitoring these metrics, organizations can gain valuable insights and pinpoint areas for improvement [11-13].

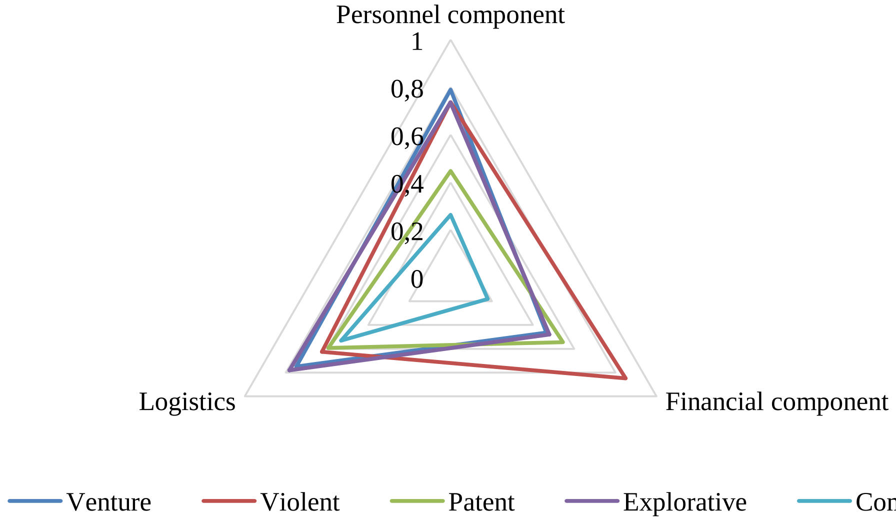

Figure 3. – Examination of strategies for different conditions within the socio-economic system

As a result of the analysis, it was determined that the choice of an innovative behavior model by a firm during planning is contingent on environmental factors. Once a certain level is reached, well-being ceases to be the primary determinant in selecting a model of innovative behavior for the socio-economic system.

Let's assess the innovation potential of socio-economic systems, taking Ukraine as an example. The innovative potential will be considered as a composite of three main components:

Personnel Component:

Number of people employed in science and scientific services as a percentage of the total labor force ***(P).***

Employment in medium and high-tech production as a percentage of the total labor force ***(F).***

Financial Component:

Total expenditures on R&D as a percentage of GDP ***(E).***

Share of the volume of sold innovative products (goods, services) in the total volume of sold products (goods, services) of industrial enterprises, in percentage ***(I).***

Material and Technical Component:

Share of industrial enterprises that introduced innovations (products and/or technological processes) in the total number of industrial enterprises, in percentage ***(T)***.

Number of registered patent applications for inventions and utility models per year, per total workforce ***(Y).***

These indicators collectively assess the proportion of individuals involved in innovative activities, financial investments in the innovation sector, and the material and technical foundation for innovation within socio-economic systems. The data for these indicators are provided for the period 2014-2023 in table 13.

Table 11.

Innovation metrics for evaluating the socio-economic system of Ukraine

	Year	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
1.Personnel component	The number of people employed in science and scientific services (thousands people) – ***P***	19261,4	19314,2	18073,3	16443,2	16276,9	16156,4	16360,9	16578,3	16590,2	16602
	Employment in high-tech production (thousands people) **- *F***	504,1	493,6	456,0	422,9	428,1	415,8	437,9	421,6	418,7	415,7
2.Financial	Total expenditures on R&D (mln.UAH) **- *E***	9419,9	10248,5	9487,5	11003,6	11530,7	13379,3	16773,7	16773,7	16891,1	17009,4
	Costs for innovations, (mln.UAH) **- *I***	11480,6	9562,6	7695,9	13813,7	23229,5	9117,5	12180,1	14220,9	14320,5	14420,7
3. Logistics	Share of industrial enterprises that introduced innovations **- *T***	2181	2002	1729	1655	1503	1376	1491	1503	1493	1482
	Number of registered patent applications for inventions and utility models per year – ***Y***	44876	45910	50234	63266	73690	73411	83654	82914	83495	84079

The examination of Ukraine's innovative profile involved analyzing the optimal strategy, identified by the highest integral indicator among all considered socio-economic systems, and comparing it with the overall average situation. This comparison visually resembled the optimal strategy (Figure 4).

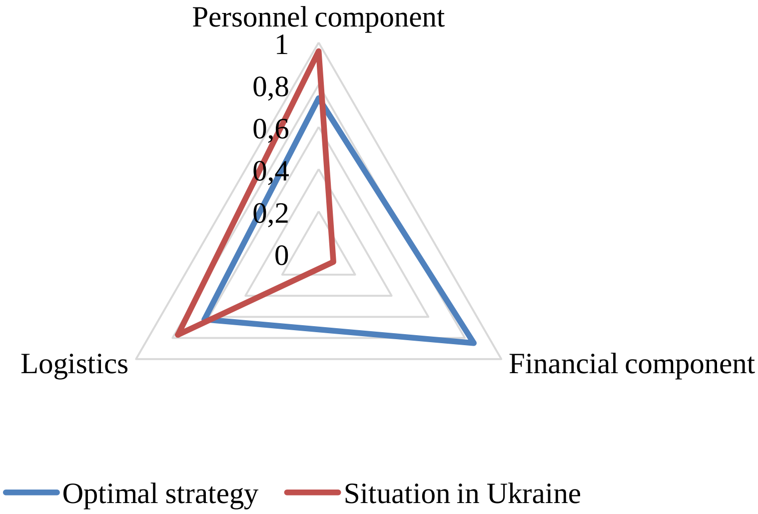

Figure 4. – Comparative analysis of strategies applicable to Ukraine

This methodology allows for the determination of the type of innovative behavior based on a set of criteria and facilitates the identification of the diffusion process, representing the outcome of increased production of innovative products consumed by the market.

Ukraine's innovative development strategy, in relation to the potentially optimal state, is characterized by a lag in the financial component and the level of well-being. A low level of the financial component signifies a formally closed innovation process. The absence of a deficit in the research resource encourages more active utilization of closed innovations aimed at improving and modernizing known products within its market. As prosperity grows in these conditions, it becomes feasible to independently create new innovations, not only for the internal market but also for the external market.

4. Conclusions

Innovation planning, integral to development as a competitive strategy, entails a multi-stage process that should be intricately linked with the mechanisms governing the development and execution of investment projects. Managing projects of innovative changes involves dealing with significant information complexity and a high degree of uncertainty. Structured information about upcoming work is crucial for the effective management of such projects. The choice of an innovative behavior model is contingent on environmental factors. The evaluation of programs (plans) is based on complex criteria derived from an analytical indicator system designed for assessing innovative activities. These studies pave the way for developing fundamental models of innovative systems and modeling techniques to address planning challenges. The research results contribute to framing the problem of planning innovation activity as an optimization challenge involving the allocation of limited resources, accompanied by a proposed search method to tackle this optimization problem in innovation planning.

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6.3 Механізми забезпечення стійкості критичної інфраструктури: європейський досвід

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У сучасних умовах критична інфраструктура є основою національної економіки будь-якої країни. Порушення роботи критично важливих систем та основних послуг, таких як телекомунікації, енерго- та водопостачання, транспортні та фінансові системи, може призвести до значних економічних збитків. Ці системи є дуже вразливими до різноманітних потрясінь – від кліматичних і геологічних небезпек до промислових аварій, терористичних атак, кіберзагроз, збройних конфліктів і бойових дій, які можуть спричинити каскадний негативний вплив на місцевому, національному та навіть глобальному рівнях.